ICPEP-4

Abstracts

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Preface

A host of urgent issues would fill their agenda, when world scientists and academia from different nations meet in Lucknow for the "Fourth International Conference on Plants and Environmental Pollution" (ICPEP-4). Among the pressing problems to be debated would be global climate change, freshwater, dwindling forests, biodiversity losses, GM food, emergent ecological disturbances on plants, environmental issues and other factors in environment and plant relation.

This "ABSTRACT BOOK' is a compilation of five hundred forty-nine abstracts on different environmental aspects, from renowned scientists having long working experience in their corresponding field of expertise. The volume elucidates the plant-pollutant relationship in a manner that defines not only the drastic effects of pollutants on plants but concomitantly highlights the hitherto less focused areas namely phytotoxicity, phytoremediation and GM Food, Waste/water management, stress tolerant bioaesthetic development, thus concentrating more on plant than the pollutant.

The abstracts included in this volume are those, which were received within prescribed date and found suitable for publication. All abstracts were peer-reviewed for acceptance and then partitioned in different sessions for Oral and Poster presentation. Many abstracts were not in desired formats as well as were long. Abridgement of such abstracts has been done with care to include significant points. Late abstracts have been printed but un-indexed and are appended. The basic purpose of this abstract book is to evaluate, identify the knowledge gaps and provide direction for future research areas of environmental problems and consequent changes and to develop desired management protocols.

We express our deep sense of gratitude to Dr. C.S. Nautiyal, Director NBRI and Dr. K.C. Gupta, Director IITR, for their moral and material support. We thank Drs., Dr. P. Nath, D.V. Amla, B.P. Singh, K.J. Ahmad, S.C. Sharma and P. Chandra for their encouragement and valuable suggestions to structure this book. We are indebted to our contributors who despite their various commitments acceded to our request to share their valuable expertise.

Thanks are due to the Scientific Program Committee for categorizing the abstracts and editing them. We are also thankful to staff of Eco-auditing Group for their co-operation in various ways.

We are also thankful to the various sponsoring agencies for financial support, which made this publication successful. The publication plan finally crystallized through the efforts of M/S Maruti Scanners and their team, we sincerely thank all these people.

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Impact of Climate Change on Biodiversity with Special Reference to Medicinal Plants

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Climate change and its potential future threats on environment have raised the concern of scientists across globe. Variation in climate conditions has deep impact on the production of secondary metabolites in plants. Research studies have brought into light that genomic expression of plants can be affected by such variation resulting in loss of secondary metabolites of human interest. Scientific evidence is mounting proving that climate change is affecting vegetation pattern, phenology and distribution. These evidences seem to be of less importance at first sight, but it is nature's warning signal for future challenges for species survival. These disturbances in seasonal cues has shown striking variation in phenological events like time of plants bud burst, initial leafing and flowering, fruiting events, time of seed/fruit dispersal. Studies reveal that climate change is forcing plants to migrate. Plants' ranges show movement towards poles and higher elevation in an attempt to restore optimal growing conditions. Computer model programs predict that "range" shift of plants will gain acceleration in future due to continued climate changes. This migration of plants in hunt for appropriate growing conditions may eventually lead to extinction of many valuable medicinal plant species. Recent years have witnessed extreme weather events like storms, droughts and floods with more prevalence and intensity. Global warming, human activities and other factors will tend to increase the occurrence of these events in future. Reports from many parts of the world stand tall voicing the fact that these extreme weather events is adversely affecting harvesters' and cultivator's requirements and condition to grow/collect medicinal plant species. If these climate impacts continue to grow uncontrolled, then the very plants that helped in evolution of modern human civilization may become extinct or will be devoid of its nutritional/medicinal qualities thereby putting in hold the well being of our future generation in jeopardy.

Key words: Climate change, global warming, medicinal plants, secondary metabolites, phenology, genomic expression

K-2

Agricultural Air Quality: Research, Policy, and Regulations

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Agricultural emissions produce significant local and regional impacts, such as odor, Particulate Matter (PM) exposure, eutrophication, acidification, and exposure to toxics, and pathogens. Agricultural emissions also contribute to the global problems caused by greenhouse gas emissions. Agricultural emissions are variable in space and time and in how they interact within the various processes and media effected. Most important in the US are ammonia (where agriculture accounts for ~90% of total emissions), reduced sulfur (unquantified), $PM_{2.5}$ (~16%), PM_{10} (~18%), methane (29%), nitrous oxide (72%); and odor and emissions of pathogens (both unquantified). Agriculture also consumes fossil fuels for fertilizer production and farm operations, thus emitting carbon dioxide (CO_2), oxides of nitrogen (NO_x), sulfur oxides (SO_x) and particulates. Current research priorities include the quantification of point and non-point sources, the biosphere-atmosphere exchange of ammonia, reduced sulfur compounds, volatile organic compounds, greenhouse gases, odor and pathogens, the quantification of landscape processes, and the primary and secondary emissions of PM. Although European policymakers have made progress in controlling these emissions, regulations in the United States remain inadequate.

Key words: Agricultural air quality, Carbon dioxide (CO_2), Oxides of nitrogen (NO_x), Sulfur oxides, Research, Policy, Regulations

Session SI

Climate Change

SI/L-1

Role of Shelterbelts in Carbon Sequestration and Climate Change of Dryland Ecosystems

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Forests figure prominently in the climate change negotiations under way in the United Nations Framework Convention on Climate Change. Forests, in both industrialized and developing countries are being singled out of their crucial role in climate change mitigation. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change estimates that the forestry sector is responsible for 17.4% of total global greenhouse gas emissions, due in large part to tropical deforestation, but also points that the C sequestration in boreal and temperate forests more than compensate for GHG emissions from tropical forests. The developing countries must undertake mitigation action if the goal of limiting the average global temperature increase to within 2°C is to be achieved. Forests are acknowledged as part of the solution. Efforts are being made to realize the mitigation potential of forests through providing positive incentives to countries to carry out forestry mitigation actions. The on-going deliberations on "reducing emissions from deforestation and forest degradation in developing countries", under way in the *Ad Hoc* working group on long term Cooperative Actions under the conventions, focus on the creation of an instrument to provide incentives to developing countries to undertake forestry mitigation actions. The potential for sequestering C in the terrestrial biosphere, aim of developing enhanced C sequestration in the biosphere is to enable a rapid game in withdrawal of CO_2 from the atmosphere over the next 50 years. In order to allow time for implementation of other technological advances that will help mitigate CO_2 emissions. C sequestration in terrestrial ecosystems is either the net removal of CO_2 from the atmosphere or the prevention of CO_2 net emissions from terrestrial ecosystems into the atmosphere. C sequestration may be accomplished by increasing photosynthetic C fixation, reducing decomposition of organic matter, reversing land use changes that contribute to global emissions, and creating energy offsets through the use of biomass for fuels or beneficial products. In an experiment conducted in transitional zone of Karnataka, *Acacia auriculiformis* one among the six shelterbelt species as sequestered highest atmospheric carbon-oxide forward by *Azadirachta indica*. Among the tree species planted in the shelterbelt in lower rain fall area of Karnataka includes *Tectona grandis, Pongamia pinnata, Casuarina equisetifolia,* and *Dalbergia sissoo*. It was concluded that shelterbelt species in low rainfall transition belt of Karnataka have performed better in sequestering highest atmospheric CO_2, it helps in reducing the global warming on the other hand reduction in the greenhouse gases hence, a rational strategy to sequester C must consider all the components of the terrestrial ecosystem. Single tree species cannot be considered in isolation from other plant species or from soil because of the interactions and interdependencies among species in an ecosystem. Likewise, soil management cannot be separated from plant productivity. Thus a study of integrative strategy element-ecosystem dynamics is necessary.

Key words: C-sequestration, Forestry mitigation, Shelterbelt species

SI/L-2

Advances in Air Pollution and Climate Change Impacts on Forests

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IUFRO (International Union of Forest Research Organizations) is the global network for forest science cooperation in the world. The Research Group 7.01.00 deals with the impacts of air pollution and climate change on forest ecosystems and state of the art findings are presented at biannual meetings. Interlinkages among air pollution, climate change and forests are everywhere. Complex effects are in progress and affect all the main forest ecosystem services: protection (biodiversity, soil, water, air quality), production and cultural services.

In this paper, we summarise the main research needs emphasized at the recent 24th IUFRO RG 7.01 Conference titled "Adaptation of Forest Ecosystems to Air Pollution and Climate Change", Antalya (Turkey), March 2010. One important point is the need for information on nutritional status of forest stands for sustainable forest management. It was suggested to maintain long-term monitoring programs and to account for the effects of extreme years, and past and present management practices. Among air pollutants, O_3 was recognised as the most damaging to plants. Plant protection regulations in the European Union are based on an exposure index derived from O_3 concentration data, but the physical parameter governing damage to vegetation is the uptake of O_3 through the stomata. Such an approach should be tested on a wide range of species of conservation importance. More and longer duration open-air studies on mature trees in different forest types are critical if we are going to understand future changes to forest productivity.

Air pollution can modify tree susceptibility to both biotic and abiotic stressors, including climate. Knowledge about the mechanisms is still imperfect because of the many variables involved. O_3 alters leaf control on water losses, and nitrogen and reduce the shoot/root ratio so that trees are more susceptible to drought, windstorms, fire and attacks by weak parasites. Because their impacts are species-specific, nitrogen and O_3 affect also plant biodiversity. O_3 may alter tree leaf chemistry and insect herbivore performance.

At present, there are well established relationships between the exceedance of critical level/loads of pollutants and

ecosystem degradation. Nevertheless, ecological interactions between critical loads and other environmental factors such as impact of increased concentrations of CO_2 and O_3, insects, pathogens, fire, drought, flooding, wind, and extreme temperatures as well as ecosystem management practices, are still poorly understood.

Modelling techniques should be improved to get more reliable results and estimations. Current process models are parameterized with data taken under steady state conditions, yet environmental conditions in natural forest systems are highly dynamic. Focused research and model development incorporating stomatal responses and carbon balance under dynamic environmental conditions will improve predictive capabilities of models. Results should be available to public for taking action. A comprehensive assessment of the economic, human health and environmental impacts of climate change and air pollution in countries in Asia, Latin America and Africa is still missing.

Key words: Air pollution, Climate change, Forests, IUFRO

SI/L-3

Air Quality, Climate and Global Agriculture

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Clearly the chemical climate of the earth has changed since the onset of the industrial era. The concentrations of a number of anthropogenic trace gases in the troposphere (~ 0 - 10 km above the surface) have increased since the late 1800s. There is also evidence that during the last millennium, the annual average global air temperature has increased by roughly 0.7°C. However, a detailed perusal of the temperature data in the last 50 years shows that daily maxima (daytime) have not increased as much as daily minima (nighttime) in N. America, W. Europe, the former Soviet Union and China.

Global climate change is of utmost international concern. However, global climate change and global warming are not the same. The former is an integrated system consisting of: (1) increases in the radiative trace gas concentrations in the troposphere, (2) loss in the thickness (column) of the beneficial stratospheric (~15 - 50 km) ozone (O_3) layer, and the consequent increases in the deleterious ultraviolet-B radiation (280-315 nm) at the surface, and (3) increases in the air temperature and changes in other physical climate parameters (e.g. precipitation patterns, aerosol optical depth) at the surface.

There is a major international initiative to curb anthropogenic carbon dioxide (CO_2), emissions because it is considered to be the main cause of global warming. However, other trace gases such as methane (CH_4) and nitrous oxide (N_2O) that occur in much smaller concentrations are orders of magnitude more radiative. More importantly, water vapor contributes to 60% of atmospheric warming, much more than CO_2 (~22%). However, water vapor levels cannot be effectively controlled because it is produced by: (a) mostly evapo-transpiration, (b) fossil fuel combustion and (c) reactions in the atmosphere driven by the sunlight. Nevertheless, there is a feedback process between increases in the air temperature and increases in atmospheric water vapor levels.

In as much as air temperature (growing degree days), soil moisture and nutrients have a critical effect on crop production, so do increasing CO_2 levels (accounting for the % offset by the negative effects of surface level O_3). However, all plants have a set functional carbon (C) to nitrogen (N) ratio. After a point, to absorb more CO_2, plants (particularly C3 species) will require increasingly more N. Increased application of N can lead to increased N_2O emissions, a potent radiative gas. As is, atmospheric N deposition (effects on biodiversity) and agricultural ground water run off and hypoxia are of much concern. Further, global fresh water supply will be a limiting factor for crop production. In the final analysis, there is a need for a major reorganization of crop production systems and global distribution of food supply and security, particularly since significant population growth is expected in the developing countries during the 21st century.

Key words: Climate change, Global warming, Trace gases, Agriculture, Food security

SI/O-1

Climate Change, Biodiversity and Urban Environmental Crisis: An Overview

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The climate of the earth is changing. The climate has always been variable, but what is alarming is that the unprecedented magnitude of changes in the climate that too because of increased anthropogenic activities like land use changes (brings about change in physical and biological properties), industrialization, population change, change in energy usage patterns etc. Ecosystem and species have always been changing with time. Many species have gone extinct over the time.

Any change in climate would lead to destabilization of environmental and social conditions all around the globe. These disturbances could jeopardize the conservation of natural ecosystems. Our planet is kept warm due to the so-called greenhouse effect. This effect consists of trapping the energy-radiated by the earth into the atmosphere- instead of allowing it to escape into outer space.

Now a days, the environmentalists are greatly concerned to check the emission of green house gases in the atmosphere chiefly responsible for climate change and global warming effects. The major constituents of green house gases are: CO_2, Methane, Nitrous Oxide, CFC's (Chloro Fluoro-Carbon), SF6 and water vapour etc. The main constituent, CO_2 intends to have maximum adverse

effect on environment. The sheer quantity of CO_2 makes it the most problematic of greenhouse gases. CO_2 concentrations in the atmosphere have also increased from 280 ppm in 1800's to about 386 ppm currently. Climate change affects vegetation in a major way, for example with tree-line shifts towards higher elevation as a response to increased temperature. In that process, least-adapted vegetation and animal species will be the most adversely affected ones, and eventually disappear. Several ramifications of warning of the climate system are now seen.

Glaciers are melting worldwide, Changing sea-temperatures, and increased level of CO_2 dissolved in the ocean are adversely affecting corals, with bleaching in them has become a more common features leading to their death, Climate changes are forcing some plant and animal species to migrate, as they are unable to adapt to their changing environments, which poses a problem for the conservation of biodiversity hotspots.

Biodiversity refers to variety and variability among living organism, ecosystem and ecological complexes. It represents the variety of genes, species and ecosystem found on our planet. The species are quickly disappearing because of gradual change in climatic conditions, human encroachment and other human influences. Consequences of climate change on the species component of biodiversity include: changes in distribution, increased extinction rates, changes in reproduction timings, and changes in length of growing seasons for plants. A major international study has warned that global warming may drive a quarter of land animals and plants to the edge of extinction by 2050.

There is a need to introduce planning approaches that can help go a long way in achieving environmentally compatible and sustainable development. Carbon sequestration through urban forestry/green belt development may prove to be an effective tool, as well as attenuating air pollution.

Key words: Biodiversity, Carbon sequestration, Climate change, Green belt development, Urban environment

SI/O-2

Variation in Soil CO_2 Flux and C Sequestration in Tropical Dry Land Agroecosystem: Influence of Application of Organic Inputs

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Global climate change and soil fertility, two major concern of this century, are being influenced greatly by soil CO_2 flux as soil has been recognized as a major source and sink for atmospheric CO_2. The balance between C-accumulation and its losses reflects the potential of C-sequestration. Management strategies of agroecosystems influence soil CO_2 flux as well as its sequestration potential in soil. Agroecosystems offer immense opportunities for attaining substantial increase in soil C sequestration as they can serve as large C sink. Available information worldwide regarding the soil CO_2 flux and C sequestration capacity in response to soil amendments is scanty and particularly lacking in tropical dryland agroecosystems, which are now becoming the focus of attention for 'evergreen revolution'. In drylands, application of organic resources has been advocated for the enhancement of crop production as these measures tend to conserve soil moisture as well as improve soil fertility. We evaluated the effect of application of soil inputs with varying resource quality on the CO_2 flux and the C sequestration in soil. CO_2 flux varied with season and differing input quality (higher flux with low quality inputs). Significant increase in soil organic C, leading to C sequestration was found in combined input and high quality input treatments. In low quality input the loss of C (in form of CO_2) was highest but the C sequestration was lower. In combined input, however, the level of soil organic C was maximum inspite of higher soil CO_2 flux. It is concluded that for sequestration of C, form of C (labile or recalcitrant) is more important than the absolute amount of C added to the soil through exogenous inputs. There is a need to further test such resource quality based soil input approach on long term basis for improved agricultural sustainability in dry tropics.

Key words: Agroecosystem, C sequestration, Soil CO_2 flux, Soil fertility

SI/O-3

Role of Micro-Climate in Plant Community Association: A Case Study in Tropical Moist Deciduous Forest of Uttar Pradesh, India

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Ecosystem level studies for phytosociological analysis have been undertaken at Katarniyaghat Wildlife Sanctuary of Uttar Pradesh, a representative of Tropical Moist Deciduous Forest Ecosystems of Central India. The Katarniyaghat Wildlife Sanctuary (KWLS) spreading over an area of 409 km^2 is located in Nanpara Tehsil of Bahraich district, U.P., India. This paper tries to reports that climatic variables play major role in shaping the plant community association in the forest ecosystem. Plant community analysis of KWLS was done by laying of 145 random quadrate sampling plots of 400 m^2 each. Quantitative analysis of different phytosociological attributes including the importance value (IVI) was done. Multivariate analysis (Cluster analysis and CCA-ordination) of the forest community for association analysis was done based on the tree species importance value (IVI). Cluster analysis of the forest community were performed using chord distance and minimum variance with the help of PAST diversity analysis software (1999). Cluster analysis classifies all the tree species into five distinct forest community/forest types: dry miscellaneous; low land miscellaneous; sal mixed; pure teak and savanna. Dry miscellaneous community is the

fastest growing with highest stem density of 822.8 stem/ha and tree diversity richness of 58. Low Land forest is comparatively young community having 53 tree species. Sal mixed community is the mature community of KWLS having highest basal cover 77 m^2/ha with 35 tree species. All the previous Teak plantations have now been naturalized and stabilized in the form of pure teak forest having homogenous teak dominated community with 25 tree species. Savanna is having lowest stem density 350 stem/ha and lowest species diversity with 15 tree species. Diurnal variations in microclimatic parameters like ambient air temperature, relative humidity, solar radiation (PAR) at shrub layer, ambient CO_2, soil temperature and soil moisture of the all the five forest communities were measured with LICOR-840 portable weather monitoring system. There is very strong positive correlation between microclimate parameters and respective forest communities. Microclimate plays a very important role in formation of tree species association and further giving platform for understorey community growth. CCA analysis of different weather variables against the five forest community was done. Results indicated that patterns of these micro-climates are strongly correlated with phytodiversity. Species composition and distribution of plant community are shaped not only by environmental conditions, but also by spatial factors, anthropogenic disturbance, and species competition etc. It is concluded that the potential importance of spatial factors, biotic interactions and other stochastic factors must be considered to understand the relationship between the plant community and environmental factors.

Key words: Tropical forest, Plant community, Phytosociology, Micro-climate, PAR, Ambient CO_2, Weather parameters, Cluster analysis

SI/O-4

Impact of Climate Change on Floriculture in India

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Climate change is one of the most important global environmental challenges in the history of mankind. Plants are key components of the ecosystem and are greatly influenced by climatic and geographical factors. Therefore, climate change has a direct impact on agriculture and horticulture as the basic factors for crop production are being influenced. Overall, a low production of horticultural crops is feared due to the climate change. Assuming a global temperature rise of 4.4°C by 2080 over the cultivated areas, India's agricultural output is projected to fall by 30-40% which would be quite alarming unless proper remedial measures are taken. Further, occurrence of new diseases, pests together with severity of the existing ones is also foreseen. Some of the well established commercial varieties of fruits, vegetables and flowers will perform poorly in an unpredictable manner.

India is becoming a strong centre of commercial floriculture in the international market. During the last 5-7 years, there was a great surge in the floricultural activity in the production of flowers (cut and loose), ornamental plants (potted and cut-greens) and dry flowers (value added products), besides marketing. The horticultural sector contributed around 28% of the GDP annually from 13.08% of the area and 37% of the total exports of agricultural commodities (2004-05). Albeit, India's present contribution in the global floricultural export market is negligible (about 0.4%) as compared to Netherlands (58%), Columbia (14%), Ecuador (7%), Kenya (5%), Israel (2%), Italy (2%), Spain (2%) and others 10%, it is not far when India will come up as a major grower/exporter by virtue of well planned policies formulated by the Government of India backed with foreign technologies for green house production. We have to plan the strategy to overcome the problems due to the climate change with reference to floral crops.

Key words: Climate change, Floriculture

SI/O-5

Measuring and Modelling Stomatal Ozone Flux in a Mediterranean Forest

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Among air pollutants, ozone is recognised as the most damaging to plants. Ozone risk to vegetation is particularly high in the Mediterranean area, where climatic conditions, associated with strong man-made air pollution, favours ozone formation. Plant protection regulations in the European Union are based on an exposure index derived from ozone concentration data, but the physical parameter governing damage to vegetation is the flux of ozone through the stomata. In the Mediterranean area, water supply is limited during summertime and plants avoid both ozone injury and water loss by closing the stomata. Correct measurements and models of stomatal ozone uptake by Mediterranean vegetation are thus essential to develop a new approach for plant protection.

We measured stomatal ozone fluxes over a *Quercus ilex* forest in central Italy and compared the results with those obtained with the DO_3SE model (Emberson et al., 2000) and the parameterization developed by Alonso et al. (2008) for *Q. ilex*. The work was carried out at a CarboEurope site (Lecceto), where ozone and water vapour fluxes were measured by the eddy covariance technique as well as the main environmental parameters during July and August 2006. Spot measurements of instantaneous gas exchange were also carried out by means of a portable analyser.

While the eddy covariance results showed that trees exchanged gases with the atmosphere, the model was unable to detect any uptake of ozone for most of the time. In fact, water content of the upper soil layer (i.e. one of the functions affecting the modelled uptake) was very frequently below the wilting point, suggesting that adult *Q. ilex* trees are able to access water in the deep ground table over the dry periods. A new parameterization for Mediterranean forests in drought

conditions should thus be developed. An empirical soil water content function was developed here by using the measurements of instantaneous stomatal conductance. The ratio of hourly values of stomatal ozone flux measured by eddy covariance and those calculated by the new model was 0.4. This suggests that either the model underestimated the uptake or the partitioning between stomatal and non stomatal ozone flux was imperfect.

Key words: Ozone flux, Air pollution, Ecosystem health

SI/O-6

Assessment of Carbon Stock in Eucalyptus Agroforestry Plantations in Saharanpur District of Western Uttar Pradesh

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Agroforestry systems prevalent in north-western India play an important role in sequestration of atmospheric CO_2 in the form of tree biomass. In western Uttar Pradesh, Saharanpur district is a good example of agroforestry dominated area where poplar and eucalyptus trees are grown on farmlands. Farmers generally grow these tree species on the field boundaries at 2 m spacing. A survey was conducted in Saharanpur district during July, 2010 and data on eucalyptus boundary plantations of different age was collected. Data on tree height, basal diameter, diameter at breast height were recorded for 25-30 sample trees from 2 to 10 years plantations.

Wood volume of eucalyptus trees was estimated using volume equation given by Forest Survey of India. Then wood biomass was computed and converted into dry biomass using dry to fresh biomass ratio. From dry wood biomass, carbon stored in wood of eucalyptus tree was estimated. From this carbon stock in eucalyptus trees per ha was calculated by multiplying with tree density. Analysis revealed that wood volume and biomass of 3 years old eucalyptus plantation was 4.20 m^3 ha^{-1} and 2.001 t ha^{-1}, respectively. At the age of 7 years, wood volume and biomass were estimated to be 42.00 $m^3 ha^{-1}$ and 20.042 t ha^{-1}, respectively which is almost 10 times that of 3 year old plantation. Wood volume and biomass were estimated to be 0.351 m^3 ha^{-1} and 169.043 t ha^{-1}, respectively for 10 year old eucalyptus boundary plantation.

Carbon stored in wood biomass of eucalyptus trees was estimated to be 0.903 kg/tree at the age of 2 years and increases with the increasing age of trees. It reached to a level of 44.12 kg/tree at the age of 10 years. Carbon stock in eucalyptus boundary plantations varied from 0.181 t ha^{-1} for 2-year-old plantation to 8.824 t ha^{-1} for 10-year-old plantation. Equivalent CO_2 assimilation by eucalyptus boundary plantations varied from 23.158 to 32.355 t ha^{-1} for 8 to 10-year-old plantation. In this way, agroforestry is not only remunerative to the farmers but also contributing in tapping atmospheric CO_2 vis-à-vis mitigation of green house gases.

Key words: Agroforestry, Biomass, Carbon, CO_2, Eucalyptus

SI/O-7

Study of Carbon Dioxide Fluxes in a Managed Grassland Ecosystem

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In recent years, the carbon cycle in terrestrial ecosystems has attracted considerable attention not only among scientists but also among policymakers, owing to its potential for sequestering atmospheric CO_2. There are evidences that some grasslands can be significant sources or sinks of atmospheric CO_2, while others are carbon neutral. In many types of grassland, high levels of soil organic matter, microbial activity, and root biomass make the rhizosphere a potentially large source or sink for atmospheric CO_2. Furthermore, land management practices such as mowing, may alter carbon (C) fluxes and, thus, may affect the amount of C sequestered or released annually from grasslands. It has been reported that mowing and grazing attributed the reduction to a decrease in canopy photosynthesis and reduced translocation of C to the rhizosphere.

The study was carried out in a playground during the month of July, 2010, at Indian School of Mines campus, Dhanbad and ground was covered by *Cynodon dactylon* grass. The soil CO_2 flux was monitored using LICOR infrared gas analyser (non-dispersive) continuously for 24-h. Data was taken in hourly interval. The F_{CO2} was measured using a survey collar, which was inserted 5-cm into the soil in mowed and unmowed sites but in disturbed sites. The grass along with roots were completely rooted out along with soil then the collar was inserted 5 cm in the soil. Soil temperature was recorded by Soil Temperature Probe and soil moisture was recorded by Soil Moisture Probe and total operation was carried out by Palm Wireless Communication. Temperature, moisture, RH and ambient CO_2 concentration (C_a) were monitored during the survey.

In this study measurements of CO_2 flux were carried out in three sites- unmowed sites, mowed sites and disturbed sites (below 15 cm depth). Baseline properties of the soils in the 0-15 cm profile exhibited the following average values: 7.1 (pH), 1.20 g m^{-2} (bulk density), 25% (sand), 47% (silt), 28% (clay), 1.3% (soil organic carbon), 185 kg/ha (available nitrogen), 7.8 kg/ha (available phosphorus) and 315 kg/ha (available potassium). The average ambient CO_2 during the study period varied between 334 - 476 ppm, with an average value of 402 ppm. Inverse relation was observed between soil CO_2 flux and ambient CO_2 concentration. The diurnal variation of temperature was observed between 26°C to 39°C with an average value of 29°C. The average soil CO_2 flux in three sites were found as follows: unmowed sites (8.7 – 16.1 µmol m^2 s^{-1}), mowed sites (5.8 – 11.0 µmol m^2 s^{-1}) and in disturbed sites (4.2 – 9.4 µmol m^2 s^{-1}). In all the sites positive correlation was observed between soil CO_2 flux and soil temperature (r = 0.71 to 0.93).

This study compared the CO_2 fluxes of natural, mowed and disturbed grassland ecosystem. The variation in CO_2 fluxes of the managed grassland ecosystem was jointly affected by air temperature and soil moisture. Ambient CO_2 concentration and temperature remains the primary factor influencing the spatial variation in net CO_2 exchange in grassland ecosystems. High degree CO_2 flux was observed above 15 cm where a high percentage of roots and microbial populations reside. While in below 15 cm depth, CO_2 flux was contributed by fine grass roots, root exudates, and consequently microbial activity in that region. The production and release of CO_2 from soil layers is an environmentally sensitive and important component of the carbon balance for most ecosystems and therefore relevant for understanding and predicting the global carbon cycle.

Key words: Soil CO_2 flux, Mowed and unmowed grassland, Temperature

SI/O-8

Long-Term Trends in the Total Ozone Column Over Indian Region

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Variations in Total Ozone content present in a column from the surface of the earth to the top of the atmosphere have its impact on the life present on the earth through variations in incoming Solar UV irradiance and affecting global climate system. In the present study, we focused on the estimation of long-term trends in the Total Ozone Column (TOC) content over Indian region. Here, we used an additive time-series decomposition approach to de-convolute the Multi Sensor Re-analysis monthly mean TOC time-series data-set, for the time-span of January 1979 to December 2008, in to different components viz. seasonal variations, long-term linear trends, inter-annual variations and random noise. Results from the present study show statistically significant declining trends of the magnitude of –0.80 to –1.50 percent per decade in the TOC content over the Indo-Gangetic Plains and Himalayan region of India (25-40N). Whereas, no statistically significant trends were found over the peninsular part of Indian region (0-25N).

Key words: Total Ozone Column, Time-series decomposition, Long-term trends, Satellite data, Indian region

SI/O-9

Climate Change Impact on Insect-Host Plant Interactions - Environmentally Stressed Plants are Weaker in Attracting Parasitoids of Insect Herbivore

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The main effects of climate change on tropical African agriculture are predicted to be drought and rising temperatures. Most climate change scenarios and models show an increase in pest range and incidence under these two phenomena. The impacts of these changes on African agricultural productivity are expected to be significant. This paper presents part of the results of a larger study to investigate climate change induced environmental changes on crop protection and crop yield on selected crop species in Mauritius.

Potted plants of various species were grown under environmental stress, namely drought condition, as well as in a normal water-sufficient condition. The plants were allowed to be infested by their respective pests, e.g. *Liriomyza trifolii* and *L. huidobrensis* on potatoes, the diamond back moth, *Plutella xylostella,* on cabbages, etc. Leaves from uninfested and infested plants grown in both environments were analysed in an olfactometer for their potential in attracting adults of the parasitoids of the respective pests.

This particular paper presents the results for *Liriomyza trifolii* and its parasitoids, *Dacnusa sibirica* and *Diglyphus isaea*. It was found that leaves of plants from the stressed environment were less attractive to the parasitoid as compared to those of plants from normal environment.

Furthermore, plants growing under warmer conditions, i.e. in summer, showed a higher degree of stress-effects on volatile production than those grown in cooler conditions.

The results of this study have implications on pest attack, and biological control of pests, under conditions of climate change.

Key words: Attractant, Insect herbivores, Olfactometer, Parastitoid, Plant volatiles

SI/O-10

Potentiality of Horticultural Crops for Carbon Sequestration Under Sodic Environment

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Global warming is inescapable. A rapid increase in green house gas (GHG) emissions after industrial revolution has increased its effects and has led to climate change. The level of CO_2 in atmosphere is rising with an alarming rate. Overloading of atmosphere with carbon tends to develop a sustainable approach for sequestration of it. For mitigation of climate change two strategies may involve that may be the reduction in emission of GHGs or by increasing their sinks. Soil may serve as a source sink for carbon sequestration. Carbon sequestration through biomass seems to be a viable and cheap option in sodic soil. In India it is estimated that 6.3million hectare is salt affected soil, out of which Uttar Pradesh covers 1.35million hectare. Land use may play a significant role in sequestration as well as for rehabilitation of degraded land. A study was conducted to assess the potential of horticultural crops grown on sodic soils to sequester carbon in a long run experiments and also to study the effect of land use on soil quality. In the present study three horticultural systems viz. guava (*Psidium guajava* L.),

karonda (*Carissa carandas* L.) and aonla (*Phyllanthus emblica* L.) and barren sodic soil were taken for comparison. It was found that the sequestration potential was higher for guava with 0.484t/ha.year followed by aonla (0.395t/ha.year) and karonda (0.321t/ha.year) whereas, the carbon stabilization percent was recorded higher for karonda plantation. Total carbon and microbial biomass carbon were also found to be affected with plantation and depth of soil. Among the aggregate fractions, meso-aggregates (0.25-2mm) of soil contribute more for organic carbon fraction. The soil physico-chemical properties also improved significantly by the adoption of horticultural systems.

From this study it may be concluded that the plantation of horticultural systems particularly guava, aonla and karonda not only improves the degraded sodic land but also may help in sequestration of carbon within the soil.

Key words: Carbon sequestration, Sodic soil, Horticultural systems

SI/O-11

Predicting Distributional Range of a Globally Endangered Tree Species *Lagerstroemia Minuticarpa* Debberm. ex P.C. Kanjilal in North East India in Two Future Climate Change Scenarios

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The northeastern region of India contains two out of the three hotspots of the country. They harbour many endemic and threatened plant species. Habitat degradation coupled with climate change is posing a serious threat to these elements of biodiversity. Studies demonstrating the impact of future climate change on plant species populations are not available. The present study attempts to predict the impact of future climate change on the distributional range of *Lagerstroemia minuticarpa* which is a globally endangered tree species found in the Indian Eastern Himalayas. The species was last collected in the year 1938. However, through rigorous field visits it was rediscovered in the Lohit and Bichom river basins of Arunachal Pradesh. To predict its current as well as future distributional range in northeast India, we have employed the ecological niche modelling using Maxent program. Ecological niche modelling (ENM) is a useful technique to depict the current as well as future geographical distribution of species based on their ecological niche. To model its current distributional range, we used different physiographic and bioclimatic variables. Prediction of its future distributional range have been made under three climate change models viz. Hadley's, CSIRO and CCCM, three time frames i.e. 2020, 2050 and 2080 and two change scenarios viz. A2 and B2. The models predicted significant reduction in geographical range of the species in both the change scenarios.

Key words: Climate change scenarios, Distributional range, Ecological Niche Modelling, Globally endangered species, *Lagerstroemia minuticarpa,* North-east India

SI/O-12

Carbon Turnover in Rice Cultivation Area by the DNDC-Rice Model

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Rice soil has been considered as greenhouse gases emission source. Flooded rice soil provide anaerobic condition suitable for methanogenic bacteria activity and produce methane (CH_4) gas. Enhancing soil fertility is energy source for methanogen and CH_4 emission from rice soil. However, organic material such as rice straw (RS) application was encouraged by environmental scientist to avoid air pollution from biomass burning. Rice straw incorporation into rice soil is useful for improving soil fertility and reduces soil salinity. However, adding soil carbon content by applying RS into flooded rice soil intends to raise CH_4 emission.

In this presentation, turnover of soil organic matter in rice soil was emphasized by using the DNDC-rice model. The model was validated against field observation in Thailand and simulated influencing of RS incorporation on CH_4 emission. In addition, soil organic carbon pools over 24 years in study area were considered. The results indicated high soil fertility produced higher CH_4 emission than less soil fertility. Methane emission from RS application case was ~50% higher than cultivation without RS application. Methane production increased in proportion to RS application rate and CH_4 emissions rate increased linearly with the amount of RS supplementation. Simulated results also showed that RS incorporated into soil significantly enhances CH_4 emissions due to RS incorporated continuously supplied carbon sources for CH_4 production; soil dissolved organic carbon (DOC), H_2. However, RS incorporation in rice soil before rice growing season or remain RS after harvesting showed high benefit for soil carbon content in rice cultivation area.

Key words: Carbon turnover, Greenhouse gas, Rice field, Soil

SI/O-13

Changing Climatic Scenario of Western Rajasthan and its Impact on Agriculture

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The Indian hot arid zone extends in an area of 0.32 million km^2 in parts of western Rajasthan, Gujarat, Haryana, Karnataka and Andhra Pradesh.61% of hot arid region of India lies in western Rajasthan. The climate of this region is characterized by great extremes of temperature and long period of severe drought accompanied by high wind velocity and low relative humidity. Annual rainfall varies from 400 mm in the eastern Rajasthan to less than 100 mm in the western part of the region. The distribution of this meager

rainfall is also erratic during the monsoon period leading to protracted drought. Drought is a recurrent phenomenon in Rajasthan. In every 100 years there are 7 years of acute drought, 27 years of scarcity, 63 manageable years and 3 normal years of drought and it is not as dramatic as other disasters. It is slow and it impacts on very large population for a long period of time.

In the western Rajasthan the rural economy is predominantly based on agriculture and animal husbandry. Livelihood of people dependent on monsoon behavior, production of crops and fodder for animals (that exceed the number of people) is entirely a variable of the frequency of showers. Rains 16-25 % below normal lead to drought and scarcity. The study of last 10 years data of agriculture production and forestry sector change are the real witnessed of the climate change and their role in the economy. The climatic parameters influence the socio economic condition of the region by affecting many ways. The main important effect of change in climate is impact on agricultural production which directly affect the little forest area and livestock. Thus frequent drought and now changing pattern of rainfall causes severe damage to traditional rainfed agriculture and make life really harsh.

Key words: Agriculture production, Drought, Socio economic factors

SI/O-14

Climate Change and Human Health

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"It is in the interest of the entire world that climate changes are understood and that the risks of irreversible damage to natural systems and the threats to the very survival of man, be evaluated and allayed with the greatest urgency" (His Excellency Maumoon Abdul Gayoom, President of the Republic of Maldives, 1987).

Human health and the environment are intimately connected and depend on society's capacity to manage the interactions between human activities and the physical and biological environments in ways that safeguard and promote health. Any disruption in the stability of climatic variables and parameters are expected to have a broad range of health impacts. Most significantly, climatic disruption threatens the adequacy of the "building blocks" of health for large population around the globe. As climate change dismantles these central elements, people with limited resources will be forced to migrate to areas where they may not be welcome, likely leading to increase civil instability and strife. Climate change, like other human induced large – scale environmental changes, poses risks to ecosystems, their life support functions and, therefore, human health. If the balance between earth ecological and other bio-physical life support system decline, human population well being and health will be jeopardized. Planned adaptations to climate change and moving to a low-carbon economy can potentially make substantial positive contributions to the health and social and economic well-being of the whole populations. Climate change, therefore, should be addressed as part of the larger challenges of sustainable development. Public health strategies, improved surveillance, mitigation of climate change by reduced use of fossil fuels and uses of the renewable energy technologies may improve the conditions by reducing exposure to pollution. There should be international agreements on the "precautionary principle", the principle of "costs and responsibility" (the cost of pollution or environmental damage should be borne by those responsible), and "equity". Adherence to these principles would help prevent future global environmental threats and reduce existing ones. With climate change under way, there is need to assess vulnerabilities and identify intervention / adaptation ones. The optimal solution, however, lies with governments, society and individuals – and requires change in behaviour, technologies and practices to enable a transition to sustainability, we need to act with urgency to reduce ecological disruption while simultaneously strengthening the resilience of populations to withstand the impacts of unavoidable environmental change.

Key words: Adaptation, Climate change, Human health, Mitigation, Vulnerability

SI/O-15

Climate Change on the Move - Climate Migration Will Affect the World's Security

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Fast forward to the year 2050. The world's population will be up to 9 billion people according to the United Nations—an increase of one-third. More than 90 percent of this growth will take place in developing countries. Estimates also predict that 200 million people will be newly mobilized as climate migrants by 2050 due to global warming's effects. This increased migration will very likely affect global security, which makes it imperative for the United States and other nations to begin formulating responses to climate migration now. As Thomas Friedman so bluntly writes, the world in 2050 will be crowded and it will be hot. Even if industrial and emerging societies were to reduce their greenhouse gas emissions tomorrow and reach instant carbon neutrality, existing pollution has locked into the atmosphere at least some unavoidable warming. No matter what steps the global community takes to mitigate emissions, we will still be forced to adapt to a warmer climate. Global warming's consequences will be felt much earlier than 2050. Climate scientists argue that extreme weather events and resource shortages will affect millions of people in Africa, Australia, and Latin America by 2050. In Asia, warming will shrink freshwater resources from large river basins that could adversely affect 1 billion people. Parts of Africa could see rain-fed agricultural yields fall by much as 50% from today's output, threatening food insecurity on top of water insecurity.

Melting snow-caps in the Andean region will harm important agricultural regions in Latin America.

The geopolitical consequences of climate change are determined by local political, social, and economic factors as much as by the magnitude of the climate shift itself." It is inevitable that as global warming intensifies hurricanes, drought adds to resource shortages. We will need to prepare for extreme circumstances, including human migration. This includes thinking about new mechanisms and interagency solutions that incorporate economic development, diplomacy, aid, and security. The goal is to muster effective responses, realizing that it is critical to set climate migration and international security agendas in the near future. Climate change is in essence an attack on the shared interests or collective security of the world, and both climate change and climate migration assault the well-being and safety of people, or human security. It will therefore test the ability of countries to preserve natural resources and protect people. Since we are entering unknown territory we must expect the unexpected and prepare for worst-case scenarios.

In response to these challenges the Center for American Progress is bringing together our energy and national security teams to launch a project focused on the intersections between global warming, human migration, and national security. Our work will focus on better understanding the climate challenges at hand and articulating a set of progressive policy recommendations aimed at addressing these challenges. Ultimately, the proper response is likely to require new governance and management structures that can deal with the fallout at different levels and combine humanitarian and developmental policies along with public diplomacy and military assets.

Key words: Climate migration, Global community, Global warming

SI/O-16

Challenges of the Climate Crisis Adopting Green Technology

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Global warming and resulting climate change are among the most serious environmental challenges being faced by human kind world over. The majority of climate experts confirmed about the signs of climate crisis due to increase in concentration of CO_2 and other GHG gases into the atmosphere. While the experts projects this increasing trends, the Obama administration is yet unacknowledged reality of the posed danger to address the climate crisis through International intervention of agreements; truly U.S. is the major contributor of GHG that accounts over to 25% of the total global share. The experts established that the climate instability threatens ecological balance of Earth, the life supporting system and is yet disruption of radiative forcing through the enhance effect of GHG and that would result imbalance to the order of 3.7 watt /$m^{2.}$ As positive radiative forcing tends to warm the climate to continue climate crisis means putting the billion of people into the edges of mass starvation due to sharp drop of agriculture output, extinction of plants and animals, erosion of cryogenic sphere, loss of bio-diversity that likely to result increased mean surface temperature beyond 2^0C by 2100 compared as of today. The global warming that results enhanced effect of GHG from power utilities, transport sector, manufacturing process, deforestation, although the Earth put efforts to retain balance due to interactions of naturally occurring atmospheric gases. The climate crisis has focus impact on ecological aspects, sustenance on living beings, on marine eco-system, estuaries, wetlands, along the coastal regions. As the climate crisis affects the energy balance of the system, this GHG has to stabilize by deep cut of the GHG and maintaining of CO_2 within 450 ppm to avert rise of temperature that would not lead to catastrophe. Deep cut of CO_2 would eventually support to halt accelerating disintegrating of planets ice cover, creating a market based economy through global transitions into low carbon path, stewardship of nature and the need to minimize the energy band of radiative forcing below 2 watt /$m^{2.}$ The break through in technology is green technology for building up competitive environment in energy sector; the main cause of global climate change can substantially be arrested by use of green technology. The authors talk about major aspects and dimensions of the issues and their effective tools to mitigate the effect of radiative forcing through green technology options and taking proactive steps to fight against the climate crisis to restore the energy balance of the Earth and to stay away ecological threats on coral reefs.

Key words: Ecological balance, Mass starvation

SI/O-17

Effect of elevated CO_2 on quality of grain in diploid, tetraploid and hexaploid Wheat

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Global atmospheric CO_2 in 2009 was 384 ppm which is about 40% higher than estimated prior to the industrial revolution. It has been projected that by the middle of this century [CO_2] may reach up to 550 ppm and by its end as much as 700 ppm. Apart from affecting important plant processes such as photosynthesis and respiration, CO_2 enrichment evaluating the effect of high [CO_2] on the quality and quantity of carbohydrates and proteins in wild and cultivated species of wheat.

Seeds of diploid wheat *Triticum monococcum* L., tetraploid *T. dicoccoides* Korn. and hexaploid *T. aestivum* L. var. *PDW 273* were sown in free air CO_2 enrichment facility (FACE) in the division of Plant Physiology, Indian Agricultural Research Institute, New Delhi wherein a [CO_2] of 550 ppm was maintained throughout the growing period of

the crops. Biochemical analysis of grains showed that CO_2 enrichment significantly increased the concentration of total soluble sugars and starch in grains. The observation was also supported by ultrastructural investigations wherein a higher accumulation of starch was observed in chloroplasts of pericarp cells of wheat. Further analysis of soluble sugars by HPLC revealed an alteration in the composition of non-structural carbohydrates such as glucose, sucrose, fructose and lactose. The response varied among three species. As compared to control, protein concentration in grains decreased in FACE grown wheat plants. Analysis of amino acids such as leucine, arginine and histidine by HPLC revealed that CO_2 enrichment led to a reduction in the concentration of arginine in all the three wheat species. Leucine concentration decreased in *T. aestivum* and *T. monococcum* but an increase was noticed in *T. dicoccoides*. Grain proteins of the three wheat species grown in ambient and elevated [CO_2] were separated by SDS-PAGE. It was observed that growth in elevated CO_2 led to an alteration in the protein profile of grains in all the tree species. However, the response varied among the species.

CO_2 enrichment leads to an increase in the concentration of carbohydrates and a reduction in the concentration of carbohydrates and a reduction in concentration of proteins leading to an increased C:N ratio. Differential response of three ploidies may be attributed to their respective genomes. However, more experiments are needed to conclusively assign a role to any one of three genomes A, B and D.

Key words: Atmospheric CO_2 concentration [CO_2], Wheat ploidies, C:N ratio

SI/O-18

Soil Carbon Sequestration: An Opportunity to Combat Climate Change

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Carbon cycle has three distinct pools globally, as the atmosphere, the ocean, and terrestrial ecosystems. Soils contain a stock of carbon that is about twice as large as that in the atmosphere and about three times that in vegetation. Global emissions of carbon occurred due to land use changes affected by deforestation, burning of biomass and fossil fuels, conversion of natural to agricultural ecosystems, drainage of wetlands and soil erosion. In other words, the depletion of soil carbon is stressed by soil degradation and aggravated by land misuse and soil mismanagement. Thus, rehabilitation and restoration of degraded soil ecosystems can reduce the rate of enrichment of atmospheric CO_2 as well as having positive impacts on food security, agro-industries, water quality and the environment. Sustainable forest management, crop and pasture management and re-vegetation have been suggested under Article 3.4 of the Kyoto Protocol. Soil carbon sinks and sources can therefore be included under these activities as the Kyoto Protocol also states that sinks and sources of carbon should be accounted for `taking into account uncertainties, transparency in reporting and verifiability'.

Soil carbon storage potential depends on climate, the nature of parent geological materials, vegetation type and land management practices. Soil sequestration of atmospheric CO_2 through land application of organic residues may have beneficial effects to reduce the increase in the concentration of greenhouse gases in the atmosphere. The significance of different variables on production of greenhouse gases' and soil carbon sink capacity can be investigated by monitoring CO_2 and N_2O fiuxes from amended soils. An increase of soil carbon pool of degraded cropland soils may increase crop yield as well as enhancing food security, reducing global greenhouse gases' emissions. The soil carbon sequestration is a truly win–win strategy.

Modeling is a useful tool of measuring changes in soil carbon stocks and it has been used as an effective methodology for analysing and predicting the effect of land-management practices on soil carbon stocks. A number of process-based models have been developed in the last two decades. Models are needed to estimate dynamics of carbon in different soil ecosystems, because changes in soil carbon are laborious to measure every time, and future levels of soil carbon can only be predicted using models. Current process-oriented soil carbon models are not suitable to all land-use management related applications. This is because of requirement of specific input information that is not available for all types of ecosystems. Therefore dynamic soil carbon model which can be used in a variety of soil applications and land-use patterns should be developed.

Key words: Carbon sequestration, Climate change, Kyoto protocol, Soil

SI/O-19

Vulnerability of Indian Tea Production to Global Climate Change - Molecular Breeding Approaches to Face Future Challenges

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The tea industry is India's main net foreign exchange earner and source of income for the majority of labourers. Tea yield is greatly influenced by weather, and especially by drought, which causes irreparable losses because irrigation is seldom used on tea plantations. Under the circumstances, the tea industry in India is clearly vulnerable to predicted climate changes, and subsequently greater economic, social, and environmental problems. This paper discusses the various aspects of adverse effects of climate change on Indian tea industry and put forward different molecular breeding strategies applied to improve abiotic stress tolerance in tea.

Drought tolerance is a complex character resulting from the interaction of many quantitative component traits. Marker assisted selection can be used to pyramid the major genes including resistance genes, with the ultimate goal of producing tea varieties with more desirable characters. Identification and association of differentially expressed TDFs between drought tolerant and susceptible genotypes using cDNA-AFLP technique was done and 38 TDFs associating with the traits were cloned, sequenced and validated using RT-PCR. PCR-based suppression subtractive hybridization was used to identify genes that are differentially expressed in response to drought. Out of total 6000 ESTs generated 12% showed no significant similarity in the database while 23% showed similarity with unknown proteins. Variation of expression was observed using RT-PCR and transcripts were identified as early responsive and late responsive. Mapping of the TDFs and differentially expressed genes is being carried out in the linkage map for identification of QTLs. Association studies will be carried out to see whether effects on phenotypic variation are observed for specific alleles, particular combinations of alleles at one locus (in heterozygous state) or at several loci interacting and involved in the adaptive traits targeted. In our studies we summarize available domain knowledge on these genes, acknowledging the fact that genomic studies of drought stress in plants reveal large numbers of potential candidates that ultimately constitute complex regulatory networks.

Key words: Drought, Genes, Linkage map, Molecular breeding, SSH, Tea

SI/O-20

Global Climate Changes and Gujarat Model in Sustainable Development of Agriculture in New Millennium

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The most important challenge of today is global warming and providing

Sustainable livelyhood through development process and maintaining it. This challenge is more in our rural areas where agriculture which includes Animal Husbandary and Fisheries, is a major ways of livelihood, Major threat to sustainable development is impact of global warming on agriculture which occupies 60% our population and majority of our people of rural areas.

There has been considerable concern on global climate changes among all the nations on our planet. The change in climate results into uncertain monsoon, scarcity of water, excess evaporation of water, cyclonic storm etc. This has a direct effect on our day to day life and agriculture.

So the impact of climate changes due to global warming will be on followings.

On cropping pattern and on product on seeds due to increase in heat.

On various methods of storage of food grains, seeds, fodder and water.

On land near sea shore due to increase in salanity resulting into higher rate of crop failure.

Up to the end of last millennium, there was uncertain agriculture and minus agro growth rate in many years in agriculture of Gujarat.

Commencing from the new millennium due to well thought out policy well planned and properly implemented efforts by Gujarat Govt. by involving Agro scientists and farmers up to the farm level by the help of newer agro techniques and agro management devices. Gujarat today is one of the leading state in development of agriculture, having average growth rate of 11% which is sustainabily higher than national growth in any other states of India, in last 10 years.

By implementing the new experiment of Gujarat Agro model it is observed that the public leadership both –elected and non elected-participated in Krishi Mahotsav (Agriculture festival),whole heartedly from CM to village Sarpanch and from Chief Secretary to VLW.They went from Village to Village met farmers at their doorstep. The farmers have become the centre of all activities of almost 18 different Govt. Departments. Here, it is committed leadership which has played the significant role in making sustainable agriculture development in Gujarat.

Moreover, Gujarat has encouraged and implemented alternative resources of energy, like solar energy, wind energy, bio mass energy, natural gas, techniques protecting and promoting soil health, rain water harvesting management, for use in household, public and private transport, agriculture and industry wherever it is required, by the way controlling the proportion of carbon in air, resulting into minimizing the effect of global warming to attain the goal of sustainable and eco friendly development in agriculture.

Key words: Climate change, Sustainable agriculture, Gujarat Agro - Model, Public Leadership

SI/P-1

Climatic Risks in Agriculture

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Climate assumes much significance in nearly every phase of agricultural activity. In spite of much technological advances in modern era of agricultural sciences, climate has remained an uncontrolled factor in crop production expect some artificial modification on a very limited scale. Consequently, there are year to year variations from normal values in various climatic elements leading to excessive and untimely rains, scanty rains, hot and cold waves, dust storms, thunder storms, hailstorms, high winds, etc. such weather abnormalities occur under extremes of any or combinations of more climatic elements which can cause damage to crops, animals, and agriculture and are termed as hazards. In general, the extremes of temperature, precipitation and wind are responsible for most of the hazards. However, worst type of hazard is created when combination of two extremes of climatic elements act adversely. Significant hazards affecting

agriculture due to climate are floods, tornadoes, tropical storms, hailstorms, dust storms, lighting, blizzards, droughts, frost and high temperatures.

Heavy rainfall over a small area within shot time, snow melting with high temperature and warm rain and rainfall lasting for many days cause floods. Rate of arrival of water at a surface of the earth is much higher than the infiltration rate into the soil. Floods cause heavy damage to agricultural crops, animals, building, life and property.

When speed of wind exceeds 150 kilometer per hour over a small area, there would be most violent storm called tornado which can cause much damage to agricultural crops, animals, etc. Tropical storms which mostly occur in Bay of Bengal and Arabian Sea, also cause much damage to agricultural crops except when they bring needed rain to drought affected areas. Hailstorms and thunderstorms cause a great damage to agricultural corps, oftenly at harvesting stage in the months of March and April. Dust storms at a speed of about 100 km per hour occur when atmospheric pressure decreases suddenly causing great damage to fruit trees generally during summer season. Forest fires are caused by lighting. The combination of very low temperatures, strong winds and snow storms forms blizzard. At high latitudes they cause heavy damage to life and property. A period of moisture deficiency (drought) is caused when the supply of water becomes inadequate for the optimum requirements of plants. Permanent drought is found in deserts where rain fall is much below the needs of plants and rained agriculture is not possible. Irrigation is most essential to raise crops. Seasonal drought will occur when there is no rainfall daring rainy season irrigation could help to raise coops in a particular season of drought. However, agricultural crops will be grown during the rainy season without irrigation when rainfall is irregular and variable especially in sub-humid and humid regions, it causes contingent drought at any season, may be at a time when water need is much more to agricultural life leading to severe damage to crops due to wilting. When daily supply of water does not balance the daily need for water of a plant, invisible drought occurs which is very harmful to crops leading to huge reductions in yield. Under such conditions, irrigation to crops becomes imperative for getting optimum yields.

Key words: Agricultural crops, Natural hazards

SI/P-2

Secure the Future using Biochar: A New Proposed Method to Minimize the Global Warming and Environmental Pollution

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The magnitude of global warming implies that an efficient and economically viable CO_2 minimization process has to be assessed in order to reduce the concentration of CO_2 in the environment and hence global warming. In this study of minimization of environmental CO_2, we have proposed an adsorption method and economical and efficient adsorbent to minimize the environmental CO_2. For that a 4 feet high, 2 ft diameter adsorption column was fabricated using cast iron sheet. The activated charcoal powder (300 mesh size) and biochar (crushed fine powder) were used as adsorbent to adsorb CO_2 from the mixture of air and CO_2 (99.5% air and 0.5% CO_2). The experimental observation was taken for the % CO_2 removal from the mixture used, amount of CO_2 adsorbed per Kg of charcoal powder and biochar, capacity of adsorption column in terms of volume of air cleaned per hour, optimum bed height required for the 100% CO_2 removal from the mixture used for the given flow rate of air mixture.

Since CO_2 environment is favorable for the plant growth, experiments are to be conducted to test the exhausted charcoal powder and biochar as a biofertilizer to check the % increase in the height of crop.

Key words: Biochar, CO_2 capture, Environmental pollution, Global warming, Pollution control

SI/P-3

Validation of Spot-Vegetation Product of NPP for Agro-Ecosystem

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Primary productivity is the fundamental process in biosphere functioning. It is an important component of the global carbon cycle because it provides a measure of the amount of CO_2 removed from the atmosphere through net carbon exchange. Therefore, it needs to assess the carbon balance of regional and global scale. Agroecosystems provides not only food security but also mitigate the climate change due to atmospheric enrichment of CO_2 and other greenhouse gases. Since agroecosystem covers major proportion of earth land surface (37.3%), thus estimation of agricultural productivity is an important issue, regarding carbon sequestration. The quantification of agricultural net primary productivity (NPP) through harvest method is very arduous and time consuming. For this, remote sensing could be an important tool for assessing NPP for vast agriculture land. Therefore, present study intends to develop a regression model between harvest and the remotely sensed data of Indo-Gangetic plains as well as Vindhyan highland. For this, agricultural NPP of dominant crop varieties (rice and wheat) were estimated on the basis of peak biomass and this value was amalgamated with SPOT – Vegetation NPP product. The conventional method yielded 10.8 and 7.6 t C ha^{-1} yr^{-1} respectively for Indo-Gangetic plains and Vindhyan highland while corresponding for these two system SPOT-Vegetation satellite produced 7.2 and 3.6 t C ha^{-1} yr^{-1}. Further result indicated that SPOT-Vegetation satellite underestimated by 32.9% for Indo-Gangetic plains and 52.4% for Vindhyan highland.

Key words: Agroecosystem, Indo-Gangetic plains, NPP, SPOT-Vegetation, Vindhyan highland

SI/P-4

Effect of Climate Change on Bryophyte Diversity

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It is assumed that Bryophytes evolved approximately 350 million years ago, somewhat between lower silurian and lower carboniferous period. The first bryophyte appeared during a period when the climate was much warmer than it is today. Throughout this time frame, the climate has continuously changed and bryophytes continued to evolved and diversify, because they have a high fidelity to environmental gradients such as moisture, pH, light, nutrients etc. This can be proved by limitation and replacement of some species, such as *Drepanocladus fluitans, Meesia triquetra, Calliergon trifarium, Scorpidium scorpioidis* and *Tomenthypnum nitens* by stress tolerant species such as *Sphagnum warnstorfii, S. fuscum, Mylia anomala, Pleurozium schreberi, Polytrichum strictum*, which act as a good bioindicator species. Effects of climate change on bryophytes can be monitored by two means 1) effects on their growth rate, and 2) effects on the distribution pattern of individual species, community association and the ecosystem which they represent. The effect of climate change appears in the form of change in global distribution of species, death rate fluctuation, change in reproduction and maturity duration etc. Recent survey in Scotland beautifully exemplifies the effect of climate change on bryophytes, in which its being reported that some species of bryophytes, viz. *Acrobolbus wilsonii, Bartramia stricta, Lejeunea mandonii, Petalophyllum relfsii* etc. are tolerant to climate change and doesn't get influenced because of it, while species such as *Andreaea frigida, Bryum calophyllum, B. neodamense, Buxbaumia viridis, Herbertus borealis, Pohlia scotica* and *Sphagnum bafticum* are pretty sensitive and disappears due to climatic changes.

As mentioned earlier, bryophyte species are very sensitive to climate change and henceforth called as bioindicators of Global warming. Changes in bryophyte species composition and distribution can be used as a warning signal of climate change. It is likely that bryophyte monitoring study of peat lands would produce quickly and valuable results in determining the potential effects of warming on the vascular flora. An important utilization of bryophyte indicator species would be to predict the migration of climatically sensitive ecosystems that is causing the destruction of about 20-30% species from biodiversity. Thus it becomes necessary to conserve this important group of plants and utilize them as a potential source of bioindicator.

Key words: Bryophytes, Climate change, Ecosystem, Global warming

SI/P-5

Restoration and Development of Tropical Dry Forests in India for Mitigation of Global Warming

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On global basis, 52% of total forest are tropical and over 42% of these forests have been classified as dry forest (TDF). They play an important role in conservation and maintenance of biodiversity. In India, TDF accounts for 38.2% of the total forest cover and is largely threatened by lopping, burning, overgrazing and clearing for cultivation. Like all tropical forests, TDF is in danger of disappearing unless steps are taken for restoration and conservation. Restoration usually requires plantations of native species. For most plants mortality rate is higher at seed and seedling stages and vegetation recovery is often very slow. Seed collection, limited time of sowing, seed viability, germination and dormancy are the factors which limits the restoration of dry tropical forest at seed stage. Seedlings are the very sensitive stage of plant life and the main determinants of tree seedling growth are light, temperature, soil nutrients, soil moisture availability, fire, herbivory, expansion in agricultural land which limits the restoration of forests. Natural events such as temporary drought, flood may also influence the regeneration of tropical dry forests. Large areas need to be brought back under forest cover in order to reserve the current trend of deforestation and to conserve biodiversity. In India for the restoration of TDF, integrated knowledge on seed characteristic such as seed size, seed viability and requirements of germination and seedling stages is crucial for region specific restoration of plants. Trees act as a carbon sink by removing the carbon and storing it as cellulose in their trunk, branches, leaves and roots. While releasing oxygen back into the air so we can say that restoration of forest can mitigate the problem of global warming.

Key words: Determinants, Plantations, Restoration, Seedling, TDF

SI/P-6

Flood Disaster in India and its Management

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Last three decades have seen around three million deaths worldwide due to natural disasters. On an average, India is affected by severe floods every third year. Out of the total geographical area of 329 mha more than 40 mha of land, roughly $1/8^{th}$ of the country is prone to floods. India is the most flood affected country in the world after Bangladesh. The economy also gets severely affected due to damage of crops directly affecting the agriculture sector. In India two types of flood disaster measures are adopted viz., structural measures and non-structural measures, also called long term measures and short term measures respectively. Albeit Disaster management plans are active at national level, state

level and district level and also the disaster management act was introduced in 2005, still there are plenty of loopholes which need to be plugged. Efficient implementation of non structural measures is a key requirement. The country needs a better and effective disaster mitigation system to ensure the safety of its people and economy.

Key words: Disaster, Flood, Non-structural measures, Structural measures

SI/P-7

Effect of UV-B supplementation on growth, development and secondary products of commercial importance in *Cymbopogon citratus* (D.C. Staph.)

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Cymbopogon citratus (D.C. Staph.) commonly known as lemongrass are used as herbal drugs in the treatment of various digestive disorders, diabetes, inflammation, fever, nervous disturbance and stress related problems. In present study, a field experiment was conducted to examine the effect of supplemental UV-B (sUV-B) on growth, physiological functions and metabolism of *C. citratus.* The study mainly emphasize on its principle objective to evaluate the effect of sUV-B on commercially most important product; yield of essential oil and its qualitative analysis. Treatments involved placing UV-B lamps over plants that increase the levels of biologically effective UV-B by either +1.8 kJ m^{-2} d^{-1} (sUV_1) or by +3.6 kJ m^{-2} d^{-1} (sUV_2) above ambient. Plants growing under higher dose sUV-B (sUV_2) had 17.6% less total biomass than those under control but at lower dose (sUV_1) biomass being unaffected. sUV-B did not affect plant height; however, specific leaf area was significantly increased assessing increase in leaf thickness. Photosynthetic measurements indicated that there was no significant inhibition in net photosynthesis at sUV-B exposure suggesting protection of the photosynthetic processes possibly by phenolic compounds and antioxidants. UV-B radiation can activate the self-protective secondary metabolism system like flavonoids, total phenolics, alkaloids. Concentrations of UV-B absorbing total phenolics and flavonoids values increased up to 45 and 53% higher under sUV-B than under control, with corresponding increase in phenylalanine ammonia lyase (PAL) activity. Quantification of essential oil showed 25.7% higher essential oil yield at enhanced UV-B level (sUV_1) compared to control. Analysis of volatile oils by Gas chromatographic -mass spectrophotometry (GC/MS) in fresh leaf samples of control and sUV-B exposed sample showed the significant change in qualitative and quantitative composition of oil constituents. Z-Citral the major bioactive compound of *C. citratus* is found be significantly stimulated (up to 117.56%) by sUV-B exposure as compared to control). Higher percentage of Z-Citral in sUV-B treated samples suggests the improvement in quality of oil after treatment; as this compound have multiple pharmaceutical importances. Other important components i.e. Geraniol formate, pulegol, linalyl formate and other compounds also showed significant variations after sUV-B treatment. These findings are of particular importance as the potential of supplemental UV-B dose to increase secondary metabolites i.e. phenolics, flavonoids, as well as stimulation of oil cell production *vis-à-vis* positive involvement in volatile oil yield and its quality, may offer the opportunity to produce plants commercially with increased health benefits.

Key words: *Cymbopogon citratus*, Essential oil, Growth, Phenolics, sUV-B

SI/P-8

Stress Adaptive Potential of High Light Acclimated Wheat Seedlings to Water Stress During Senescence

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In nature plants may experience environmental stress factors operating either simultaneously or in sequence. In the present study, the developing primary leaves of wheat seedlings have been acclimated to high light stress and their photosynthetic response to polyethylene glycol (PEG) mediated water stress has been examined, during different developmental phases including senescence. The high light acclimated leaves show higher level of total chlorophyll, carotenoids and proteins as compared to their non-acclimated counterparts experiencing osmotic stress during senescence. The acclimated plants retain significantly higher level of β-carotene and lutein, in particular, as compared to non-acclimated plants. They also exhibit greater membrane stability as indicated by the measurements of fluorescence polarization, energy transfer efficiency in photosystem I (PSI) and Photosystem II (PSII) and lipid peroxidation. From the data of DCPIP photoreduction, oxygen evolution, thermoluminescence and pulse amplitude modulated (PAM) fluorimetry, a similar trend is observed for PS II photochemistry of the leaves experiencing osmotic stress during senescence. These results may suggest that the stress adaptive potential induced by one stress during development is retained by the leaves and helps to mitigate another stress effect operating in sequence during other developmental phases including senescence.

Key words: Adaptive potential, High light, PEG, Senescence, Stress

SI/P-9

Lichenometric Studies in India

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Lichens are the composite organisms which have an ability to colonize on a variety of substrates including rock, soil, trees and man-made structures in diverse environmental conditions. The thallus of the organisms comprises of fungus and algae growing in a symbiotic association. The slow growing and sensitive nature of lichens can be utilized as an indicator of environmental changes, load of atmospheric fallout of metals and dating the rock surfaces on which they are growing. Lichenometry is one of the chronological tools that have appeared to estimate the elapsed time ranging from decades to millions of years by utilizing different lichen species. Lichens grow on rock surfaces at relatively uniform rates over time scales of centuries. Once attached to a substratum (including rocks and trees), lichens do not change their place during entire lifespan. Hence, the age of lichen is an alternate for the minimum exposure time of a substrate to the atmosphere and sunlight. The orbicular lichens are usually preferred for performing the lichenometric studies. The lichen species such as, *Dimelaena oreina* (Ach.) Norm., *Lecanora muralis* var. *muralis* (Schreb.) Rebenh. *em*. Poelt, *Rhizocarpon geographicum* (L.) DC., and *Xanthoria elegans* (Links.) Th. Fr., have orbicular thallus. Most of the lichens have a peculiar type of thallus comprising of crust forming areoles in the centre and small lobes at the periphery. The *R. geographicum*, *X. elegans* and *D. oriena* grow on the rocks frequently in the proximity of glaciers in upper temperate and alpine regions. These lichens have ability that they can inhabit rocks which are usually covered by the snow during winters. Most of the work regarding lichenometric studies in India and other regions of the world are performed with the help of *R. geographicum* due to its luxuriant growth, wide distribution, easy identification, radial growth circumscribed by hypothallus, slow and constant growth rate and long life span.

The lichenometric technique is mostly applied in dating surfaces, glacier moraines, debris flow due to land-slide and earthquakes, old monuments, buildings and graveyards. It gives easily an estimate for their minimum age of exposure and establishment or formation. Glaciologist and geologist in different regions of the world have worked upon various aspects of lichenometry. The study not only helps to date the geomorphic changes occurred in the past but also analyses the frequency and intensity of the hazards.

The technique has been greatly appreciated world-wide but not much research investigation on this aspect of lichens is perused in India. However, some geological activities in Gangotri and Chorabari Glacier of Uttarakhand and Pawari landslide zone of Himachal Pradesh have been noticed. Few Indian lichenologists have shown their interest in correlating lichens with dating surfaces (of Pindari Glacier in Uttarakhand). In developing countries like India, melting of glaciers, glacial lake outburst floods, landslides and earthquakes could be an additional stress on ecological processes that is already under tremendous pressure due to rapid urbanization and industrialization. Therefore, it is necessary to undertake lichenometric studies to estimate the rate of such natural disasters accelerated due to changing environmental conditions. The study would help us to know the fate of some important glaciers in the nearer future, which feed the life line rivers of India. So that necessary action can be taken to control anthropogenic activities and conserve nature.

Key words: Debris flow, Glacier moraines, Lichenometry, Lichens, *Rhizocarpon geographicum*

SI/P-10

Ameliorative Effect of Ethylenediurea against Ozone in three Cultivars of Black Gram (*Vigna mungo* L.)

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Rapid economic growth, industrialization, urbanization, increased use of motor vehicles and lack of proper implementation of environmental regulations lead to serious air pollution problem in India. High level of O_3 in biosphere could be detrimental to all living and non-living objects as it is a potent oxidant. Ozone is very phytotoxic and regarded as one of the most damaging air pollutant to which plants are exposed. Tropical countries including India are at a greater risk due to their meteorological conditions (high solar radiation and temperature) being conducive to the formation of tropospheric O_3. Several studies have been conducted for the last few decades to study the potential for protection of vegetation from O_3 injury using chemical applications. Chemicals used for plant protection are mainly fungicides, insecticides, herbicides, growth regulator and various antioxidants. The most effective antiozonant chemical is *N*-[2-(2-oxo-1-imidazolidinyl) ethyl]-*N*-phenylurea or ethylenediurea (EDU). Due to its specific characteristics, EDU has been used in the field as a phytomonitoring agent to assess crop losses due to O_3. Field experiments were conducted on three cultivars of black gram (*Vigna mungo* L. cv. Barkha-1, Shekhar-2 and TU-94-2) grown under natural field conditions in a suburban area of Varanasi, Uttar Pradesh, India during July October 2007 to determine the impact of O_3 on various growth and yield parameters. Mean O_3 concentration at the study site for the experimental period was 51.0 ppb. EDU solution (0 ppm and 400 ppm) was applied as soil drench (100 ml plant^{-1}) 10 days after germination (DAG) at an interval of 10 days. EDU treatment positively affected various growth and yield parameters with distinct variations among test cultivars. EDU-treated plants showed significant increase in shoot and root lengths of Barkha-1 whereas number of leaves and leaf area increased in Barkha-1 and Shekhar-2. Reduction in biomass of non-EDU-treated plants of Barkha-1 and Shekha-2 indicated that O_3 induced suppression in growth and EDU treatment helped the plant to alleviate the O_3 stress. Significant increment in net assimilation rate (NAR) and specific leaf weight (SLW) was observed in EDU-treated plants of Barkha-1 and Shekhar-2 but not in TU-94-2. Yield (g plant^{-1}) was significantly higher by 36.4% and 35.6% in EDU-treated

cultivars Barkha-1 and Shekhar-2 as compared to non-EDU-treated ones. However, non-significant effect of EDU was observed for cultivar TU-94-2. EDU, thus proved its usefulness in screening the sensitive/resistant cultivars of black gram in an area experiencing higher concentrations of O_3.

Key words: Biomass, Black gram, EDU, Ozone, Yield

SI/P-11

A Proteomic Approach to Analyze Drought-Responsive Proteins in Cotton Leaf

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Effect of drought was studied on cotton (*Gossypium herbaceum* var. RAHS 187) plants with reference to leaf protein expression changes using two-dimensional polyacrylamide gel electrophoresis (2-D PAGE). Cotton plants were subjected to gradual drought and leaves were sampled at different relative water content (RWC) stages viz. 75%, 50% and 35%. Proteins from different samples were extracted and separated on first dimension (Iso-electric focusing) and then second dimension (SDS-PAGE). Silver stained gels were scanned and analyzed using ImageMaster 2 D Platinum Software. The interesting spots were excised and trypsin digested. The resulting peptides were analyzed on MALDI TOF/TOF (4800, ABI). The data was searched against NCBI nr/SWISS prot protein sequence database with MS/MS ion search (www.matrixscience.com).

Analysis of at least 3 replicated gels revealed that 387 spots were matched to all the gels. Sixteen spots were up-regulated while 6 spots were down-regulated. Many up-regulated proteins were associated with stress signaling e.g. 14-3-3 protein, similar to cdc2 protein kinases and ethylene-responsive transcription factor. Some up-regulated proteins were associated with stress response and detoxification e.g. probable glutathione S-transferase, peroxiredoxin type 2, putative and polyphenol oxidase. Other up-regulated proteins were identified as ATP synthase CF1 alpha subunit, phosphoribulokinase, cytochrome P_{450} 90 D2, acetyl-coenzyme A carboxylase, GTP-binding protein G alpha subunit. One protein identified as Serine carboxypeptidase was significantly reduced at 75% RWC however at 35% RWC its expression was more than control leaves. The down regulated proteins included mitochondrial ATP synthase subunit (energy metabolism), Rubisco subunit binding-protein beta subunit (photosynthesis), magnesium and cobalt efflux protein, putative Translation initiation factor IF-2, putative cadmium/zinc-transporting ATPase 2, Glutamyl-tRNA reductase 2, chloroplastic (chlorophyll biosynthesis). A protein which expressed only in drought stressed leaves was identified as pentatricopeptide repeat-containing protein, putative (involved in cell cycle). Further proteomic studies are going on cotton varieties differing in drought sensitivity to identify drought responsive proteins.

Keywords: *Gossypium herbaceum,* Drought stress, 2-D PAGE, MALDI-TOF-TOF, Stress responsive protein

SI/P-12

Morpho-physiological characterization of wheat cultivar under water stress conditions

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A study was conducted to characterize the morpho-physiological parameters in wheat during FC (Field capacity) percent treatment at the seedling stage. Wheat cultivar (Var. 2496) was subjected to water stress (FC) percent treatment in pot culture. The study revealed that plant height, shoot length, root length, fresh weight and dry weight decreased with increasing water stress at seedling stage in the wheat. The concentration of proline increased significantly with an increase in the degree of water stress. Similarly phenolic contents also increased along with increased water stress level. However, photosynthetic pigments were highly reduced with increasing water stress at seedling stage.

Key words: Chlorophyll, Proline, Root length, Shoot length, Water stress, Wheat

SI/P-13

The Role of Bamboo in Carbon Sequestration and Global Climate Change

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'Bamboo' also known as 'the green gold' is the only giant grass which has been recognized as fast carbon sequester among the woody and non-woody terrestrial plants. Due to the rapid growth rate during the initial phase, bamboos generally achieve their full height up to a maximum of forty metre within three months after the induction of tender shoot. It is well evident in case of *Bambusa balcooa, Bambusa arundinacea, Dendrocalamus giganteus, D. hookerii, D. sikkimensis, Gigantochloa macrostachya* etc. These bamboo species can sequester environmental CO_2 and accumulate up to 100 Kg per individual within a period of 3-4 years. Bamboo can accumulate the aboveground standing biomass up to 290 tonnes/ha with a net primary productivity up to 47 tonnes/ha/yr, which is almost double the rate exhibited by eucalypt clones. The total standing biomass of mature *Bambusa* spp. with 149 t C/ha at 6 years is even higher than that of teak at 40 years with only 126 t C/ha. Bamboo being the grass, can withstand various environmental stress including different types of metallic and nonmetallic pollutants up to quite higher concentrations, at which other plants are killed. Due to multiple applications, valued products and high commercial value, bamboo is in high demand all over the world. Therefore, its luxuriant growth is also linked with socio-economic conditions of the people.

Although, gregarious flowering in bamboo is an undeciphered natural phenomenon having serious ecological implications, because this causes sudden and large-scale decline in large population of bamboos due to mass death of clones followed by the gregarious flowering, resulting in withdrawal from the sequestered carbon

Key words: Bamboo, Carbon sequestration, Climate, Flowering, India, Pollution

SI/P-14

Influence of Rising Temperature on Rice Production and Potential of Greenhouse Gases by the DNDC-Rice Model: Case Study at Samutsakorn Rice Field in Thailand

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The site mode of the DNDC-rice model was tested against field observation for rice growth, rice yield and methane (CH_4) emission from irrigated rice fields in various ambient temperatures. Field observation data under continuous water management regime at Samutsakorn rice field in the central plain of Thailand were was used as baseline. Carbon content of harvest part, root residue, and shoot were decreased when rising temperature from 29 to 31 and 35ºC. N uptake by crop, gross mineralization, assimilation of N, and net mineralization were also decreased. Total CH_4 and soil CO_2 emissions were decreased under rising temperature from 29 (baseline) to 31 and 35ºC. But CO_2 emission from rice root was similar from all treatments. The results from this study suggest that rising temperature effect on rice growth, rice yield, and CH_4 emission from rice cultivation.

Key words: Methane, Rice field, Rice growth, Rice yield, Rising temperature

SI/P-15

Mitigating Impact of Climate Change on Chickpea Yield

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Chickpea (*Cicer arietinum* L.) is one of the major pulse crops covering 7.97 m ha area contributing about 50% (7.06 m t) to the total pulses production (14.57 m t) in India registering all time high productivity of chickpea (885 kg/ha) during 2008-09. This has become possible due to development and popularization of high yielding varieties insulated well against various biotic and abiotic stresses along with matching crop management technologies for different agro-ecological regions of the country. Climate change can be seen as abrupt change in temperature (low or high), erratic rainfall etc. leading to reduced grain yield in most of the crops. It is well established fact that productivity of chickpea suffers when temperature goes beyond 34-35°C at reproductive stage i.e. flowering and podding stage. An empirical estimate suggest varying degrees of losses (8-12%) in productivity of chickpea during 2009-10 in different parts of the country including Rajasthan, Uttar Pradesh, Madhya Pradesh, Gujarat, Maharashtra and Bihar due to high temperature. The losses due to heat stress can be even more when crop is sown late and there is sudden rise in temperature at reproductive stage. The reduction in seed size, forced maturity leading to shriveled and varying colour grains, poor biomass production etc. can be seen in response to high temperature in this crop.

The efforts were made at Indian Institute of Pulses Research (IIPR), Kanpur and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru independently to study the variability present for tolerance to heat stress. Accordingly large numbers of advance breeding lines were evaluated heat stress both at IIPR and ICRISAT. The selected breeding lines along with ICCV 92944, which is known as heat tolerant genotype, were sown on 14th January 2010 in replicated trial and observations were recorded on phenological and yield attributes at IIPR, Kanpur. The diurnal temperatures (minimum and maximum) were also recorded during entire crop duration. IPC 2007-94, IPC 2006-84, IPC 2004-53, JG 130, ICCV 7102, ICCV 89314, ICCC 37, ICCV 92944, IPC 2008-89 and IPC 2006-53 produced good number of pods at high temperature (>35°C). Out of these, ICCV 92944, ICCV 2006-84 and ICCC 37 were found promising at both locations. The minimum reduction in biomass, seed size and number of pods per plant was the main reason for higher yield in tolerant genotypes. However, the early maturity has been found as another important trait contributing towards better yield. On the basis of preliminary study it can be suggested that transfer of genes conferring heat tolerance in genotypes having higher biomass and early maturity will be desirable to mitigate impact of climatic change on chickpea. All these breeding lines are being subjected for detailed physio-genetic analysis to test their worth with respect to heat tolerance. This preliminary study has clearly indicated the scope for mitigating effect of climate change, heat stress in present context, on chickpea yield.

Key words: Chickpea (*Cicer arietinum* L.), Climate change, Heat stress, Productivity

SI/P-16

Climate Change and its Impact on Aquatic Ecosystem

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Aquatic ecosystems include lakes and streams, non-tidal wetlands, coastal environs, and oceans. Temperature increase caused by climate change may reduce the diversity

and geographical distribution of species, the productivity of organism in ecosystem and the mixing priorities of lakes. Increase in air temperature can shift the geographic range of species by about 150 km. Pole ward. Most favourable effects of warming will be felt at high latitude, where biological productivity and species diversity are likely to increase. Most significant negative effect will be experience by cold or cool water species in low latitudes where extinction is likely to increase and biodiversity will decline. Climate change will affect biological, biogeochemical and hydrological functions of wetlands. An increasing temperature could affect the wetland by thawing permafrost, which is crucial for maintaining the water table in ecosystem. Climate change effects, such as sea level rise, changes in atmospheric temperature and variation in the rainfall patterns. And many valuable economic and ecological functions including tourism, fisheries, storm and floodwater protection and biodiversity would be threatened by climate change. The greatest impacts of climate change on many aquatic ecosystems would be the exacerbation of already existing stresses resulting from human activity. In this paper harmful effects of climate change on aquatic ecosystem are discussed.

Key words: Aquatic ecosystems, Increase in air temperature, Low latitudes

SI/P-17

Climate Change vs. Sustainable Agriculture

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The development of agriculture during the "Green and Gene revolution" led to dramatic increases in productivity, but unfortunately, it is not sustainable as a result number of negative impacts arises such as Starving people in poor nations, obesity in rich nations, changing food prices, on-going climate changes, increasing fuel and transportation costs, flaws of the global market, worldwide pesticide pollution, loss of soil fertility and organic carbon, soil erosion, decreasing biodiversity, desertification, and so on. The objective of the study was to identify the most appropriate mechanism for sustainable agriculture with respect of climate change that used long term development of nation without harming environment.

Sustainable systems avoid dependence on synthetic fertilizers, pesticides, growth regulators and livestock feed additives. Instead, they rely mainly on crop rotation, crop residues, financial support to farmers who implement the environmentally-sound agriculture, and sufficient treatment of livestock waste, animal manure, legumes, green manure, off-farm organic waste, mechanical cultivation and mineral-bearing rocks to maintain soil fertility and productivity, and on natural, cultural and biological controls to manage insects, weeds and other pests. Indigenous knowledge and biotechnology must be implement for managing soil fertility, controlling pests and diseases, weeds, soil preparation, diagnosis of plant and animal diseases, planting materials, harvesting and storage. In agriculture every land use has different effects on the water environment, that is, paddy fields and wetlands can effectively remove nitrogen (N) from strongly contaminated water, and moorland fields can be serious N pollutant sources, to construct the N flow from moorland fields to paddy fields should be effective to reduce N load outflow from the agricultural catchment. Further, to construct recycling systems for agricultural drainage and domestic effluent within rural areas are effective to contribute the water environment conservation. The paper concludes that the indigenous knowledge and technology mutually support to plan innovative idea and relationship between sustainable agriculture and climate change adaptation which used for sustainable agriculture for future generations.

Key words: Biotechnology, Climate change, Indigenous knowledge, Sustainable agriculture

SI/P-18

Assessing impacts of ambient O_3 a component of global climate change on sensitivity of three wheat cultivars

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The current concentrations of O_3 have been shown to cause significant negative effects on crop yield. The present study was conducted to evaluate the O_3 sensitivity in wheat cultivars (M 234, PBW 343 and M 533) at a rural site in the IndoGangetic plains of India, using open top chambers. The experiment was conducted in a randomized complete block design within the plot with three replicates of filtered chambers (FCs), nonfiltered chambers (NFCs) and open plots (OPs) of different cultivars. Photosynthesis rate (Ps), stomatal conductance (g_s), photosynthetic pigments, number of leaves, leaf area, relative growth rate (RGR), net assimilation rate (NAR) and leaf area ratio (LAR) were assessed at vegetative and reproductive phases. Yield and grain quality was quantified at the time of harvest. In the present study, AOT 40 value was 0 ppm.h in FCs and 6.2 ppm.h in NFCs. O_3 concentration frequently exceeded above 40 ppb during reproductive phase. Percent inhibition in Ps rate and g_s was highest in M 234. Highest inhibition in number of leaves and leaf area was recorded in M 533 during vegetative phase and in M 234 during reproductive phase in NFCs compared to FCs. Percent inhibition in RGR was higher in M 533 during vegetative phase but at reproductive phase RGR increased. NAR showed higher value for M 533 than PBW 343 and lowest in M 234 during reproductive phase, however, percent inhibition in leaf area ratio was higher for former than latter in NFCs. The ozone resistance was higher in M 234 during vegetative phase and in M 533 and PBW 343 at reproductive phase in NFCs compared to FCs. Reductions in number of grains, test weight and yield were lowest in M 533 followed by PBW 343 and highest in M 234 in NFCs. Concentrations of starch and protein in grains decreased significantly in all cultivars in NFCs.

The study concludes that under ambient O_3, the three cultivars responded differently. M 533 adapted under O_3 stress by reducing number of leaves and leaf area, increasing NAR and RGR during environmentally sensitive reproductive phase, favouring assimilate translocation towards developing ears and maintaining yield. Cultivar M 234 was found to be most sensitive showing maximum yield reduction.

Key words: Ambient O_3, Growth, Photosynthesis, Translocation, Wheat cultivars, Yield

SI/P-19

Community Level Adaptation to Climate Change: A Case Study of Garhwal Himalayas

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The Himalayan region is one of the most dynamic and complex mountain ranges in the world due to tectonic activity, and they are vulnerable to global climate change and increasing human activities. In addition to the already existing threats and pressure on mountain ecosystem, climate change can be an additional burden to bear by the mountain ecosystem, species and people. Mountain people have lived with and survived great hazards for thousand of years, but current rates of climate change are among the most rapid known and they are superimposed on serve and, equally, uncertain socioeconomic pressures. The poor people are most vulnerable to climate change, which will increase the Poor's vulnerability and make pro-poor growth more difficult. While poor people are contributing less to the climate change with simple living, they are most likely to suffer the problems of heat stroke, water scarcity, and less food.

The Impacts of climate change are not evenly distributed in intensity within the region, nor among different communities and sectors of society. However, the poorer more marginalized, people are likely to suffer the earliest and most.

Over the years communities have developed and practiced their own mechanisms to cope with adverse climate and other stresses beyond their control. The Aim of this paper was that documentation of such local examples from mountain areas would develop feasible and effective adaptive strategies to cope with climate change.

Key words: Adaptive strategies, Impacts of climate change, Mountain ecosystem

SI/P-20

Effect of Climate Change on Mountain Biodiversity and Ecosystem Functioning: A Case Study of Nagtibba Hill in Central Garhwal Himalaya

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All ecosystems will experience climate change but ecosystems of the high mountain are considered to be particularly sensitive to warming because they are regulated by low temperature conditions. After expedition of different high altitude landscape the Nagtibba Mountain (3000-3500 m) has been selected for ecological study. The mountain zone comprises real wilderness habitat with ecosystem undisturbed by direct anthropogenic impact. This allows the study of impact caused by climate change without effect caused by human land use. GLORIA a standardized method has been used. The data of plant density, diversity, biomass and energy contents has been compared. The density m^{-2}, biomass gm m^{-2} and energy value gm^{-1} of some important sensitive species has decreased in 2009 as compared to the 1998. It is very strong indicator of climate change and temperature rise in mountain site.

Key words: Anthropogenic impact, High altitude landscape, Plant density, Plant diversity

SI/P-21

Biophysical Non-Invasive Screening of Cucumber Germplasms against Chilling Stress

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Biophysical techniques viz., Chlorophyll fluorescence and infra-red gas analyzer has been routinely used for many years to monitor the photosynthetic performance of plants non-invasively. The relationships between chlorophyll fluorescence parameters and leaf photosynthetic performance are reviewed in the context of applications of fluorescence measurements to screening programme, which seek to identify improved plant performance. The potential role of chlorophyll fluorescence is screening of plants for tolerance to environmental stresses and for their improvements. Cucumber (*Cucumis sativus* L.) is an important vegetable crop plant for many parts of the world, Asian countries in particular. For these crop, chilling or low temperature (0-15°C) is unfavorable as it affects growth and development and limits their ability to survive. Low temperatures slow down the electron transport chain and inhibit alternative energy dissipation paths. In present investigation 27 germplasms of cucumber was collected from different region of Uttarakhand and grown in polyhouse; the temperature range was ca. 4-15°C.the observations were recorded at different growth stages using plant efficiency analyzer (PEA meter) and net photosynthetic rate by infra-red gas analyzer (IRGA). We observed the net photosynthetic rate, transpiration rate and stomatal conductance and chlorophyll fluorescence parameter viz., Fo, Fm and Fv/Fm at three different plant growth stages i.e., vegetative, flowering and maturity stages. The germplasms collected from high hill region of Uttarakhand had shown some level of tolerance to low temperature as compare to other germplasms collected from plane region. An Fv/Fm

value and net photosynthetic rate were found to higher in tolerant germplasms of cucumber. As per the findings of the data the 18 out of 27 cucumber germplasms showed the cold tolerance and rest were cold susceptible.

Key words: Chlorophyll fluorescence, Cucumber, chilling, IRGA, Transpiration rate

SI/P-22

Effect of Acute Drought and Temperature Stress on Phytochemistry of *Plumbago zeylanica* L.

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The purpose of this paper a study carried out to evaluate the effect of acute drought temperature stress on phytochemistry of medicinal plant *Plumbago zeylanica* L. Plants has two types of metabolites i.e. primary metabolites and secondary metabolites. Primary metabolites like glucose, protein etc. has dietary importance besides secondary metabolites are useful in medication. Plant produces secondary metabolites like alkaloids, glycosides etc with the help of primary metabolites. All these process has an impact of abiotic facto temperature, humidity, soil etc.

We have chosen medicinal plant known as *Plumbago zeylanica* L. (Shweta chitrak) to access the effect of drought temperature stress on phytochemistry i.e. total % of alkaloids and glycoside.

The phytochemistry *Plumbago zeylanica* L. are significantly influenced by acute drought temperature Stress. In this study, plants were subjected to brief drought and temperature stress. Roots of *Plumbago zeylanica* L. collected from herbal garden of YMT Aurvedic Medical College, Kharghar, Navi Mumbai. Roots and Flower collected in different temperature shade and dried, powdered and used for further study. During both flower and development periods exhibited. Experiment D-1: Plants that received drought stress during the period of flowering [collected root and flower] Experiment D-2: Control plants that received adequate water during the period of initial flowering.

In this study phytochemicals plumbasgin concentration are studied in drought- temperature stressed plants as compared to well-watered control plants.

Acute drought and temperature stress decreased flower dry weight significantly during both drydown periods, vegetative parameters (height, root dry weight leaf dry weight and stem dry weight) were not adversely affected. While acute drought stress significantly altered the chemical yield in the root and flowers.

Key words: Drought stress, *Plumbago zeylanica* (Shweta chitrak)

SI/P-23

Climate Change in South-Western Bangladesh: An Ecological Perspective

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South-western Bangladesh has been experiencing severe negative impacts due to frequent attacks of natural calamities (Aila and Sidr Cyclone). Over the years changing climatic condition has its negative impacts in different forms (saline water intrusion, storm surge) at the south-western coastal area of Bangladesh (Satkhira and Khulna District). The negative impacts were also reflected on the floral composition and biodiversity of south-western region and over the years the composition of Sundarbans, the largest mangrove area in the world, has been changing significantly. Negative impacts also impose appalling impacts on freshwater fisheries resources and socio-economic sectors of the south-western Bangladesh. This paper highlights and relates negative impacts on live and livelihood options of south-western coastal Bangladesh due to climate change focusing ecological perspectives.

Key words: Biodiversity, Calamity, Ecology, Sea level rise, Sundarbans

SI/P-24

Accumulation of Proline to Screen Genotypes in their Ability to Tolerate Osmotic Stress

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Drought and salinity are major abiotic stress factors that severely affect agricultural systems and food production. Many plant species including most important crops are subjected to growth inhibitions under high NaCl conditions. In the present study, ten different rice seeds were allowed to germinate and grow in the absence (control) and presence of different concentrations (50 mM, 100 mM, 150 mM and 200 mM) of NaCl. Seed germination was observed after 5 days. The varieties ASD-16, ADT-36 and ADT-43 show higher percentage of reduction of germination than IR-50, JGL-1728 and MDU-5. After 5 days, 10 days and 15 days of salt treatment, the plants were harvested and measured the shoot lengths and root lengths. Many eubacteria, algae and higher plants accumulate free proline in response to osmotic stress. Ten days old seedlings were transferred to 50mM and 100mM of NaCl and accumulation of proline was monitored after 12, 24, 48, 72 and 96 hours. The rice varieties IR-50, JGL-1728, MDU-5 and ADT-43 show better tolerance once against other varieties. Utilization of genetic variation in tolerance level against salinity to improve salt tolerance of rice may benefit from an improved understanding of response of rice to salinity stress.

Key words: Abiotic stress, Proline, Rice, Salinity

SI/P-25

Monsoons of 2010 in Northern India: A Climatic Shift!

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Amongst the several natural disasters, flood remains as a fore-runner in the Indian scenario. Most of these floods are related to monsoonal cycles which represent an annual ritual by climatic controls. The excessive downpour leads to other disasters as well amongst which, landslides, soil erosion, weathering, flash floods and mass wasting are the key disasters. This year (2010), the rather late monsoon in India had made climatic managers in a state of confusion and shock. Nevertheless, the spate of massive downpours in the Himalaya and adjacent regions let to massive flood like conditions so much so that the national capital "Delhi" was partially submerged under the Yamuna waters!

It was not only Yamuna, but all other major rivers and their tributaries of the Ganga plain that had gushing waters. That led to massive flood in the Indo-Gangetic plains. The excessive rains in the lower Himalayan region in Uttarakhand, Himanchal Pradesh and Jammu & Kashmir witnessed some of the worst monsoonal conditions of all times that have disrupted the life of people and destroyed their buildings, roads and other infrastructural networks. As a side effect of these rains, mountainous roads were destroyed due to onslaught of landslides and process of mass wasting. The excessive downpour on some of the major national highways in the mountains left thousands of vehicles stranded and left most of the travelers staying back on the roads for a few days. Normal life was disrupted.

Another impact related to excessive physical weathering due to the rains was the removal of large amounts of rock mass and soil from the lower Himalayas as the sediment load in these mountain rivers. This load was carried forward southward by various rivers systems and got dumped as a deposit where the water-flow energy was low. It is envisaged that the floods of this year would have deposited enormous sediment load that would give rise to river shifting, generation of ox-bow lakes and formation of new land-forms and soil profiles.

On the environmental front, most of the river basins in northern India were able to get de-polluted as a consequence of the rains where 3-4 decades of filth, pollutants and toxic materials had become a permanent source of pollution causing agents. The erosion of the old river bed and deposition of new soil/ sediments would recharge the soil cover and may become from bane to boon for crop productivity for the next few years/ decades.

This year's (2010) excessive monsoonal rains seem to represent a major climatic shift from the past few decades and needs deep investigation, proper climatic modeling and understanding of the probable causes with its correlation with similar events of the past to comprehensively understand the process of this meteorological oddity that has affected large parts of the country. The final verdict about its exact cause would only be possible after these investigations are completed.

Key words: 2010, Climate-shift, Floods, Impact assessments, Monsoon

SI/P-26

Floristic Composition and Climate During Siwalik Periodin the Himalayan Foot Hills of West Bengal, India

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The Siwalik groups attains an average thickness of 6000m and are exposed all along the Himalayan foot hills covering a distance of 2400 Km in length. The Siwalik foot hills of the West Bengal vary considerably in thickness and do not occur continuously. Acharya (1972) sub divided the Siwalik sequence of this area into three units. 1. Upper pebbly sandstone and conglomerate units. 2. Middle sandstones units. 3. Lower clay stone unit. The lower unit well exposed in Ghish river however, the middle unit is exposed along Lish and Ghish River in Oodlabari area. The plant fossils including petrified woods, leaf, fruit and seed impressions found abundantly in both lower and Middle units of Siwalik.

The upper unit usually devoid of plant megafossils.

A comparative study of morphological features between the fossils and extant taxa reveals the presence of 20 new taxa belonging to 12 angiospermous families. On the basis of present data as well as already known data from there. The palaeoclimate of the area during the Siwalik period (Mio-Pliocene) has been deduced. The dominance of evergreen element (64%) in present fossil assemblage indicates the prevalence of tropical warm humid climate with plenty of rainfall during the deposition of sediments. The analysis of present day distribution of all the recovered taxa from the Siwalik foot hill of Darjeeling District in West Bengal shows that they are mostly known to occur in Northeast India, Bangladesh, Myanmar and Malayan region wherever favourable climatic conditions are available. About 30% taxa of total assemblage found to grow presently in the Himalayan foot hills of the region and remaining 70% taxa are locally extinct. This indicates that the climatic changes must have taken place after Mio-Pliocene.

Key words: Darjeeling District, Palaeoclimate, Plant diversity, Plant fossils, Siwalik Group, West Bengal

SI/P-27

Soil Carbon sequestration: Challenges and future research perspectives

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Global warming due to increasing green house gases emission and the subsequent global climatic changes are the most serious environmental challenges faced by environmental scientist, academicians, regulatory agencies and policy makers worldwide. Among the various green house gases, CO_2 constitutes a major share and its concentration is increasing rapidly. Therefore, there is perhaps an urgent need to formulate suitable policies and programs that can firmly reduce and sequester CO_2 emissions in a sustainable way. In order to combat the predicted disaster due to rising CO_2 level, several CO_2 capture and storage technologies are being widely pursued and deliberated. Among the various carbon capture technologies, soil carbon sequestration is gaining global attention because soil is the most stable and long-term surface reservoir for carbon and is a natural, low cost and eco-friendly process to combat climate change. Apart from the carbon capturing, the process of soil carbon stabilization also provides other tangible benefits including, achieving food security by improving soil quality, wasteland reclamation and preventing soil erosion. Even if a handful of legally binding international treaties are formulated to reduce the CO_2 emission, majority of the signatory countries irrespective of their economic status are reluctant to come forward with a clear cut emission cut-off. In this context, soil carbon sequestration gains special attention as an innovative technique to capture atmospheric CO_2, and every country can sequester a lions share of their per capita emission without any legal obligation. Furthermore, the economic benefit of the soil carbon sequestration i.e. carbon credit will enable the countries to meet their expenditure towards the sequestration process. The present article aimed to address all these concerns and provide strategies and critical research needs to implement soil carbon sequestration as a mitigation option for increasing atmospheric CO_2 level and ensuring global food security by sustainable soil management practices and its future directions.

Key words: Carbon credit, Climate change, Food security, Global warming, Green house gases, Soil carbon sequestration, Soil management, Sustainable development

SI/P-28

Antioxidant System Response in Moss *Barbula indica* under Water Stress

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Possibility of desiccation tolerance in a common leafy moss *Barbula indica* was investigated for its ability to process reactive oxygen species which are generated during desiccation and rehydration. Fv/Fm and relative water content (RWC) were used for sampling of desiccation and rehydration stages. De1 (0.49Fv/Fm, 35%RWC), De2 (0.26Fv/Fm, 23.5%RWC), De3 (0.05 Fv/Fm, 13.5%RWC) rehydration stages as Re1 (0.182Fv/Fm,78%RWC), Re2 (0.45Fv/Fm, 85%RWC), Re3 (0.72Fv/Fm, 100%RWC) in laboratory conditions. Moss collected from institutes moss house. Moss recovered rapidly upon rehydration its, Fv/Fm value 0.05 (De3) reached 0.18 (Re1) in 24 minutes and to 0.45 (Re2) in next 20 minutes.

Desiccation enhanced production of superoxide radical and H_2O_2. Lipid peroxidation also increased more under dehydration than in rehydration. However, electrolytic leakage was more pronounced during rehydration than dehydration. Proline content increased more than 3 fold at De2 stage. SOD activity decreased with respect to control in dehydrated and rehydrated stages. CAT increased in dehydrated and rehydrated stages and maximum activity increased by 136% in De3 stage. APX showed a significant increase of 80% in De3 and maintained higher level in dehydration and rehydrated stages. GR activity decreased in both dehydrated and rehydrated stages. Total ascorbate and glutathione content increased during course of dehydration and maintained higher level even after rehydration. Chlorophyll a/b ratio remained constant during dehydration and rehydration stages while, carotenoid content increased significantly by 43% in De3 stage and upon rehydration its level decreased. Anthocyanin level increased throughout the dehydration and rehydration stages maximum by 143% in Re2. The results indicate that APX and CAT, ASC and GSH together with stable pigment-protein complex played an important role during desiccation and also helped in quick recovery upon rehydration.

Key words: Antioxidants, Desiccation, ROS, Fv/Fm, *Barbula indica*

Session SII

Environment & Biodiversity

SII/L-1

Biotechnological Applications for Conservation of an Endangered Forest Tree *Givotia Rottleriformis* – Important in Toy Making Industry

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Forest trees are an integral part of human life, and vital component of biodiversity. Forest trees are in particular renewable sources of food, fodder, fuel wood, timber and other valuable products. Due to the rapid growth of population and the human desire to progress, depletion of genetic resources coupled with escalating human needs, there has been a tremendous reduction in forest cover from the earth's surface. To maintain and sustain forest biodiversity, conventional approaches have been exploited in the past for propagation and improvement. But conventional breeding is rather slow and less productive and can't be used efficiently for the genetic improvement of trees. Hence there is need to apply biotechnological strategies for genetic improvement of economically, commercially and endangered forest tree species. In view of this, we have attempted to conserve the species which play a major role in toy making industry.

The species *Givotia rottleformis* (ver. Thella poniki, white catamaran tree) is a medium sized tree. The wood of this tree is valuable and is used for making toys, fancy, lacquered articles, catamarans and carving figures. Seeds yield a valuable oil for lubricating fine machinery and used as medicine for curing psoriasis. The wood of this tree is very soft, light white and used in toy making industry by artisans in Andhra Pradesh, Tamilnadu, and Karnataka. Due to over exploitation of the species and difficulty in seed germination, the species is almost on the verge of extinction. The artisans depending on this industry for their lively- hood are put to a major set back for want of wood. So, there is an urgent need to conserve and multiply this endangered tree using Biotechnological approaches.

In view of the potential importance of this endangered species, the protocols have been developed for rapid *in vitro* multiplication and plantlet establishment through mericlone, clonal technologies and also somatic embryogenesis. Somatic embryogenesis and plantlet establishment was achieved on MS medium supplemented with 0.5mg/L NAA + BAP followed by shifting them on to 0.25 mg/L BAP +NAA for germination of somatic embryoids. For mericlone technology, shoot tip explants were cultured on MS medium fortified with different concentrations of BAP/Kn/Zeatin individually. For clonal propagation, nodal segments were used. These were cultured on BAP/Kn.

For *in vitro* rooting the micro shoots developed after shoot tip and nodal cultures were transferred on to MS medium supplemented with NAA/IBA/IAA. A break through was also achieved in inducing the *ex vitro* rooting in *G.rottleformis*. The *invitro* regenerated plants were hardened and successfully transferred to field. Thus the protocol developed during the present investigation can be used for rapid multiplication of this endangered species. Various factors including growth regulators concentrations and combinations for the formation of multiple shoots and also *in vitro* and *ex vitro* rooting are presented.

Key words: Forest tree, Endangered, *Givotia rottleriformis*, Conservation, Toy making, Industry

SII/L-2

Are the Sacred Groves of Meghalaya Still Remnant of Climax Vegetation: Diversity and Distribution of Woody Vegetation along Disturbance Gradient

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Since time immemorial the sacred forests of Meghalaya are protected and conserved by local indigenous tribal communities on religious and cultural ground, and representing treasure house of plant diversity as well as climax vegetation. Some economically important species are restricted to the groves only and size of groves varies from 0.1 ha to 900 ha. The tribal communities of the area perform some cultural events inside the groves. The collection of plants or plant parts from such groves is allowed only for religious and cultural purposes. But, during last two decades, anthropogenic activities such as extraction of timber, collection of fuel-wood and cattle grazing have been extended even inside the sacred groves, despite of religious and cultural boundaries. The decline in religious beliefs associated with such groves could be attributed due to population pressure, as there is enormous growth in human population, leading to continued struggle between needs and resource availability. The survey depicts that majority of groves are under threat and facing different degrees of disturbance. Only few sacred groves (2-3) are still intact and protected.

The ecological investigation was carried out in the Swer sacred grove (altitude, 2030 m asl; area, 40 ha; location, 28 km south of Shillong, in the East Khasi Hills district), characteristically representing undisturbed (15 ha), moderately disturbed (15 ha) and highly disturbed (10 ha) forest patches. The study depicts that anthropogenic activities have led to massive destruction of grove vegetation, resulting into change in community organization and alteration of botanical composition. There is progressive reduction in tree density and basal area from undisturbed to highly disturbed stand. This indicates illicit felling of mature trees. The dominance of species is positively linked to disturbance stress. The shift in position of families, genus and species in trees of their dominance seems to be linked with the level of anthropogenic disturbance. The mild disturbance favored species turnover, colonization and persistence of high species richness and diversity. The dominant growth forms were trees, shrubs and herbs in the undisturbed, moderately disturbed and highly disturbed stands, respectively. The shrubs present in undisturbed stand appeared to have greater ecological amplitude with respect to

degree of disturbance. The tree species absent in disturbed stands appeared to be more vulnerable to disturbance. *Heptapleurum khasiana,* the secondary species restricted to highly disturbed stand only, indicating that it cannot compete with primary tree species in undisturbed and moderately disturbed stands. The thinning of woody layer and change in forest microclimate from undisturbed to highly disturbed stand resulted natural regeneration. The sciophilic species showed better regeneration under tree canopy, however, heliophilic species in gaps created due to disturbance. Log-normal dominance-distribution curves in the undisturbed stand indicates climax vegetation and community stability, however, biodiversity in terms of species richness was maximum in the moderately disturbed stand.

Key words: Anthropogenic activities, Community stability, Cultural and religious beliefs, Natural regeneration, Sacred grove

SII/L-3

Air Pollution and Global Climate Change: Threats to Biodiversity

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The continued functioning of ecosystems is dependent on the constituent species and their distribution, as well as on genetic variations within the species and the dynamics of the interactions that exist between different species and the physical environment. Alteration of the chemical status of the atmosphere has the potential of adversely affecting plant diversity at the local, regional and global scale. Emissions of gases such as sulfur dioxide, hydrogen fluoride, chlorine, ammonia, etc. and particulate containing toxic metals adversely affect the vegetation structure and function locally around large polluting sources. Regional-scale impact on vegetation may be ascribed to secondary air pollutants formed as a result of different transformations of primary pollutants present in air masses traveling long distances. Global-level effects of changes in atmospheric composition on biodiversity are due to increases in persistent pesticides and trace metals, greenhouse gases, and stratospheric depleting gases, etc.

Disruption of the carbon cycle due to increase in the concentration of CO_2 in atmosphere and the nitrogen cycle due to human-induced nitrogen fixation leading to increase in nitrous oxide emissions and higher levels of N depositions may cause drastic changes in species diversity. A change in climate faster than the migration of most species will reduce the suitable area for a large number of species, leading to drastic reduction in global species diversity. Depositions of atmospheric S and N compounds of anthropogenic origin affect the ecosystem functioning in forests and grasslands by acidifying the water and soil through N and S enrichment. These perturbations have been found to affect biodiversity severely. Air pollution thus constitutes a major evolutionary challenge for biodiversity in managed and natural ecosystems.

Forest systems, while resilient to stresses, may be strongly controlled by a balance in competitive potential of a few key species. Responses of individual species and the developmental stage of the ecosystem at the time of stress are key determinants of competition response. Plant diversity loss is implicated in altered host-parasite relationships, plant-pollinator relationships, plant-pathogen relationships, etc. Loss in diversity has many unfavorable implications related to ecosystem functions such as energy flow and biogeochemical cycles. The current problems of air pollution and global climate change have clearly emphasized the need to understand the biodiversity response to these anthropogenic stress factors.

Key words: Air Pollution, Climate Change, Biodiversity, Natural ecosystems

SII/O-1

Survey of Phytotherapic Tree Species of Jogimatti Forest, Chitradurga District, Karnataka, India

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India has one of world's richest medicinal plant heritages. The wealth is not only in terms of the number of unique species documented, but also in terms of the tremendous depth of traditional knowledge concerned to human and livestock health.

Present investigation was undertaken to study ethno medicinal tree species of Jogimatti Forest, Chitradurga district, Karnataka, Local traditional knowledge associated with the tree species of Jogimatti forest was collected through questionnaire and interaction with local healers. The local health healers found to use 27 tree species belonging to 19 families for the treatment of 25 diseases with 47 formulations either in single/multiple applications. The study reveals that among the families, Mimosaceae claims highest number of species (04), with 22.2 percent, followed by Euphorbiaceae and Moraceae (03 species), with 16.6 percent, Moringaceae, Myrtaceae, Rutaceae, Fabaceae, Arecaceae (02 species) with 11.1 percent and Santalaceae with a single species of 5.5 percent. These medicinal trees species include, *Acacia Arabica, Emblica officinalis, Melia azadirachta, Eugenia jambolana, Phyllanthus acidus* etc, were used to treat snake bite, antifertility, dental problems, menstrual cycle, Jaundice etc. Analysis of the data revealed percent contribution of different plant parts viz., bark was frequently used (29.8%), followed by leaves and fruit/seeds (21.2%), root (8.5%), stem and meristem (6.3%), and flowers 4.2 of least percentage.

Key words: Ethnomedicinal, Jogimatti forest, Traditional practitioners, Hakki-pikki, Kuruba

SII/O-2

Clonal Plantations Conserve Natural Forests in India

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Forests in India cannot meet national demand for firewood, timber and wood based products on sustainable basis because of low growing stock, poor increments, unbearable biotic pressures and serious degradation of forest resources. Substantial improvement in productivity of forest resources and promotion of large scale farm-forestry plantations are most essential for meeting these national needs. Success stories covering development, testing and large scale deployment of genetically improved clones of eucalypts and poplars are discussed in this paper.

Trials of various exotic species of poplars (Populus sp.) were carried out in the Tarai areas of present Uttarakhand state since 1961. Genetically improved and field tested fast growing clones of *Populus deltoides* like G3 and G48, supported with competent technical extension services, improved package of practices, long term bank loans and buy-back guarantees played crucial role in success of poplar plantations project launched by Wimco Limited in 1984. By the year 1999- 2000 planting of poplars under agro-forestry system on private farm lands increased to 15 million plants annually covering nearly 30,000 ha.

ITC Bhadrachalam Paperboards Limited launched an ambitious programme in 1989 for development, testing and commercial scale deployment of fast growing, high yielding and disease resistant clones of eucalypts in Andhra Pradesh state. True to type, uniform and genetically improved clonal planting stock of Eucalyptus, Poplars and Acacias has transformed the productivity and profitability of plantations. Average yields from such clonal plantations are 20 to 25 times higher compared to the average productivity of natural forests in India. Many farmers have achieved record growth rates of 50 m^3. $ha^{-1}.yr^{-1}$ even under rain-fed conditions making clonal eucalyptus plantations an economically attractive land use option both for reforestation projects and ago-forestry plantations.

Current levels of clonal Eucalyptus and poplar plantations produce nearly 5 million cubic meters wood annually. Plantations sustain most of the wood based pulp and paper mills and plywood/ veneer factories in the country saving precious foreign exchange. Short rotation clonal Eucalyptus plantations can meet country's fuel-wood needs on sustainable basis. High yielding clonal plantations help conserve our bio-diversity rich natural forests, promote local processing and value addition, and ameliorate the environment through carbon sequestration simultaneously generating vast employment opportunities along with larger sustainable incomes. Therefore clonal plantations on degraded forest lands and under agro-forestry system should be encouraged through innovative policy support and efficient extension services. Continuous research and development support is most essential for any clonal plantations programme for widening the genetic diversity of deployed clones and regular replacement of existing clones with new superior clones.

Key words: Clonal plantations, Poplars, Eucalyptus, Productivity, Genetic diversity

SII/O-3

An Overview of Phytocaps and the Suitability of Plant Species for Australian Landfills

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Landfill phytocaps are a recent ecotechnology for capping municipal garbage dumps. Phytocaps are a vegetated phytocover designed to use the principles of plant-soil water balance to minimise percolation of water into the landfill and prevent environmental contamination from leachate. A porous soil layer stores the precipitation, whilst the vegetation pumps out the water by transpiration. To ensure that landfill phytocaps are effective in maintaining the site water balance, the most appropriate soil type and depth, plant species and planting densities must be identified.

Five trial locations with differing rainfall patterns and evapotranspiration were selected: Townsville (tropics), Lismore (subtropics), Melbourne (temperate), Adelaide (temperate) and Perth (mediterranean).At each site the phytocaps plots (10 by 20 m) were comprised of different local soil types and native plant species. One of the main aims was to determine which of the plant species at each site performed best over time with respect to: (1) survival rate, (2) root and shoot growth.

The Townsville phytocap had the greatest diversity and survival of plant species (32 tree species). The best performing trees at Lismore were *Acacia melanoxylon, Melaleuca saligna* and *Eucalyptus tereticornis,* and at Melbourne were *Acacia meamsii, Melaleuca ericifolia* and *Eucalyptus tereticornis*. At Lismore after 2 years the roots had extended 110 cm into the soil profile whereas at Melbourne root distribution was largely confined to the top 40 or 50 cm of the soil profile. Only grasses were planted at Adelaide *Austrodanthonia racemosa, Bothriocholoa macra,* and *Dicanthium sericeum* had the greatest performance. At Perth 3 *Eucalyptus* sp *E.gomphocephala, E. utilis* and *E. decipiens* and 3 *Acacia sp A. saligna, A. cyclops* and *A.lasiocarpa* had the best performance. The leguminous Acacias appear to play an important nitrogen fixing role during phytocap establishment.

The results of our trials to date indicate that as the plants become established the phytocaps can be highly effective in controlling percolation of rainfall into the buried municipal waste thereby reducing the potential for leachate. At the same time phytocaps provide enhanced biodiversity compared to conventional landfill covers.

Key words: Phytocaps, Landfill cover, Plant suitability, Evapotranspiration

SII/O-4

Fragmented Habitat Often Leads to Loss of Biodiversity in Matha Protected Forest, Purulia, West Bengal, India

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Causes for loss of biodiversity are manifold. Habitat fragmentation is the prime factor in most of the cases, which literally means breaking apart of a large habitat into smaller patches accompanied by habitat loss or its destruction. Matha Protected Forest at Purulia is one of the most biodiversity rich areas with undulating topography, which has been subjected to repeated maltreatment by human. Biotic factors like fire, grazing by cattle, forest felling, sweeping of forest floor; illegal hunting contributes to loss of habitat. In addition, certain demographic changes in the concerned area cause destruction. Thus potentiality of the habitat decreases and consequently affects biodiversity. Habitat fragmentation is also based on patch size, patch shape, patch isolation and patch interaction depicting fragmentation. Habitat becomes smaller patches, decreasing the core area that supports smaller population causing reduction in species richness, composition and diversity. Apparently, ecotones are created. Due to non availability or scarcity of resources, species in the habitat either become extinct or emigrate to other habitat as the available habitat becomes critical for the survival of wild species. Therefore, three major effects of habitat fragmentation are found: reduction in the total area of habitat; increase in the amount of edge; decrease in the amount of interior habitat accelerating loss of biodiversity that ultimately leads to nature imbalance. The aim of the study is to identify the causes of habitat fragmentation that affects biodiversity, which will provide added information for the habitat restoration and conservation.

Key words: Habitat fragmentation, Patch size, Patch shape, Patch isolation, Patch interaction, Species diversity

SII/O-5

Geospatial Modelling of Biodiversity in Uttar Pradesh State

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Biodiversity conservation necessitates not only preservation of single or multiple species but also the habitat as a whole along with its environment. Biological richness (BR) is a cumulative property of an ecological habitat and its surrounding environment, which has emerging implications in terms of management and planning. Six biodiversity attributes (i.e., spatial, phytosociological, social, physical, economical and ecological) were attributed to stratify biological richness of forest vegetation in the state of Uttar Pradesh using customized software, SPLAM. This simple idea of integrated 'three-tier modeling approach' of (i) utilization of geospatial tools, (ii) limited field survey and (iii) landscape analysis; formed the basis of rapid assessment of biologically rich areas.

Satellite image interpretation using hybrid classification approach provided spatial distribution of vegetation types (corresponding to ecological habitats), with 92% accuracy. The vegetation type map showed 29 classes, which is further sub-divided into 13 natural and 4 semi-natural forest, 4 shrub/ scrublands, 3 grasslands/ herbs and 5 orchard classes, with other land use/ land cover classes. Landscape analysis was done using various quantitative indices that measured the heterogeneity and evaluated the patch characteristics. Biotic disturbance buffers (i.e., proximity zones around roads and human settlements) along with landscape parameters were combined to calculate disturbance index (DI), which in turn became an intermediate surrogate for BR assessment. Species diversity patterns along fragmentation and biotic disturbance gradients were adjudged to derive relative weights for DI computation. Species diversity (Shannon's index), ecosystem uniqueness (endemism status) and biodiversity value (BV) (total importance value (TIV)) were enumerated quantitatively that provided relative weights for BR computation. Terrain complexity (TC) was generated by calculating variance of the elevation image. BR index of the state was presented in five qualitative levels. Forest managers can use the DI and BR maps for gap analysis and prioritization of conservation activities *viz*., introduction of locale-specific species, thus protecting the forest habitats *in situ*. The geospatial biodiversity database prepared for the sate will serve as (a) baseline data for forest managers and conservationists and (ii) will have implications for long term biodiversity studies *in lieu* of 'climate change'.

Key words: Vegetation type, Remote sensing, GIS, Disturbance index, Biological richness

SII/O-6

Estimation of Genetic Variability and Population Structure in *Sapindus emarginatus* Vahl. (Sapindaceae)

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Sapindus emarginatus is an economically important tropical tree species sparsely distributed in different geographical provinces like Gangetic Plains, Western Ghats, Deccan Plateau in India. In the present paper estimation of genetic variability within and among five populations representing forty one genotypes was carried out using three single primer amplification reaction (SPAR) methods *viz*. RAPD, DAMD and ISSR. The cumulative data analysis was carried out for all three SPAR methods, and showed 82.32% polymorphism across all the genotypes of *S. emarginatus*.

The pair wise distance matrix calculated by NJ method using Jaccard's coefficient showed a distance range from 0.15 to 0.49 with an average value of 0.37 among all the 41 genotypes. The intra-population genetic diversity study revealed highest values of Nei's genetic diversity (0.19,) Shannon information index (0.29) and polymorphic loci (55.18%), among the genotypes of GJ population, and the lowest values of genetic diversity (0.10), Shannon information index (0.15) and polymorphic loci (26.40 %) among the accessions of RJ population. The maximum inter-population average distance (0.20) was between KA and RJ, while the corresponding least distance (0.06) was between AL and VS populations. These results suggest that genetic diversity is corroborating with the geographical diversity. The analysis of molecular variance (AMOVA) revealed maximum percentage of variation among individuals of populations (72%) followed by 16% among regions and 12% among populations. Principal coordinate analysis (PCA) of cumulative data also supported the clustering pattern in the UPGMA dendrogram. Mantel's test was performed which revealed a highly significant correlation between cumulative vs RAPD, and showed the maximum (0.93) correlation coefficient, followed by cumulative vs ISSR (0.78) and cumulative vs DAMD (0.91) respectively, and this clearly indicates that the SPAR methods (RAPD, DAMD and ISSR) are sufficiently informative and are suitable to analyze the genetic variability within and amongst the populations of *S. emarginatus.*

Key words: DAMD, Genetic diversity, ISSR, *Sapindus emarginatus*, RAPD, UPGMA

SII/O-7

Aeropalynological Investigation in Kermanshah Area (West of Iran)

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A Durham sampler has used to study atmospheric pollen in Kermanshah area during three years. Also allergic pollen of 120 species from this area were undertaken by using light microscope (LM) and 40 of them species by scanning electron microscope (SEM).

Pollination of studies plants begin from the first week of February, and the maximum concentration of pollens in atmosphere registered between the end of March and the first two weeks of April and the lowest observed during autumn. Pollens were present until the last week of December.

The vegetation surrounding the sampling point includes ornamental, non-ornamental trees, shrubs and herbaceous species. The main pollen types were *Aceraceae, Amaranthaceae, Anacardiaceae Chenopodiaceae, Compositae, Cupressaceae, Euphorbiaceae, Fagaceae, Gramineae, Juglandaceae, Moraceae, Oleaceae, Polygonaceae*, *Rosaceae*, *Salicaceae*, *Ulmaceae.*

Key words: Aeropalynolog, Durham sampler, Pollen grain, Pollen calendar, Pollen allergy, SEM

SII/O-8

Biophilia

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Biophilia means a love of life and the living world or affinity of human beings for other life forms. An appreciation of life and the living world. In 1984, sociobiologist Edward O Wilson first used the term *Biophilia* to describe his belief that humans inherently enjoy the diversity of life on earth, and that much of our well being comes from that enjoyment. While a constructive view, it is also a physical fact that our survival as a species depends on preserving biodiversity. The primary mission of the Biophilia is to support efforts that protect, restore, enhance, and preserve wildlife habitat for all species of native plants and animals.

Our secondary mission is to help reconnect individuals with nature. We believe that once individuals become aware of the value of preserving biodiversity they will work toward its preservation, especially if conflicts between conservation and their economic interests can be minimized, and conservation opportunities are made easier to obtain. Invitation to all to support this type of work and to make a personal and continuing commitment to understanding and preserving biodiversity, the web of life of which we are a part and which sustains us.

Biophilia compacts the distance between subject and object, inside and outside. Where "the reproductive value of certain signs is dependent upon processes of symbiotic or co-evolutionary signification and communication." Likewise Biophilia creates hybrid forms, which emerge through the complex interaction between, theory and practice, matter and representation.

Over the greater course of human evolution, the survival of our species relied heavily on learning to coexist in delicate balance with nature. But our dependence on a deeply interwoven relationship with the natural world has lessened, and our drive to connect with nature has diminished. It has been overcome by an even more intense human drive, one marked by the desire to build, to develop a systematic knowledge of things. This is *technophilia,* a side of human intelligence that represents our conquest of nature.

Depending on one's perspective, we have either intentionally or inadvertently succeeded in alienating ourselves from other forms of life by introducing technologies that utilize, replace, or manipulate the natural world. In developed countries, a common worldview is one of human dominance over all other lifeforms. Why live susceptible to the whims of the natural world when we can control nature with technologyfi This type of thinking, which is controlled by our technophilia, has driven us further from animals and plants.

Through our agricultural and industrial technologies, we have caused nature to become unbalanced, which facilitates outbreaks of disease and the loss of species. Today, we have reached a point where in order to fulfill our human drives without destroying the world we depend upon we must productively unite technophilia with biophilia. However, in light of the damage that we continue to inflict upon nature, it is difficult to argue that all humans possess an innate love of living systems. In fact, biophilia most likely surfaces through learning, and therefore the optimal time in life to develop an appreciation and respect for the natural world occurs in childhood.

Key words: Education, Gurukulam, Kibbutz, Moral teachings

SII/O-9

Local Communities, Medicinal Plants and Sustainable Biodiversity (The Intellectual Property Rights Perspective)

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The continuous exploitation of several medicinal plant species either by the local people or by the patent holders for commercial purpose in the market has led to the extinction of many species with medicinal value and many more becoming endangered. The natural cum anthropogenic pressure on these bioresources has disturbed the delicate balance between the environment and the plant as well as it has also raised intellectual property rights issues. For example, the responsibility for conservation of the medicinal plants remains undefined between patent holders and holders of traditional knowledge associated with medicinal plants. Amidst such ambiguity, the sustainable management of these biological resources suffers. All these factors have affected Goal 7 of the Millennium Development Goals (MDGs) set to ensure sustainable environment.

The paper is based on a literature survey to evaluate how far the community rights over plant genetic resources, as envisaged by Convention on Biodiversity (CBD) would help in biodiversity conservation and maintenance of a sustainable environment. Most of the background information is sourced from research projects/reports/case studies and policy texts.

The paper is divided in four sections. First section deals with introduction dealing with traditional knowledge associated with medicinal plants and its treatment in the two important international instruments, CBD and Trade Related Aspects of Intellectual Property Rights (TRIPS).The second part deals with case studies to highlight the role of communities in conserving biodiversity and environment through sustainable management of medicinal plants. The third part focuses on the main issue in this paper i.e. the possible intellectual property rights options in dealing with the management of medicinal plants while the fourth section includes the steps for checking biodiversity erosion and ends up with a conclusion based on the findings in this paper.

Key words: Traditional knowledge/medicinal plants, CBD, TRIPS, MDGs, Biodiversity conservation, Customary rights

SII/O-10

Distribution of Woody Species of Vindhyan Highlands on the Basis of Functional Traits

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During recent decades, plant geographers are attempting to describe and predict the distribution of plant species on the basis of plant function and its relationship with the abiotic environment. The traditional approach to accomplish this aim was the categorical representation of plant species as plant functional types. However, to understand the ecological implications of trade-offs in plant form and function, functional ecologists are attempting to refine categorical functional types through quantitative functional traits. Here, we analyzed the composition and distribution of the woody species in five experimental sites located in the forests of Vindhyan highlands. We measured various abiotic environmental parameters of the experimental sites and also estimated morphological and physiological traits of the woody species present in those sites. We sought to ask: (1) is there a relationship between the abiotic environment and the distribution of woody speciesfi, (2) are the distribution of the woody species changing according to their functional trait valuesfi and (3) is there a strong relationship between the abiotic environment and the distribution of functional trait values in the forest sitesfi. The results showed variations in the distribution of woody species according to their functional trait values and these distributions were strongly related to the abiotic environmental conditions. We also detected a high correlation of the functional trait distributions with abiotic environmental parameters of the experimental sites and concluded that the distribution of woody species of Vindhyan highlands can be described and predicted on the basis of combination of functional traits in which specific leaf area, leaf relative water content and chlorophyll concentration are most important.

Key words: Important value index, Leaf chlorophyll concentration, Leaf relative water content, Photosynthetic rate, Plant functional traits, Relative growth rate, Specific leaf area

SII/O-11

Diversity in Tree Deciduousness, Phenological Traits and Phenology in Indian Tropical Deciduous Forests

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Seasonally dry tropical forest trees are characterized by functional traits like deciduousness (~leaflessness) and

drought tolerance. In these forests deciduousness (reciprocal to growing season length) is an important tree strategy to survive in water stress period. Quantitative phenological studies in Indian Vindhyan tropical forest revealed the co-existence of four phenological tree functional types (one semi-evergreen and three deciduous ones) showing progressive increase in deciduousness. Differing deciduousness in tree species exhibited substantial differences in their leafing (vegetative growth) patterns. Deciduousness showed significant positive relationship with leaf strategy index (LSI, reflecting resource use patterns) and strong negative relationship with both stem wood density (SWD) and leaf mass per area (LMA). In dry tropical trees deciduousness reflects integrated effect of seasonal drought, tree characteristics and soil moisture conditions, resulting in minimized activity during unfavorable season, and growth resumption with variable rates of resource use during the short favorable season.

Variation in flowering time relative to leaf flushing, a least studied aspect, revealed several flowering types in dry tropical tree species. Winter flowering with the onset of leaf fall in leaf exchanging species and dry-season flowering on leafless shoots of species having maximum extent of deciduousness, indicated predominant role of leaf shedding in triggering flowering. Species with intermediate duration of deciduousness showed summer, rainy and autumn flowering. Wide range of time lag between the start of vegetative (first-leaf-flush) and reproductive (first-visible-flower) phases was recorded in deciduous species; this time lag showed significant negative relationship with SWD, LMA and fruiting duration and significant positive relationship with deciduousness and LSI. In these flowering types duration of fruiting phenophase varied considerably. Since environmental characteristics affect flowering and fruiting either directly (e.g. through conditions in the habitat) or indirectly (e.g. through deciduousness, LMA, wood density), thus, the impact of probable climate change will have long implications on future reproductive success of dry tropical trees.

The impact of impending climate change (e.g. changes in precipitation and temperature) on phenology of tropical tree species can be better assessed through functional types based on the duration of deciduousness and timing of bud break because tropical dry forests represent greater diversity of phenological patterns and a mosaic of several phenological functional types adapted to seasonal drought in different ways.

Key words: Quantitative phenology, Tree functional types, Flowering type, Leaf strategy index, Stem wood densit, Climate change

SII/O-12

Assessment of Diversity of Tree Flora of Katerniaghat Wildlife Sanctuary, Uttar Pradesh, India Based on Taxonomy and Ecological Studies

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The present study highlights the assessment of diversity of tree species occurring in the forest of Katerniaghat Wildlife Sanctuary (KWS). Katerniaghat Wildlife Sanctuary, a moist deciduous forest is situated between 27^0 41' – 27^o56' N and 81^o48' – 81^o56' E with elevation ranges from 116 – 165 m along the international border of Nepal in Bahraich district of Uttar Pradesh, India. The forest is spread over an area of 40 km long and 10 km wide range. The present study has documented *ca.*139 tree species from the study site contrary to the earlier report of 91 which belongs to 78 genera under 33 families. Leguminosae (*nom. alt.* Fabaceae) is the largest family with 12 genera and 15 tree species. Among various genera *Ficus* of the family Moraceae occupies first position with 9 tree species. However, the area is predominant with *Shorea robusta*, *Tectona grandis*, *Mallotus philippensis*, *Syzygium cumini*, *Ficus racemosa, F. hispida*, *Streblus asper, Terminalia alata, Lagerstroemia parviflora, Mallotus nudiflorus* and *Ehretia laevis*. The different vegetations of forest exhibit differences in tree dominance and diversity: sal mixed forest is dominated by *Shorea robusta, Mallotus philippensis* and *Terminalia alata*; pure teak forest by *Tectona grandis, Mallotus philippensis, Shorea robusta and Lagerstroemia parviflora*; miscellaneous forest by *Mallotus philippensis, Syzygium cumini, Ficus rasemosa, F. hispida* and *Mallotus nudiflorus* and savannah grass land by *Bombax ceiba, Sterculia villosa, Lannea coromandelica* and *Hymenodictyon excelsum.* The presence of different tree species belonging to different genera and families indicate the heterogeneous nature of the forest. Further, the dominance of some plants like *Ficus spp., Syzygium cumini and Mallotus nudiflorus* exhibit the moist nature of the forest. All tree species have been provided with detail taxonomic information like correct nomenclature, description, phenology, local name, distribution and voucher specimens. The entire area has also been divided into 8 permanent and many random plots (*ca.* 150) to record the ecological data like phenology, frequency, density, abundance and dominance which are further used to calculate Importance Value Index (IVI), similarity indexes, diversity indexes and cluster analysis of tree species. *Shorea robusta*, *Tectona grandis*, *Mallotus philippensis*, *Syzygium cumini*, *Ficus racemosa, F. hispida*, *Streblus asper, Terminalia alata, Lagerstroemia parviflora, Mallotus nudiflorus* and *Ehretia laevis* showed maximum IVI. Simpson index ranged between 0.09 (miscellaneous forest) to 0.72 (teak forest) showing highest heterogeneity in miscellaneous forest. Cluster analysis grouped all plant species into five categories which represent five different types of vegetation occurring in the forest. The detail phenological studies of *Ficus hispida* and *Shorea robusta* have been initiated.

Key words: Diversity, Tree species, Taxonomy, Ecology, Katerniaghat Wildlife Sanctuary

SII/O-13

Influence of Anthropogenic Activities on Plant Diversity and Regeneration Status of Sal (*Shorea robusta*) Forest of Assam

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Plant species diversity varies from place to place or forest to forest. The present study was carried out in Hojai reserve forest of Nagaon district of Assam, which is a Sal (*Shorea robusta*) dominated forest. The study was carried out to understand the plant diversity, regeneration status of tree species and affects by the existing disturbance in the forest. Community study was carried out by quadrate methods using fifty quadrates of (10 × 10) m for tree species and (5× 5) m size for shrub species. Hundred numbers of (1×1) m size quadrate were laid for herbs. For tree species DBH was mapped at 1.3 m height. Tree individuals having girth ≥30 cm was considered as an adult, <30 to ≥10 cm was considered as a sapling and <10 cm at the base was considered as a seedling. Highest number of species was recorded in herbs having 49 species followed by tree with 19 species and least number of species was obtained in shrub species having 15. The density of the adult, sapling and seedling of tree species were 240 ha^{-1}, 636 ha^{-1} and 7794 ha^{-1}, respectively. Whereas the basal area of the adult, sapling and seedling of the tree species were 67 m^2 ha^{-1}, 1.44 m^2 ha^{-1} and 0.94m^2 ha^{-1}, respectively. The density and basal area of shrub and herbs were 5816 ha^{-1} and 1.66 m^2 ha^{-1} and 217200 ha^{-1} and 1.58 m^2 ha^{-1}, respectively. The dominant tree species Sal (*Shorea robusta)* revealed good regeneration status showing the trend that number individuals of seedlings > sapling > adult. The regeneration status of all the plant species, particularly the tree species is largely affected by the degree of human and animal disturbance. The forest is largely disturbed for various purposes like fire wood collection, artificial fire, grazing by domestic animals, etc. which may affect the productivity of the forest and regeneration potential of species thereby, the in due course of time, forest as a whole may be under threat of loss. The study analyzes the plant species diversity and regeneration status of the tree species with reference to the human and animals' disturbance exist in the forest.

Key words: Plant diversity, *Shorea robusta*, Regeneration, Disturbance

SII/O-14

Solutions for Enhancing Biodiversity in Rural Areas in Mediterranean Context: The Case of the Area of Intensive Olive Farming in the *Low Murgia Plateau* (Puglia region – South Italy)

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Agriculture is one of the most important economic sector in the scenery of Mediterranean countries where great parts of the territory has been transformed in rural land already in the historical period. Among the most important crops in Mediterranean landscape, olive (*Olea europaea*), a typical stenomediterranean species has a primary role not only because huge portions of the territory in the coastal, in the lowland and in the hilly districts show abundant olive tree crops, but also for a great symbolic value that this tree has in the Mediterranean culture.

In the last period olive farming it's always more conducted in an intensive way, nevertheless some districts with a traditional farming, more extensive, still exists. It's well known how monocultures are dangerous for biodiversity conservations for implications that limit possibility for habitats. Puglia region, a southern eastern Italian region is the most important area for olive farming in a country, Italy that is the second producer of olive oil in the world.

Abundance of coastal plane and good soils for the crops has encouraged olive farming in great part of the Regions. Just some portion of the olive fields are still conducted in a traditional way as it happens in the coastal plane between Monopoli and Ostuni where really very old stands survive, modelling in an amazing way the landscape of the considered area, but the general trend is the intensification in olive farming.

Signal of this process are: substitution of less productive variety;substitution of crops in the recent past spread in the olive fields such as almond tree (*Prunus dulcis*) and other minor crop species (*Eriobotria japonica, Crataegus azarolus, Ficus carica, Ceratonia siliqua, Sorbus domestica);* use of irrigation; use of mechanical harvesting; intensification in the plant density; elimination of spontaneous vegetation.

Results of this process cause a strong reduction of habitat possibility with a great loss of biodiversity contents. These aspects are more important if the considered processes is spread in a very huge area as happens in the northern portion of low Murgia Plateau, district which include great part of the central-northern district of Province of Bari and the southern portion of the new Province of Barletta-Andria-Trani

Key words: Olive tree, Intensive farming, Murgia Plateau, Biodiversity, Crop substitution

SII/O-15

Distribution of Epiphytic Lichens on Three Major Trees of Aalo Town, West Siang District, Arunachal Pradesh

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The Eastern Himalayan region of India shows excellent diversity of phorophytes. Among the different trees *Castanopsis indica, Terminalia myriocarpa* and *Artocarpous heterophyllous* grows abundantly in different regions of Arunachal Pradesh. The Aalo town in West Siang

district of the state also shows luxuriant growth of all these trees. Most of the trees are smooth barked, semievergreen and tall and provides excellent habitat for different epiphytes to colonise including lichens. Together with some epiphytic orchid and ferns orchid, the lichens also grow abundantly on these trees.

The epiphytes on a particular tree are dependent on a wide range of complex interrelated factors. The topographical situation, the microclimate experienced by different parts of a tree and the nature of bark are important factors in determining the lichen growth on a tree. The age of bark, smoothness, or roughness, fissured or ± spongy nature at base, pH, nutrient status, water-holding capacity and buffer capacity are other important bark properties affecting the lichen growth on trees.

Lichens are excellent bioindicators of atmospheric pollution and environmental changes. After Orchids the epiphytic lichens are considered as most sensitive organisms to the microclimatic changes in an environment. To investigate the epiphytic lichen diversity of Aalo town occurrence of lichens on 45 trees are recorded. A total of 117 species are reported found growing on different parts of the trees from base to the twigs.

Among the different phorophytes growing in and around Aalo town *C. indica* has maximum diversity of lichens represented by 42 species followed by *T. myriocarpa and A. heterophyllous* with 21 *and* 20 species respectively. *C. indica* shows growth of 29 species exclusively on its trunk while 11 and 8 species of lichens exclusively grows on *T. myriocarpa* and *A. heterophyllous* respectively. Most of the trees growing in the area have similar bark characteristics thus exhibits maximum sharing of lichen species. *C. indica* shares 7 species with *T. myriocarpa*, 9 species with *A. heterophyllous. T. myriocarpa* and *A. heterophyllous* have 6 species in common. Only 3 species *Hemithecium lamii* (Redgr.) V. Tewari and Upreti, *Sarcographa labyrinthica* (Ach.) Müll. Arg. and *Malcolmiella granifera* (Ach.) Kalb & Lücking were growing on all the phorophytes. Though the major lichen bearing trees of the area have more or less similar bark pH and water holding capacity but *Castanopsis indica* bears maximum diversity of lichens. The probable reason of luxuriant growth of lichens may be due to its tall trunk, thick, smooth, fleshy bark which retains more moisture for a longer time than the other trees. The present distribution of lichens on different trees will act as a baseline data to study the biomonitoring studies in the area in future.

Key words: Epiphytic lichens, *Castanopsis indica, Hemithecium lamii*

SII/O-16

Plants and Microbial Diversity Conservation in Tropical Rainforest Ecosystem of South West Nigeria: A Case Study of Three *In situ* Methods

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This study was carried out in three different in-situ methods for biodiversity conservation in Nigeria namely Strict Nature Reserve, Biosphere Reserve, and the Forest Reserve. The aim of the study was to consider the present status of these forest ecosystems in terms of plant species and microbial diversity and the effects of anthropogenic activities on biodiversity and environmental conservation in the study area. Data were collected from four equal sized (25 x 25m) plots centrally located in each forest type. Within the plots, all tree species encountered were identified. Two 1 x 1m quadrants were also laid in each plot where all undergrowths and lianas were identified. Soil samples were collected from three locations in each plot at a depth of 0-15cm. Fungi and bacteria were isolated and characterized using standard methods. The results show that the highest number of tree species (72 in 27 families) was present at the SNR, followed by the Biosphere reserve with 51 species in 26 families and the least in the forest reserve. Highest number of individual stems per hectare (742) was recorded for Biosphere reserve, followed by the SNR with 393 stem/ha and lastly the forest reserve (148). Greatest diversity of species using the Shannon-Weiner (H') index was at the SNR (3.34) while the values for Biosphere and the forest reserves were 3.31 and 3.01 respectively. Highest evenness value of 0.78 was also recorded for SNR and the least evenness value for the Forest reserve (0.47). The most prominent species in the three locations were those in the Sterculiaceae family. The results of the one-way ANOVA revealed that there were significant differences ($P < 0.05$) in the number of species, total number of stems per hectare, and the diversity indices. The population of these undergrowths in the site was estimated to be 135,000 per hectare. *Capolobia lutea* had the highest relative density (25.93), followed by *Bulcholzia corinacea* and *Diospyros* spp with relative density of 22.22 and 15.74, respectively. The least relative density of 3.70 was recorded for *Draceana manii*. The forest undergrowth plants were characterized by a Shannon- Wiener diversity index of 1.90 and species evenness of 0.16. For microbial diversity, the diversity of fungi ranged between 12 and 15 species while that of bacterial was between 11 and 23 with SNR having the highest diversity. The general Aspergillus and Bacillus were the most abundant fungi and bacteria respectively in the forest ecosystems. The least values recorded for the forest reserve was attributed to the anthropogenic activities of rural dwellers and loggers. These activities have adverse effect of biodiversity and environmental conservation. SNR and Biosphere are effective means of biodiversity conservation. However, if activities are controlled in the reserves, it could also serve as a way of biodiversity and environmental conservation.

Key words: *In situ* conservation, Biosphere reserve, Undergrowth, Microbial diversity

SII/O-17

Genetic Variation, Character Association and Selection for Early Fruiting in *Pongamia pinnata* (L.) Pierre

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Pongamia pinnata (L) commonly known as Karanja is a moderately fast-growing, leguminous tree with the potential for oil seed production and added advantage to grow on marginal land and in semi arid conditions. Karanja seed is used for biodiesel production and hence there is need to identify elite genotypes with high oil content and seed yield to make it sustainable and economically viable. Keeping this in mind, the present study consisted of the 16 candidate plus trees (CPT) of *Karanja,* which were collected from different areas of Uttar Pradesh, Madhya Pradesh, Rajasthan and Haryana during May-June 2005. Their nursery was raised during July 2005 and then progeny of each genotype was planted in July, 2006 at 5x5 m distance in randomized block design (RBD) with three replications. The each plot consisted of five trees of each genotype under each replication. The field has red gravelly, poor quality soil and low soil depth. The area is rain fed. All the accessions were evaluated for various morphological traits i.e. tree height, tree girth, number of primary branches, leaf length, leaf width, branch angle and canopy diameter. The data was analyzed to estimate ANOVA, GCV, PCV, heritability and correlation coefficient. Analysis of variance revealed significant differences among the 16 genotypes for all the traits (p-0.01). The maximum tree height (322.91cm) was recorded in CPT- 21 followed by CPT - 7 (315.10 cm), while the minimum tree height was recorded in CPT-5 (199.42 cm). The maximum basal girth was recorded in CPT -15 (33.15 cm) followed by CPT-14 (32.29 cm). The minimum basal girth of 15.92 cm was recorded in CPT-12. The maximum number of primary branches per tree were recorded in CPT-23 (3.86) followed by CPT-14 (3.85) and minimum branches were recorded in CPT-1 (2.55). Maximum canopy diameter of 418.75 cm was recorded in CPT-15 and this was followed by CPT-10 (379.51 cm), while minimum canopy diameter was recorded in CPT-5. Maximum leaf length was recorded in CPT-19 (11.33 cm) while minimum leaf length was recorded in CPT-12 (8.58 cm). The maximum branch angle of 51.27^{o} was recorded in CPT-1 followed by 49.63^{0} in CPT-13 and minimum branch angle of 36.17^{o} was recorded in CPT-2. Among 16 genotypes, seven genotypes were recorded for early flowering and fruiting viz. CPT-7, 10, 15, 16, 19, and CPT-22. Moderate genotypic coefficient of variation (GCV) was observed for tree height, tree girth, number of primary branches, canopy diameter and similarly moderate phenotypic coefficient of variation (PCV) was recorded in leaf width and branch angle. The values of PCV were slightly higher than GCV, indicating the presence of environmental components of variation (ECV). Heritability varied from a minimum of 0.2082 in leaf length to maximum of 0.6054 in branch angle. Maximum genetic advance can be obtained in tree girth 42.24% followed by number of primary branch 37.63% and in tree height 29.87%. Tree height had significantly high positive correlations with all other traits. Similarly the tree girth had significantly high and positive correlation with number of primary branches, canopy diameter, leaf length, and leaf width and branch angle. The variance found in different accessions can be very useful in genetic improvement of this species. Based on overall performance of morphological traits and early flowering and fruiting the four genotypes viz. CPT- 2, CPT-7, CPT- 16 and CPT- 21 were selected for use in future selection and breeding programme.

Kew words: Biodiesel, Candidate plus tree, Correlation, Genetic variation, *Pongamia pinnata*

SII/O-18

Ecological Study for Submergent Macrophyte Communities in the Central Part of the Marshes of Southern Iraq

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The environment of submerging macrophytes in the central part of the marshes of southern Iraq were described by the study of their standing crop biomass and vegetation cover percentage in relation to 14 environmental variables (WT, EC, Sal., pH, WD, LP, Tur., DO, TH, Mg^{+2}, Cl^{-}, $NO_3^{=}$, NO_2^{-1}, $PO_4^{=}$). Five submerging macrophytes communities were determined in the different three stations during the study period, which are *Ceratophyllum demersum, Potamogeton lucens, Potamogeton crispus, and Najas armata.* These communities are dominant submerging communities. While the community of Ranunculus *sphaerospermus* observed at spring season only. Six associated submerging macrophytes, are occurred with the dominant communities; including *Myriophyllum spicatum, Potamogeton pectinatus, Potamogeton perfoliatus, Najas minor, Hydrilla verticillata, and Vallisneria spiralis.* The Pearson's Product Moment Correlation Coefficient (r) and CANOCO ordination programs (CCA) were used to analyses the data. *N. armata* and *R. sphaerospermus* appeared in the station one only as communities, while *P. crispus* disappeared in this station. The station one has four submerging macrophytes communities, while the other stations have three submerging macrophytes communities, which are *C. demersum, P. lucens, and P. crispus*. The results showed that the station 3 has standing crop biomass and vegetation cover percentage more than other stations; also the growth was in its peak at summer season (warm season). The vegetation growth increases with decreasing water depth and turbidity, and increasing nutrients and light penetration. There is positive significant effect for WT on the growth of submerging macrophytes (standing crop and vegetation cover percentage), while pH value has negative significant effect.

Key words: Ecological Study, Macrophyte Communities, *Ceratophyllum demersum, Potamogeton lucens*

SII/O-19

Floristic and Ecological Studies of Bakhira Bird Sancturary: A Wetland of International Importance

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Bakhira bird sanctuary is situated in the Santkabir Nagar district, recently carved out of district Basti of eastern U.P. with cartographic coordinates 26° 25' 30" - 26° 55" 15' north latitude to 83° 5' 30" - 83° 10' 30" east latitude, it covers an area approximately. Bakhira bird sanctuary an important ecotourism spot. It have rich biodiversity of both flora and fauna. Bakhira bird sanctuary is the best during the winter months as most of the birds tend to leave in march. During the survey of this lake 97 species was collected which are belonging to 42 genera and 38 families out of which 22 families of dicots and 16 families of monocots are represented by 58 and 39 species respectively. It comprises numerous floating and submerged aquatic plants like *Alternanthera seuilis, Ipomea aquatica, Potamogeton pectinatus, Potamogeton nodosus, Trapa bispinosa, Eclipta prostrata, Hygrophilla auriculata, Polygonum glabrum, Cerratophyllum demursum, Eicchornia crassipes, Typha elephantina, Colocassia esculenta, Eleocharis dulcis, Hygroryza aristata, Eragrostis tenella* etc which are growing in their natural condition. This wetland is suffering from eutrophication, activity of cultivation, grazing animals, hunting, solid waste dumping, surface drainage and cattle wading. Only few literatures are available on the wetland vegetation of this bird sanctuary. The vegetation of this wetland was not studied so for before this survey was conducted. Therefore, it was very important to study the wetland vegetation of the area in order to make inventory of the plants. The present research paper deals with taxonomy, habit, habitat and economic importance of angiospermic plants occurring in this wetland.

Key words: Ecotourism, Eutrophication, Submerged

SII/O-20

Flora for Fauna Movement could be the Right Approach to Check the Depletion of Biodiversity in the Developing Countries

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Flora for fauna movement in the developed countries especially Scotland (UK) has been proved to be a right measure to protect and augment the biodiversity. Ecologically the approach is well accepted. To maintain more biodiversity; much biodiversity must be protected. Co evolutionary links are interwoven into the Nature is a fact. Monophagous and oligophagous species existence depends only on availability of one particular or a few species of plants respectively. Compartmentalized use of resource becomes easier and can make conservation more eco centric through this movement. Case studies in this regard will be presented.

Key words: Flora for fauna, Monophagous and oligophagous

SII/O-21

Dew: Boon or Bane for Himalayan Plants

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Water, the wonder of life, is vital for the survival and metabolism of all living organisms from bacteria to plants to humans. Life cannot be expected without water. It is one of the most important factors influencing the occurrence, distribution, composition, growth and productivity of plants and vegetation. It has been reported that the growth and productivity of plants and ecosystems can be constrained by deficits of water more than by any other factor. A vast majority of area in the Indian Himalayan region is rainfed. Precipitation is the most important source of moisture. It occurs in various forms such as rain, drizzle, snow, hail, fog, frost and dew. Formation of dew is a common phenomenon during October to February for plants growing in the tropical and subtropical Himalaya. Occurrence of dew for such a lengthy period may have important implications on physiological and biochemical processes that contribute to the growth, survival and productivity of plants. There is conflicting evidence in respect to the impact of dew formation on plants. While artificial and/or natural dew has been reported to improve water potential, photosynthesis, growth and survival of plants, others have found negative effect of dew formation on photosynthesis and growth. However, such studies are lacking for Himalayan plants. The present paper deals with the effects of dew on photochemical efficiency, photosynthetic capacity, relative water content, osmoprotectants and chlorophyll content in three multipurpose agroforestry tree species of central Himalaya. Two year old healthy seedlings of the three species were divided into two sets of 60 plants each during November; one set of plants of each species were shifted to a glasshouse (control plants) and the other set was left in the botanic garden (dew exposed plants). Measurements were made on the youngest fully expanded leaves during November to February. The dew exposed plants of all the three species showed significant reduction in photosynthetic rate, transpiration rate and stomatal conductances for CO_2 and water vapour. The reduction was more prominent in *Boehmeria rugulosa* Wed. and *Olea glandulifera* Wall.ex G. Don than in *Grewia optiva* Drummond. The dew exposed plants of *B. rugulosa* and *O. glandulifera* showed significant reduction in water use efficiency. A significant reduction in the Fv/Fm ratio and chlorophyll content was also recorded in *B. rugulosa* and *O. glandulifera* dew exposed plants which also contained more total soluble carbohydrates but less proline content. Further, dew also did not seem to improve

the water status of plants as the relative water content of dew exposed plants did not differ from that of control plants. Based on the data it may be suggested that dew, a form of precipitation, could not be useful to the Himalayan plants at least for the three species studied.

Key words: Dew, Fv/Fm ratio, Himalayan plants, Photosynthetic response, Relative water content

SII/O-22

An Introduction of Medicinal and Aromatic Plants in Pine Forest of India: A Sustainable Technique

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In a scenario of decreasing availability of good lands for agriculture in one hand and declining forest and tree cover throughout the world on other, with degrading soil and water resource, increasing pollution hazards and threats to the environment and ecosystem, innovative approaches in cultivation are required to meet food, fodder, medicines and many other wood and non wood products for the 21st century. With this concept in view a trial was undertaken to introduce seven medicinal and aromatic plants in Chir pine forest of mid hills of western Himalayas in India using agro-forestry technologies which were developed as per the topography of the area in Dr. Y.S. Parmar university of Horticulture and Forestry, Solan, H.P. (India) where seven medicinal and aromatic plant species namely *Andrographis paniculata*, *Mucuna pruriens*, *Solanum khasianum*, *Spilanthes acmella*, *Withania somnifera*, *Cymbopogon nardus* and *Ocimum basilicum* were grown during the year 2006-2007 and 2007-2008 on three aspects (Northern, Northwestern and Western) and under three tillage practices (Minimum, medium and deep) in both understorey of Chirpine and in open conditions. From an economic point of view *Andrographis paniculata*, *Mucuna pruriens, Solanum khasianum* and *spilanthes acmella* were found to be better yielding and more remunerative in comparison to *Withania somnifera, Cymbopogon nardus* and *Ocimum basilicum*. The findings of the present investigation indicate that raising medicinal plant with Chir pine is a viable option for enhancing the diversification and rise in income from Chir pine forest. Hence these silvi-medicinal systems with agroforestry technologies can act as a key for utilization of unutilized land in and outside of Chir pine forest of India for socio-economic development of the rural people besides conservation of medicinal plant resources under *in-situ* conditions. This is likely to help in the sustainable development of the natural resources of the country.

Key words: Agro-forestry, Tillage practices, Aspects, Diversification, Silvi-medicinal

SII/P-1

Ecological Variation in *Gymnema sylvestre* Leaves from Three Different Zones of India

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Gymnema sylvestre a plant used in the Ayurvedic medicine of India for the treatment of Diabetes mellitus has been known from antiquity also to have an antisaccharin taste effect. The active principles are glycosides (several Gymnemic acid) which shows selective anaesthetic effect. Arial part of *Gymnema sylvestre* Linn. were collected from their natural habitats from three different zones of India including Chhattisgarh, Madhya Pradesh, Rajasthan and different microscopic studies, physicochemical studies and phytochemical screening were performed. Comparative anatomic study of *Gymnema sylvestre* leaf and stem of different zone showed variation in various parameters but main variation was shown in the rosette crystals of calcium oxalate which were maximum in the Rajasthan region and minimum in the Chhattisgarh region where as moderate in the Madhya Pradesh region, trichomes also showed variation which were maximum in the Rajasthan region and minimum in the Madhya Pradesh region where as moderate in the Chhattisgarh region. Physicochemical parameters were also varied in all the three regions which include - estimation of total ash in GC, GM, GR was 9.60-10.10%, 10.03-10.05%, 13.89-14.14% respectively, acid insoluble ash in GC, GM, GR was 9.45-13.15%, 0.82-0.93%, 0.775-0.99% respectively, extractive value (water soluble) in GC, GM, GR was 26.85-27.50%, 27.95-29.50%, 27.25-28.99% respectively, extractive value (alcohol soluble) in GC, GM, GR was 7.92-9.98%, 8.07-12.37%, 8.23-12.98% respectively, moisture content in GC, GM, GR was 7.55%, 9.12%, 8.66% respectively. Estimation of Lupeol and Stigmasterol in the drug was performed with the help of HPTLC, the percentage of Lupeol in GC, GM, GR was 0.114%, 0.239%, 0.105% respectively and percentage of Stigmasterol in GC, GM, GR was 0.059%, 0.117%, 0.062% respectively analyzed in the sample of different places which were collected from the Chhattisgarh, (GC) Madhya Pradesh, (GM) and Rajasthan (GR). Hence the given study of ecological variation of different region plants play an important role in identifying the best habitat of plant for selection of crude drug for preparation of herbal drugs/their products.

Key words: *Gymnema sylvestre,* HPTLC, Rosette crystals, Lupeol, Stigmasterol

SII/P-2

Comparison of Phyto-Diversity Status in Three Different Types of Tropical Forest

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Use of Forest policy in our country has shifted its focus from exploitation aimed at maximising financial returns, to sustainable management and protection. The present study highlights biodiversity assessment in three different types forests, viz. natural forest, manmade conserved forest and degraded reserve forest.

For natural forest, Katarniyaghat wildlife sanctuary, situated between 28° 6' to 28° 24' N and 81° 24' to 81°19' E at district Bahraich UP, was selected. While, Banthara Forest (80° 45–53 E, 26° 40–45N, at Lucknow, Uttar Pradesh) and Kukrail Reserve Forest areas represented man-made Conserved forest on reclaimed sodic land and reserve forest of State Forest Department being utilized for recreational and crocodile rehabilitation centre, respectively.

The ecological study revealed that natural forest has more than three times tree diversity and basal cover value compared to man-made and reserve forests. Natural Forest has 58 tree species richness, Manmade Forest has 27 and Reserve Forest occupied only 17 tree species richness. *Mallotus philippensis, Syzygium cumini* and *Shorea robusta* are dominant tree species of natural forest. *Syzygium cumini* and *Termenelia arjuna* are dominant species of man-made forest. *Pongamia pinnata* is dominant tree species in the Reserve Forest.

It can be concluded that man-made and reserve forests, which were developed at degraded sites, are now been progressive towards attaining similar phytodiversity of a native natural ecosystem, subjected to more conservation efforts.

Key words: Natural forest, Man-made forest, Reserve forest, Phytosociology, Tropical forest

SII/P-3

Proposal for a Classification and Interpretation of Historical Rural Landscape: The Case of Study of Puglia Region (South Italy)

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Biodiversity conservation is one of the most important pillars for the future. Erosion of biodiversity, destruction of forests, increasing in the extinction rate of species of flora and fauna caused in the last years a great attention to the conservation all over the world.

Efforts have conducted to several actions, plans, directives, studies all over the world to achieve the goal of conservation of biodiversity at all levels (ecosystems, species, genes). However is important to observe how conservation involves a broad sense which goes over the concept of conservation of biodiversity. In land with great historical tradition, it becomes important to think about the conservation of historical rural landscape.

In Western Europe anthropogenic influence is strong as well in natural and semi-natural area. For examples in Italy selection in cutting has modelled forest compositions encouraging some species and causing disappearing of others. Some relevant aspects are great expansion of chesnut (*Castanea sativa*), important as food source for the ancient populations of Appennines Mountains, or always in Appennine the almost total disappearance of silver fir (*Abies alba*) that with beech (*Fagus sylvativa*) covered the original mountain forest fringe *Abieti-Fagetum*.

Historical aspects become still more important in rural areas. Wide areas of the southern Italy interested by pastures are the effect of old regulation (Regia Dogana delle Pecore) which has maintained for centuries pastures where a great number of flocks of sheeps came from the central southern Appennine Mountains to flat and hilly areas of Puglia Region. Part of these pastures still survive and are important for conservation of biodiversity since they are habitats included in the Annex I of 92/43/EEC (Habitat Directive).

The territory of Puglia Region is characterized by a great rate of agricultural land use. Not just olive trees which are extremely spread along the coastal plain and in the lowest part of the hilly districts, but also wheat, widespread in the *Tavoliere di Foggia* alluvial lowland and in the *Fossa Bradanica* valley and also grapes, cherries, peaches, orchards. Processes of land use substitutions with relevant consequences on landscape have interested some crops (tobacco, barley, almond tree) and cultivars with a general scheme which has preferred the more profitable crop.

The importance to preserve an historical agricultural landscape in Puglia appear a relevant task for several reasons which can be conducted to sustainability of system, multi-functionality, conservations of signs and architectural elements and conservation of traditional agricultural practices.

Here are explained some aspects to be considered to evaluate an historical agricultural landscape; the following scheme is modelled on the rural landscape of Puglia Region:presence of typical historical architectural elements of Puglia region (muretti a secco, pozzi, cisterne, specchie, masserie, pagghiari, fogge); presence of historical crops (crop which shows an historical permanence);presence of historical cultivars (this aspect is important cause in Puglia some cultivars are disappearing or in great regression);presence of historical agricultural practices (hand-picking of olives; cereals crop rotation weath-barley);traditional plantations (number of plants per hectare – population density);presence of historical crops in the peri-urban fringe (urban orchards).

The presence and the richness of the considered aspects can help to individuate and classify the different historical agricultural landscapes of Puglia. This process in necessary to obtain a conservation of the landscape values and this becomes fundamental in a moment where great transformations of rural landscape occur in some districts of

the region, as consequence of building of wind farms and photovoltaic parks.

Key words: Rural landscape, Land use, Conservation, Puglia

SII/P-4

Soil Seed Bank in Grassland of Moist Tropics of Uttar Pradesh

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The present study has been carried out on soil seed bank of grassland present near airport of Gorakhpur district of north eastern Uttar Pradesh. Data related to seed bank in grassland shall be presented here out of as part of whole study of soil seed bank composition in different ecosystems of moist tropics. The result highlights significantly higher seed bank of annuals, grasses, sedges, and forbs in comparison of dominant perennial grasses. Average seed bank of one annual cycle comprising of rainy and winter seasons through seedling emergence method recorded as 16050 m^{-2} in 0-10cm and 9200 m^{-2} and 3200 m^{-2} in 10-20cm and 20-30cm depth, respectively. There is higher contribution of annual grasses in soil seed bank composition as compare to perennial grasses, forbs and sedges. Dominant species were *Blumea lacera, Cynodon dactylon, Cyperus kyllingia, Cyperus rotundus, Desmodium triflorum, Dicanthium annulatum, Digitaria ciliaris, Euphorbia hirta* and *Oplismenus burmannii*. This paper will discuss around various attributes of soil seed bank of grassland of moist tropic of north eastern UP.

Key words: Soil seed bank, Grassland, Annuals, Perennials, Seedling emergence, Moist tropics

SII/P-5

Study of Important Medicinal Plants from Parner Tehsil, Dist. Ahmednagar, India

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The present study deals with exploration of medicinally important plants from Parner tehsil of Maharashtra. Parner is bordering the west part of Ahmednagar district. The tehsil has hilly as well as plain aeas with its distinct flora. 170 medicinally important plants belonging from 58 families have been recorded with their botanical name, vernacular name, family and plant part used in the medicines. Family Asteraceae, Cucurbitaceae, Papilionaceae, Apiaceae, Caesalpiniaceae were the richest in medicinal plants. It has been found that in 50 plant species leaves are found to be medicinally important, in 39 species fruits are found to be medicinally important, in 26 species seeds are medicinally important, in 16 species stem, in 13 species flowers whereas in 10 species whole plant body is medicinally important.

Key words: Medicinal plants, Parner tehsil

SII/P-6

Biodiversity of Mushrooms in Pathariya Forest of Sagar

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Pathariya forest is situated on Vindhyan ranges at about 457.2-533.4 m above msl. Forest is mixed and dry deciduous type, dominated by *Tectona grandis, Butea monosperma, Acacia* species, and ground flora consisted of *Lantana camara, Parthenium hysterophorus, Euphorbia geniculata, Heteropogon contortus, Cynodon dactylon, Biophytum sensitivum, Cassia tora* etc. During the period of study (July 2008 to July 2009), a total 40 species of mushrooms were collected in which 28 species belonging to 16 families have been identified i.e. 1. Clavariaceae- *Clavulina cristata*; 2. Sprassidaceae- *Sparassis crispa*; 3. Coprinaceae- *Coprinus attramentarius, Panaeolus sphinctrinus*; 4. Tricholomataceae- *Mycena leptocephala, Lepista nuda, Calocybe species, Omphalina ericetorum, Collybia butyracea*; 5. Ganodermataceae- *Ganoderma lucidum, G. appalantum, G. tsugae*; 6. Xylariaceae- *Daldinia concentrica*; 7. Agaricaceae- *Lepiota cristata, Agaricus brassiliensis, Macrolepiota rhacodes*; 8. Hymenochataceae- *Coltricia perennis*; 9. Polyporaceae- *Polyporus varius, Tremetes versicolor*; 10. Lycoperdaceae- *Langermannia gigantea, Bovista nigriscens*; 11-Amanitaceae- *Amanita citrine*; 12. Nidulariaceae- *Cyathus striatus*; 13. Coriolaceae-*Fomes fomentarius, Tyromyces lacteus*; 14. Tremellaceae- *Tremella mesenterica*; 15. Coniphoraceae- *Conifera puteana* and 16. Strophoriaceae- *Hypholoma elongate*. These were categorized into edible (*Clavulina cristata, Sparassis crispa, Coprinus attramentarius, Lepista nuda, Agaricus brassiliensis, Calocybe* sp., *Collybia butyracea, Macrolepiota rhacodes,*), medicinal (*Ganoderma lucidum, G. appalantum, G. tsugae, Tremetes versicolor, Tremella mesenterica, Polyporus varius, Langermannia gigantea*) and poisonous (*Panaeolus sphinctrinus*, *Mycena leptocephala, Omphalina ericetorum, Daldinia concentrica, Lepiota cristata, Coltricia perennis, Cyathus striatus, Tyromyces lacteus, Conifera puteana*, *Amanita citrina,* and *Hypholoma elongate, Bovista nigriscens, Fomes fomentarius*) forms.

Key words: Biodiversity, Mushrooms, Medicinal mushrooms, Poisonous mushrooms

SII/P-7

Physiological Study to Assess Seed and Seedling Quality of Multi Purpose Trees

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The material for present study comprised of seeds and seedlings of three multipurpose tree species viz., *Albizia lebbek* (L.) Benth., *Acacia catechu* wild and *Melia azadirach* L. Seeds of these species were categorized on the test weight

basis viz., large, medium and small sized and subjected to hot and cold water treatments. Seedlings were raised in mist chamber having controlled temperature and humidity. The germination was high after 21 days after hot weather treatments as compared to cold water treatments. The first mature leaves of seedlings were observed for relative humidity (%), Stomatal resistance (cm/s), leaf transpiration ($g/cm^2/s$) and leaf temperature (^oC). These observations were recorded after 120 and 140 days of seedling growth using Li-Cor 1600 Steady State Porometer different time of day i.e. 0800h, 1000h, 1200h, 1400h and 1600h. The variation in relative humidity was more due to species character rather due to treatments. Relative humidity was more in morning hours as compared to evening hours. Not much variation in leaf temperature was evident among different species. The variation in leaf temperature are within physiological limit and its ranged between 21.4^{o}C and 33.1^{o}C. Stomatal resistance varied significantly except for 140 days old seedling of *Melia azadirach*. Stomatal resistance decreased as the day progressed. An inverse relationship between stomatal resistance and transpiration was evident.

Key words: *Albizia lebbek, Acacia catechu, Melia azadirach,* Relative humidity, Transpiration, Stomatal resistance, Seed weight, Seed size

SII/P-8

Histopathologhical and Biochemical Evidence of Antihepatotoxic Activity of the Leaves of *Cassia tora* L.

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Antihepatotoxic activity of *Cassia tora* L. (Leguminoseae) was evaluated using *in-vivo* screening of ethanoilc extract and its ethyl acetate and butanoilc fractions. Histopathological studies were also carried out. The biochemical parameters selected were estimation of SGOT, SGPT and SAPT. The enzyme levels compared with control showed significant protection. The protective percentages was maximum for butanolic fraction which was 82.92%, 83.49% and 75.8% respectively. In histopathological finding of butanolic fraction also a remarkable recovery was observed with distinct hepatocytes, prominent nucleus and nucleolus. There were no lesions. The data justify etanopharmacological application of *Cassia tora*.

Key words: Antihepatotoxic, SGOT, SGPT, SAPT, CCl_4, Histopathology, Enzyme level, Extracts, Fraction

SII/P-9

Studies on Estimate of Genetic Parameters and Correlations among Different Clones of *Eucalyptus Tereticornis* Smith

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The present investigation was conducted to evaluate a set of twenty clones of *Eucalyptus tereticornis* planted at two sites viz. Bithmara in district Hisar (latitude 29°10N, longitude 75°46E and altitude 215.2 m above mean sea level) and Seonthi in District Kurukshetra (latitude 29°59N, longitude 76°50E and altitude 258 m above mean sea level) and generate information on genetic variability, heritability and genetic advance as percentage of mean for different characters in these clones. The estimates of phenotypic coefficients of variation and genotypic coefficients of variation clearly reflected the presence of large amount of genetic variability for clear bole height and unforked height and their increments and reasonable amount of genetic variability for total height and diameter at breast height. Heritability estimates (in broad sense) reflected the predominance of heritable variation for most of the characters under study. The estimates of genetic advance as percentage of mean clearly suggested the potentiality of the clonal material for improvement of clearbole height and unforked height. Index score analysis indicated the superiority of clone number 132 and 147. Correlation coefficients estimates revealed highly significant and positive correlations among clear bole height and unforked height indicating the positive associations of these characters with each other.

Key words: Genetic parameters, *Eucalyptus Tereticornis* Smith, Correlation coefficients

SII/P-10

Ethno Botanical Survey of *Catunaregum uliginosa* (Retg.) Sivarajan: A Historical Religious Plant of Sivasagar District, Assam (India)

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Assam as well as the North Eastern regions of India is of special bio-geographical interest. The floras of this area are very rich in having some important religious, endangered and medicinal plants, for which the botanists of various places of the world have attracted this regions of India. *Catunaregum uliginosa* (Retg) Sivarajan is a historical plant found at Bokata in Sivasagar district of Assam. It is a very strange plant locally known as Bakhor Bengena which is about 800 years old and has a long history. It was planted by the king (Borahi Rajya) Mahamanikya (1200-1400)

Catunaregum uliginosa under the family Rubiaceae is a branched tree with green leaves and thorns. The height of the plant is about 30ft. The beautiful, dazzling flowers appeared in the month of April and May. It is an unique historical religious plant and during the survey it was observed that the people of the area worship the plant.

Key words: *Catunaregum uliginosa*, Bakhor Bengena, Historical religious plant, Endangered species

SII/P-11

Community Characteristics, Biomass Accumulation and Soil Properties in a Rehabilitated Forest on Sodic Land in North India

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Forest communities often show dynamic changes over a period of time. In this study community structure, biomass assessment and soil properties were observed in a subtropical man-made forest ecosystem (40-50-yr-old) developed on barren sodic land at Lucknow, north India over a period of 10-yr interval. Plant population decreased between ten years whereas the basal area increased slightly over the period. Number of species remained almost same. Equitability increased in overstory and understory vegetation; and Shannon Wiener index (H) of species diversity increased only in overstory vegetation. These differences have influenced the biomass accumulation in the forest stands which has increased almost 10% (342 to 378 Mg/ha) in ten years for overstory species and 25% (27 to 34 Mg/ha) in understory vegetation. The composition of different species in the forest community shows the dominance of *Albizia lebbeck*, *Ficus* sp., and *Terminalia arjuna* which contributed nearly 60% of biomass in the forest community and other few species namely *Azadirachta indica*, *Bauhinia variegata*, *Cassia siamea, Syzygium cumini, Syzygium heyneanum* contributed 20%, while rest of the species (30) contributed in minor proportions (<1% each) in remaining 20% biomass contribution. It is observed that biomass accumulation in ten years has increased in *Ficus* sp. and *Terminalia arjuna* and decreased for *Albizia lebbeck* in overstory vegetation. Understory dominance was observed in few species namely *Syzygium cumini, Syzygium heyneanum, Lantana camara, Bauhinia variegata* and *Leucaena leucocephala*. Contribution of *Syzygium heyneanum* reduced to less than half during ten years. A large number of species contributed <1% of the understory biomass which increased from 17 to 42% after ten years. Biomass contribution in different plant components consisted of greatest contribution in branch in overstory vegetation followed by stem, root and leaf components but in case of understory, branch and stem contributions were almost similar. Changes in diagnostic soil properties were noticed at the interval of ten years for pH, electrical conductivity (EC), organic carbon, available phosphorus, nitrogen and microbial biomass carbon (MBC). Significant differences were observed in upper depth (0-15 cm) for pH, EC, phosphorus, nitrogen and MBC and in lower depth (15-30 cm) for electrical conductivity only.

Key words: Vegetation analysis, Diversity indices, Biomass, Overstory species, Understory species, Soil properties

SII/P-12

Source Variation in Fruit, Seed and Seedling Traits of *Hippophae salicifolia*

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Hippophae salicifolia D.Don (Vernacular – Chuk. Tarwa) is a deciduous tree species restricted to the Himalayan region, between 1500-3500 m a.s.l. It has been reported as one of the best species of genus Hippophae in terms of high quality fruit, high yield and fewer thorns. Quality seed has been recognized as an important input in forestry and is considered essential for increasing production and also seed polymorphism has been found to play great role in seed germination, survival and seedling growth. Source variation tests are necessary to screen the naturally available genetic variation to select the best planting material for higher productivity. However to achieve higher productivity and select suitable genotypes for future breeding programmes, seed source testing is important. In this study, an effort has been made to evaluate the extent of variation among the seed sources with respect to different fruit, seed and seedling traits.

The seeds of *H. salicifolia* were collected from three districts of Uttarakhand in India in the month of October 2008 from twelve seed sources. Initially fruits and seeds were measured for length and width and also 100 seed weight. Seed germination test involved 4 replications of randomly selected 25 seeds each, from the working sample.

The present investigation reports the variation in fruit, seed and seedling characters of *Hippophae salicifolia.* The maximum fruit length (7.15 mm), seed length (5.20 mm), and 100 seed weight (2.83 g) were observed in S_9 seeds source of Chamoli district. The 100 seed weight in S_9 seed sources was found to be highest (2.83 g) and lowest among S_5 seed sources (1.30 g) respectively. Germination percentage observed in seeds of S_9 is highest (96.25 %). length of radicle (2.3 cm) and plumule (4.43 cm) under laboratory condition also showed maximum values in S_9. From the present study, S_9 seed source can be recommended for large scale plants production of the species from this locality for afforestation programme.

Key words: Seed sources, Variation, Radical, Plumule, Germination percentage

SII/P-13

Influence of Plantation Location and Seed Sources in *Dalbergia sissoo*

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Seed quality parameters and seed production potential of eleven clones of *Dalbergia sissoo* established at Dehradun and Hisar by transplanting plants raised using cuttings from plus trees growing in different regions of northern India were

worked out during January 2001 and January 2002..The analysis of variance in individual environment along with data pooled over all the four environments indicated significant clonal differences for 100-seed weight, electrical conductivity of seeds, seed density, tetrazolium test, respiration rate, oil content, protein content, seed production potential, standard germination, vigour index-i, vigour index-ii, speed of germination, accelerated aging, seed length and seed breadth. Environments were found significantly different for electrical conductivity of seeds, seed density, tetrazolium test, respiration rate, protein content, seed production potential, standard germination, vigour index-ii, accelerated aging, seed length and seed breadth. The magnitude of these characters varied considerably over the years and over the locations in same year. Year to year variations were observed less in comparison to location to location. Hisar location was found favorable for tetrazolium test, protein content, seed production potential, standard germination, seedling dry weight, seed vigour index-II and speed of germination, whereas for seed length, seed breadth, 100-seed weight, seed density, electrical conductivity, dehydrogenase activity, accelerated aging, respiration rate, oil content, seedling length and seed vigour index-I, Dehradun location was found better. The environmental indices suggested that the magnitude of different characters varied considerably at different locations and in different years.

Key words: *Dalbergia sissoo*, Seed quality, Location, Vigour

SII/P-14

Lichen Biomass Estimation in Some Sites of Nanda Devi Biosphere Reserve, Chamoli District Uttarakhand

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The lichens play an important role in the nutrient cycling of the forest ecosystem by contributing to structural complexity, ecological functions and biodiversity. The lichen litter fall available on the forest floor contributes vital role in humus production of the forest. Lichens grow luxuriantly in the alpine and temperate areas in the Himalayan region. Though, much more is known regarding the taxonomy of the lichens of the Himalayan region, however the biomass estimation studies are by and large neglected in the country. Thus in the present research paper an account of the lichen biomass available on the forest floor of five temperate and alpine regions of Nanda Devi Biosphere Reserve is provided. The Lata Khark and Malari are the localities in alpine region of Nanda Devi Biosphere Reserve exhibit higher biomass ranges of 0.80-53.17 g/m^2 of lichen biomass while Valley of Flowers, Jammu Malari, and Belta in temperate region has the lichen biomass range of 0.52-11.39 gm/m^2. The higher temperate and treeless alpine areas exhibit the more biomass of lichens. The Parmelioid lichens contribute the maximum in production of lichen biomass together with the members of the family Physciaceae.

Key words: Lichen biomass, Nanda Devi Biosphere Reserve, Himalayan region

SII/P-15

Algal Database: An Online Resource for Fresh Water Algal Flora of Chattisgarh, India

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Biodiversity is a gift of nature to man. Nature through it animate and inanimate process has not only given rise to this diversity, but has also given it a self-generating characters. India is one of the world's top mega biodiversity countries. Preservation of this rich diversity is important for sustainable development. The rich biodiversity and ecosystem at species level is due to its varied climatic conditions and geographical physical features.

Organization and presentation of biodiversity data is greatly facilitated by databases that are specially designed to allow easy data entry and organized data display. Such databases also have the capacity to serve as Laboratory Information Systems. At NBRI Algal Database is designed to showcase specimens collected mainly from Chhattisgarh state and other part of India, enabling users around the world to compare their specimens with our specimen photographs. It is our hope that ecologists and taxonomists from the India and around the world will find this database useful for collaborative and comparative work on large biogeography scales.

In this connection the present investigation has been carried out from the Plateau and plan regions of Chhattisgarh, which will help in preparing distributional map as well as algal diversity. The sea-horse shaped Chhattisgarh state came in to existence on 1st Nov 2000 by the bill "Madhya Pradesh reorganization Act 2000"passed in the parliament. It is situated between 17^{0}46' to 24^{0}05' N latitude and 80^{0}15' to 84^{0}26 E. comprising an area about 1,35,194 sq km. Chhattisgarh is abundantly endowed with natural resources. This state lies in the valley of rivers Mahanadi and Sheonath. Thus the whole region has got a unique assemblage of flora and fauna.

Fresh water algal samples were collected from different water bodies of Chhattisgarh. These were preserved in 4% formalin and deposited at Algology laboratory of National Botanical Research Institute, Lucknow. Microscopic observation was done in Leica ATC 2000 research microscope and microphotographs were taken with the help of Nikon Coolpix-4500 digital camera. A total of 52 taxa belonging to class-Chlorophyceae, Order-Chlorococcales and family-Hydrodictyaceae, have been studied on the basis of morpho-taxonomic observation. Out of 52 taxa genus *Pediastrum* was dominant in occurrence followed by *Closterium* and *Hydrodictyon*. Genus

Pediastrum with 16 species 22 variety and 5 forma while genus *Closterium* with 3 species and genus *Hydridictyon* with 2 species were reported. Systematic enumeration, morpho-taxonomy, occurrence and diversity of the green algal taxa of Chattisgarh has been digitized in Algal database of PADAP, NBRI, Lucknow.

Key words: Algae, Database, Biodiversity, Chhattisgarh, India

SII/P-16

Exotics in Chhattisgarh

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Exotics are species invading a defined area from outside i.e. the species has not originated within that defined area. However, the term is used generally for the species of recent invasion and generally causing some environmental problems. Chhattisgarh region is divisible in to three physiographic regions: The Northern Hills, Central Plain and the Southern Plateau. Area of the state is covered more than 40% by forests. Some of the exotic plants of the State are: *Alternanthera tenella, Axonopus compressus, Cassia sericea, Chromolaena odorata, Eichhornia crassipes, Ipomoea carnea, Lantana camara, Parthenium hysterophorus, Pistia stratiotes, Prosopis juliflora, Ricardia scabra.*

Spread and distribution of the exotics is not uniform in the state. Notorious weed *Parthenium hysterophorus*, so common in several parts of the state is almost rare to observe in Bastar region. *Chromolaena odorata* is another example of irregular distribution. Although, the species is reported to be widely distributed in India but in Chhattisgarh state, so far, it has invaded only the Bastar region. It may co-exist with *Lantana camara* but ultimately dominates the *Lantana*. Most spectacular of the occurrence of *Chromolaena odorata* species is the Kanger Valley National Park, near Jagdalpur, where the species has made extensive and thick growth, inside as well as outside the National Park area. *Alternanthera tenella*, has invaded the area of the state, not long ago, but is replacing many of the local plants. Most to suffer are the plants of the wet places like the *A. sessilis and Echonochloa colonum*. Together with the wet places it is occupying also the open grounds. It makes gregarious, carpet like growth in large patches. *Riccardia scabra,* although, has become widely distributed in the state, but has so far not become a nuisance. Most recently introduced species of plants, to Chhattisgarh region is, *Axonopus compressus*, a grass. Starting its growth as a sporadic plant, very rapidly it replaces all other herbaceous plants from the grassland. Control of the exotics has always been a scientific challenge. However, at one place a good example of control of *Parthenium* by the legume species *Cassia sericea*, was observed. Attempts to control *Eichhornia crassipes* has been made with the help of some weevils (insects) but has so far not proved to be practicable.

Key words: Exotics, Chhattisgarh, Bastar, *Axonopus*

SII/P-17

Assessment of Diversity and Distribution of Dominant Acrocarpous Moss Families in Pachmarhi Biosphere Reserve, India

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Pachmarhi Biosphere Reserve (PBR), situated in Madhya Pradesh, India is well known for its biodiversity in general and bryo-diversity in particular. PBR is an important biodiversity hotspot of central India and covers three civil districts of Madhya Pradesh - Chhindwara, Betul and Hoshangabad, undertaking an area of 4987.38 square km. This region is of great importance due to the fact that this area is the part of, what was known in the past as Gondwanaland. The flora and fauna of the region thus hold much importance phylogenetically. Further, the region also forms a link between the biodiversity of the southern Indian region and that of the Himalayan region, and this makes the Biosphere Reserve a connecting link between the two belts. The bryophyte diversity in India is considerably sound in general and very well in some zones, PBR being one of them. Nearly 57 species of liverworts, 37 species of epiphytic mosses and 46 species of terrestrial mosses have been reported from there so far. Pachmarhi Biosphere Reserve has not been explored to a satisfactory extent previously for the assessment of Bryophyte diversity. Moss flora of the region is immensely significant considering the fact that mosses are abundantly found here. Among the moss families: Bryaceae, Pottiaceae, Dicranaceae and Fissidentaceae are the most abundant ones being represented by 30 taxa in total. Among these, Bryaceae is represented by 9, Pottiaceae by 8, Dicranaceae by 7 and Fissidentaceae by 6 taxa. Interestingly, all the four moss families are acrocarpous indicating the dominance of erect mosses in the region. Further, *Fissidens* Hedw., *Bryum* Hedw., *Campylopus* Bridel. and *Hyophila* (Hook.) Jaeg. are the most abundant genera of these families. While Pottiaceae is dominant in terms of frequency of occurrence of its genera in different localities of PBR, Bryaceae shows maximum representation with 9 members. The mosses account for both epiphytic and terrestrial members and contribute substantially to the ecology and diversity of PBR.

Key words: Bryophytes, Acrocarpous mosses, PBR, Madhya Pradesh, India

SII/P-18

Algal Biodiversity of Girna Dam Water from Nashik District (Maharashtra)

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Water is life-supporting system; each type of water has their own communities. They have their specific flora and fauna. Algae constitute the main autotrophic component of the aquatic ecosystem. They constitute about 40 % the total carbon fixed annually on this planet and thus is an important component of the ecosystem. The undisturbed and stable ecosystem normally allows growth of a large number of species, which are distributed with a quite equal dominance. For the biodiversity study of Algae, analysis was done on water of Girna Dam from Nashik District (Maharashtra) during the years 2005- 07. The diversity was studied quantitatively, qualitatively and periodically. Six stations viz. GDS- I, GDS- II, GDS- III, GDS- IV, GDS- V and GDS- VI of Girna Dam were selected based on human interference, inlet and outlet of the water body. Monthly samples for algal analysis were collected. In present study, 363 taxa belonging to 94 genera, from four groups of algae were recorded. The population density and algal composition followed the same trend in present study i. e. Chlorophyceae > Cyanophyceae > Bacillariophyceae > Euglineneae. In algal species composition among Chlorophyceae genera *Scenedesmus, Tetraedron* and *Pediastrum* were dominant. From desmids *Cosmarium* were dominant. Among Cyanophyceae the dominant genera were *Oscillatoria, Gloeocapsa* and *Phormidium.* In Diatoms dominance was shown by centric diatom genera *Cyclotella* followed by pinnate diatoms genera *Navicula*, *Gomphonema* and *Cymbella.* The dominant genera among Euglenineae were *Phacus* and *Euglena.* The total phytoplankton population shows bimodal pattern of variations. The first peak was observed during summer and another in winter.

Key words: Water, Algae, Biodiversity, Qualitative, Quantitative, Periodicity

SII/P-19

An Overview of Bryophytes Diversity in Western Ghats

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Bryophytes are the simplest and most primitive of the land plants but occupy an important place in the plant kingdom. They are pioneers to colonize terrestrial habitat from aquatic environment. Bryophytes are seen growing on a wide range of substrata. They grow on rocks, pebbles and stones, fallen logs, river banks and road side cuts.They inhabit many microclimatic niches like old discarded/abandoned leather, rubber and wooden goods, tiled and asbestos roofs. They also grow as epiphytes on barks of trees and on leaves of other plants.

Bryophytes are one of the rich group which consists of nearly 20,000 species and about 960 genera distributed all over the world. In India 850 species of liverworts belonging to 140 genera and 52 families, hornworts with 37 species and 6 genera and mosses with 2300 species belonging to 342 genera and 54 families are reported. Mosses are the most diverse and speciose group.

India possess a large area with unique assemblage of rich floral communities and is one of the 12 mega biodiversity countries of the world.The biogeographical zones have been divided into eight bryogeographical regions viz Western Himalayas, the Eastern Himalayas, the Punjab and West Rajasthan, the Gangetic Plains, the Central India, the Western and the Eastern Ghats and the Deccan Plateau, and the islands of Andaman and Nicobar.The Western Ghats and Eastern Himalayas are identified as 'hotspots' in the world. The bryophytes diversity of Western Ghats is high which consists of about 850-1000 species. Of these, 682 species are mosses, 190 of them are endemic. Among the 280 species of liverworts and 14 species of hornworts, there are 121 and 2 endemic species respectively.The Idukki district specially the hilly areas of Munnar, Wayanad region, Agasthyamalai Biosphere Reserve,Aralam Wildlife Sanctuary, tropical rain forests of Silent valley in Kerala, Nilgiri hills, Palni hills, Kanyakumari District,Tirunelveli District, Brahmagiri Wildlife Sanctuary, Coorg area of Karnataka, Eravikulam National Park are some regions of Western Ghats which has a rich diversity of bryophytes.

Key words: Bryophytes, Western Ghats, Hotspots, Mosses, Liverworts, Hornworts

SII/P-20

Biological Meltdown and *Cedrus* Biodiversity in North Sikkim Himalayas

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Mountains provide a special habitat for the survival of many plant species**.** The life support systems of the earth are under pressure of human activities and biological meltdown is accelerating leading extinction of various species. Many important species on earth has already been wiped off and one in every five of the world's 3,80,000 plant species is threatened with extinction.

Teesta river basin in Sikkim has deep valleys and ravines to gentle slopes in glaciated valley floors in north making it rich in floristic diversity and recognized as a part of Indo-Burma hot spot. The region also harbors the elegant conifers which are still less researched or untouched aspect in particular line of investigation. *Cedrus* is one of the important taxa among conifers which is taken as the study material for mapping.

Only one species *Cedrus deodara* (Roxb.) G. Don has been reported from this region. *Cedrus* is extensively exploited for railway sleepers, construction timber, some furniture making and firewood uses and its biomedical actions are reported to be carminative, antispasmodic, creates sweating, urination, increase digestive function, remove toxins from the bowel, alleviate coughing, and cure skin disorders such as eczema and psoriasis. Its applications cover soap perfumes, household sprays, floor polishes and

insecticides, antifungal and clearing oil agents.

The study aims to priorities and formulates action and organize awareness and conservation programs to save such an ecologically and economically significant species in North Sikkim Himalaya.

Key words: Biodiversity, Biological meltdown, *Cedrus deodara*, Evolution, Eastern Himalaya

SII/P-21

Studies on Genetic Diversity and Convergence in *Fusarium oxysporum* f. sp. *lycopersici*, Purvanchal Region (U.P.), India

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An epidemic of vascular wilt caused by *Fusarium oxysporum* f. sp. *lycopersici* is currently occurning on *Lycopersicon esculentum* L. (Tomato) in region of purvanchal. The population selected for this study included Fol. Isolates which show pathogenisty.The causel agent of Fusarium wilt of tomato, analyzed the morphological, cultural, and genetic variability existing within and among 16 known pathogenic race of this fungus. RAPD analysis of isolates of the pathogen was undertaken to elucidate its genetic complexity. The genetic similarity coefficient range was from 0.20 to 0.90, indicate that no any two or more isolates were 100% similar. RAPD profiles revealed up to 20% genetic diversity among ten isolates.

Key words: Fusarium wilt, Tomato, Genetic diversity, RAPD, Pathogenic

SII/P-22

A Comparative Study of Eutrophication with Relation to Algal Biodiversity of Aner Dam & Aner River of Dhule District of Maharashtra

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Eutrophication refers to the continuous enrichment of water by the addition of substances that provide for the increasing growth of aquatic life. The enrichment of nutrients either by natural or artificial means. Algae are closely correlated for eutrophication. The nitrogenous compounds, Phosphorous and carbon are occurred by the addition of organic substances and drainage from agriculture lands, and addition of organic pollutants in these water bodies. When gross eutrophication is reached large visible aggregation of floating algae which forms it to water blooms or growth. In present study six station of Aner dam aner River was selected for study of eutrophication and biodiversity of algal flora. Trophic state indices of Nygaard's (1949) are used to set meaningful evaluation of the extant of eotrophication of Aner dam and Aner River.Trophic state indices like Myxophycean, Chlorophycean, Diatoms, Euglenineae and Compound indices are used for assessing the eutrophication of six stations of Aner dam and river. The most eutrophic form like *Microcystis* were recorded in the form of water blooms.

Key words: Eutrophication, Dam, River, Algae, Shirpur, Dhule

SII/P-23

Cyanobacterial Diversity at World Heritage Monuments of Uttar Pradesh, India

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Taj Mahal, Agra Fort, Sikandra Fort and Fatehpur Sikri are the world heritage monuments in Uttar Pradesh, India. Stone monuments and historic buildings are constantly exposed to the physical, chemical and biological factors. These monuments would be colonized by different groups of micro-organisms including bacteria, algae and fungi. Knowledge of these microbial populations living on the stone material of monuments is the starting point of successful conservation strategy. Algae especially cyanobacteria are considered the pioneering inhabitants in the colonization of monumental stone substratum. Identifying the colonized algae involves in bio-deterioration which is one of the most important steps in the study of the algal ecology of monumental stones. It helps to understand the diversity, the phase of colonization and the relationship among population on the surface and between algae and the substrata.

A total of 64 Cyanophyceaen taxa belonging to three different orders namely Chroococcales, Nostocales, Chamaesiphonales were identified from the collected samples from these heritage monuments. Out of these three orders Chroococcles represented with 10 genera and 33 species, order Nostocales with 12 genera 30 species and order Cheamosiphonales with 1 genera with 1 species. At Sikandra Fort, *Microcystis, Gloeocapsa, Chroococcus* were found dominant. *Calothrix, Aphanocapsa, Chroococcus*, were dominant at Taj Mahal fort. *Microcystis,* and *Chroococcus* were dominant at Red Fort and *Gloeocapsa, Merismopedia*, *Phormidium, Calothrix* were dominant at Fatehpur Sikri. While *Synechocystis, Homeothrix, Pseudocapsa, Anabaena, Spirulina*, were found rarely in the entire study. In the present investigation the *Microcystis, Aphanothece, Calothrix, Oscillatoria, Lyngbya* and *Scytonema* were common cyanobacterial species found predominantly on the surface of monumental walls. Colonization and distribution of cyanobacterial flora on the world heritage monuments of Uttar Pradesh, India are described in dehe present communication.

Key words: Cyanobacttail in teria, Colonization, Heritage monuments, Taj Mahal; India

SII/P-24

The Diversity of Daedaloid and Hexagonoid Polypores Form the Forest of Western Ghats and Satpura Ranges of Western Maharasta

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In the present study the diversity of Daedaloid and Hexagonoid polypores from the forests of Western Ghats and Satpura ranges of western Maharashtra, were carried out. The collections were made from twelve different sites and sixty five specimens were critically examined with respect to their external and internal characters of basidiocarp and cultural behaviour. On the basis of these observations they are placed into four genera namely Daedalea Fr., Daedaleopsis Schroetl., Lenzites Fr. and Scenidium (Klotzsch.) O. Kuntz. and fifteen species. The collected samples of all these species are cultured on artificial media and their cultural characters are studied. These are the economically important wood rotting fungi.

Key words: Diversity, Daedaloid polypores, Hexagonoid polypores, Cultural studies, Wood rotting fungi

SII/P-25

Destruction of Mangrove Diversity due to High Pace Development at Kochi Coasts, Kerala

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The mangrove stands are the salient victims of the development boom in Kerala, especially, Kochi. Present study was conducted at different developmental sites of Kochi city, such as Valanthakkad, Edakochi, Mulavukkad, Vyppeen and Puthuvypeen. Mangroves of these places are facing threats of extinction due to the proposed Hi-Tech city, coastal road, cricket stadium, container terminus, and LPG&LNG storage tanks. A detailed survey was conducted at the study areas and data were compared with the earlier studies using statistical methods. A heavy decline in the species such as *Rhizophora apiculata, Brugiera sexangula, Kandelia candel, Sonneratia alba, Sonneratia caseolaris* and *Aegiceras corniculatum* are noted due to the developmental activities. Developmental activities conducted evidently are against the biological diversity rules (2002) of National Biodiversity Authority and Biological diversity rules (2004) of Kerala State Biodiversity Board. Violation of Coastal Zone Regulation (CRZ) act, 1991 and 2001 are also noticed. Immediate steps to protect the mangrove diversity of this area should be taken by the government of Kerala and India through the application of law is necessary to safe guard further destruction.

Key words: Mangrove diversity, Developmental activity, Violation of rules, Implementation of laws

SII/P-26

Agricultural Rice Germplasm Biodiversity in Bonda Hill Area of Malkangiri District of Orissa, India as Influenced by the Environment

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Preservation and conservation of various life forms especially higher groups of plants and animals is the cry of the present day so called Environmentalists, Policy makers, Administrators as well as the conscious citizens of the entire globe. With this in mind the present International Conference on Plants and Environmental Pollution is being organized from various angles for the sustainable use of the natural resources thereby conserving the biodiversity. The sub-theme number five under which of the present field survey and participatory research was alone is "Environment and Biodiversity" as a Rice Research Worker the author became tempted to present a research paper on "Rice germplasm biodiversity and environment" in and around his place of work, Balimaela College of Science and Technology. In this piece of field work Bonda Hill area was chosen because they are the most primitive ethnic group of tribal people having their distinct tradition in agriculture and social culture. The group of tribal people having their distinct tradition in agriculture and social culture. The genetic biodiversity of rice (*Oryza sativa* L. – Family Poaceae) was recorded through participatory research in the Bonda Hill area of Mudulipada Panchayat in Khairput Block of Malkangiri District. Methodology followed in the use investigation was to collect the paddy grains from the local marginal tribal farmers and interact with them for their cultivation practices, duration of paddy harvest (yield per hectare, cooking qualities, taste as well as scented aromatic properties. After collection the grains were brought ti the Department of Botany Laboratory, Balimela College of Science and Technology, Balimela. Agronomic characters such as length and breath of the grain, colour, one thousand grain weight were recorded. Healthy and uniform seeds were selected for further investigation and the germplasm preservation in gene banks. Different characters were studied. Infection and other entomological studies were not undertaken during this investigation. It was observed that aromatic scented rice was moderately popular among the tribal people of the area under report. The Bonda Hill Area is a small patch of Hill land and the forest cover is being lost gradually due to intensive agriculture through shifting cultivation which affects adversely to the environment. It is suggested that both the rice genetic biodiversity and in general plant species biodiversity (especially higher plants) must be conserved for a clean, green and healthy future.

Key words: Agriculture, Rice, Biodiversity, Germplasm, Genetic environment

SII/P-27

Biodiversity of Freshwater Hyphomycetes form North Maharashtra (M.S., India)

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The present paper deals with submerged aquatic hyphomycetes, it represents a heterogeneous assemblage of fungi growing on submerged decaying plant materials. Most of the species are found on wood litter blocked by rocks in fast flowing streams or babbling brooks.

Eight species of submerged aquatic hyphomycetes belonging to seven species were found during October 2008 to October 2009 one year investigation. Two species viz. *Canalisporium exiguum* Goh and Hyde and *Trichocladium angelicum* Roldan and Honrubia are being reported for the first time form India. Four species *viz. Bactrodesmium indicum* Udaiyan *Centrospora acerina* (Hartig) Newhall *Sporidesmium altum* (Preuss) Ellis and *Sporoschisma saccardoi* Mason and Hughes are being reported for the first time form Maharashtra state.

Key words: Biodiversity, Aquatic hyphomycetes, North Maharashtra

SII/P-28

Biodiversity of Mushrooms in Eastern Uttar Pradesh

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The use of wild mushrooms for food in all probability began with the prehistoric man. During the long period human as a hunter gathered the fungi of the forest that has served as an important source of nourishment. Mushrooms have been found in fossilized wood that are estimated to be 300 million years old and almost certainly, prehistoric man has used mushroom collected in the wild as food. These are invariably high protein rich and have been considered as potential source of proteins, amino acids, vitamins and minerals. Besides, they are valued for food and medicinal properties by people.

Several mushrooms grow wild in Eastern Uttar Pradesh forest during the rainy season on dead and decaying plant or animal remains. Local tribes collect a number of mushrooms and eat during rainy season. The traditional identification knowledge among the tribes are followed from generation to generation. The bio-diversity in the mushrooms is least documented in India. The germplasm collection of such mushrooms is very poor. Field survey was conducted for collection of various mushrooms from different localities of the Eastern Uttar Pradesh forest. The collected mushrooms were studied for their macroscopic detail pertaining the habit, habitat, morphology and other phenotypic parameter noted in fresh form.

Key words: Mushrooms, Biodiversity, Germplasm collection, Vitamins and minerals

SII/P-29

Biodiversity of Chlorophyceae in Mosam River of Baglan (Maharashtra)

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A critical study has been made on the diversity of Chlorophyceae in Mosam river of Baglan during the period from July 1998 to June 2000. Algal samples were collected at first week of monthly intervals from 3 stations of Mosam river during the period of two years of investigation. Line drawings of Chlorophyeae were made by camera lucida. Forty one taxa of Chlorophyceae were identified with the help of standard monographs and recent literature. In present study this class consists of mainly species of *Gonium, Chlorococcum, Pediastrum, Hydrodictyon, Tetradedron, Chlorella, Quadrigula, Colestrum, Crucigenia, Scenedesmus, Uronema, Cladophora, Stigeoclonium, Schizomeris, Oedogonium, Mougeotia, Spirogyra, Zygnema Cosmarium* and *Staurastrum*. The member of Chlorococcales were found to be dominant as compared to other forms of green algae. The desmids were also variable in their composition. All these forms were observed from 3 stations of Mosam river. In the present study 41 taxa of belonging to 21 genera are Chlorophyceae were studied taxonomically.

Key words: Biodiversity, Freshwater, Green algae, River

SII/P-30

Biodiversity of Magnicolous Fungi from Mangroves in Mahanadi Delta, East Coast of India

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Samples of dead and decaying mangrove wood belonging to 11 host plants were collected from Mahanadi delta (Orissa) east coast of India yields 59 fungi. These include 41 Ascomycetes (69%), 2 Basidiomycetes (3%) and 16 Mitosporic fungi (27%). Maximum number of species (38) were recorded from *Avicennia marina*, followed by *Avicennia officinalis*(16), *Ceriops tagal*, *Rhizophora apiculata* (14 each), *Heritira fomes* (07), *Ceriops decandra, Excoecaria agallocha, Kandelia candel, Sonneratia griffithii* (06 each), *Aegioceros corniculatum* (05), *Aegialitis rotundifolia* (01). *Verruculina enalia* was recorded on 10 out of 11 host plants, followed by *Periconia prolific* on 7 host plant examined.

Key words: Biodiversity, Mangnicolous fungi, Mangroves

SII/P-31

Biodiversity of Euglenineae of Sonvad Dam and Devbhane Dam of Dhule

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Biodiversity of algae from different aquatic habitats were studied extensively in India but very few workers have paid attention on biodiversity of euglenioids in Maharashtra. The present investigation was carried out by selecting Sonvad dam and Devbhane dam of Dhule district of Maharashtra.

In present study 32 taxa of euglenineae were reported from study area of both dams. Out of 32 taxa of euglenoids 15 of *Euglena*, 01 taxa of *Petalomonas* and 16 species of *Phacus* have been reported from the study area first time. The species of *Phacus* were dominant as compared to other taxa of euglenoids in present study.

Key words: Euglenineae, Biodiversity, *Petalomonas*

SII/P-32

Distribution of Lichens on *Areca Catechu* in Cachar District of Assam

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Areca catechu, commonly known as Betel palm or Betel nut is an erect, unbranched tree reaching heights of 15-30m with a trunk of 20- 30cm in diameter, depending upon the environmental conditions. Betel nut is grown for its economically important seed crop, the betelnut. It however thrives in areas of high rainfall and low altitudes. Being a shade loving species, it shows its excellent growth in a mixed forest with fruit trees. It is sensitive to drought and therefore irrigation is essential in areas with prolonged dry spells. *Areca catechu* is an excellent host tree for the growth of lichens in Cachar district, Southern Assam. The present study provides a floristic account and distribution pattern of the epiphytic lichens growing on betel nut tree of Cachar district. A total of 48 lichen species belonging to 23 genera and 11 families were identified from different localities of the study area. The lichen family Graphidaceae dominates the *Areca* trees represented by 16 species and 6 genera followed by Physciaceae having 7 species and 2 genera.

The climatic condition, availability of water, sunlight, unpolluted atmosphere, wind currents and absence of biotic interference together with nature and type of substratum are major factors responsible for diversity of lichens in a particular area. The *Areca* trees provide three distinct niches within a single tree. The base of tree with thick furrowed and soil laden bark has more moisture than the trunk at the chest height, while the trunk above the chest height is more smooth and receive more sunlight than the basal and middle region. The nature of the substratum, smoothness or roughness nature at different parts of the tree, pH and water holding capacity are important bark properties which affect the lichen growth on trees.

The tree in its upper parts show growth of light loving lichens belonging to the family Graphidaceae. The middle part bears growth of foilose lichen genera *Dirinaria* and *Pyxine* while the basal region having higher moisture content due to shade provide substratum for shade loving lichen species.

So far the distribution of lichen on *Areca catechu* in India are not available. The present enumeration of lichens on *Areca catechu* will be helpful to know the status of epiphytic lichen diversity of Indian trees in general and also provide information for preparation of floristic account of the lichen flora of the Cachar district in particular.

Key words: *Areca catechu,* Lichen, Biodiversity

SII/P-33

Mycorrhizal Association in Forest Trees in Sarguja District (C.G.)

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Mycorrhizal fungi are often thought to be determined by their host plant, but mycorrhizal fungi tend to be generalists. The diversity of mycorrhizal fungi does not follow patterns of plant diversity. Samples of roots and soil of different trees from different sites of Mainpat region were collected, examined for VAM fungi. A very wide range of %colonization, spore count was recorded, indicating the richness of mycorrhizal fungi with plants. Altogether, 17 different VAM *species* are identified from different sites; minimum of 03 *species* from one site to maximum of 09 *species* from another site. The most frequent genus was *Glomus*, followed by *Acaulospora* and *Scutellospora*.

Key words: VAM, Diversity, Forest, Plant, Spore count, % root colonization

SII/P-34

Genetic Diversity within and among the Wild Populations of *Murraya koenigii* (L). Spreng., as Revealed by ISSR Markers

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Murraya koenigii (L). Spreng., commonly known as

curry leaf plant in India, is an aromatic shrub or small tree found growing both in wild and cultivated forms. Wild forms in India occur in the hills of Assam, Central India, Himachal Pradesh, Kerala, Punjab, Sikkim, Tamil Nadu, Uttarakhand, West Bengal and Western Ghats, whereas in Southern parts of India, the plants are extensively cultivated for its aromatic leaves. In the present paper, estimation of genetic diversity within and among the wild populations of *M. koenigii* was carried out employing Inter Simple Sequence Repeat (ISSR) markers. Fifty nine accessions representing eight populations were analyzed using ISSR markers. Thirteen ISSR primers resulted 136 polymorphic bands revealing 89.47% polymorphism across the accessions. The pair-wise population genetic distances ranged from 0.05 to 0.13 between the populations. AMOVA and Nei's genetic diversity analysis revealed higher genetic variations within populations than among populations. The clustering of populations in the dendrogram was not in congruence with geographical affiliations in the dendrogram. The results indicate that the ISSR method is sufficiently informative and powerful to estimate the genetic diversity in *M. koenigii* populations. The information on genetic variability of this economically important wild genetic resource might be a potential source as breeding material for development of commercially valuable traits in *M. koenigii* plants.

Keywords: Genetic diversity, Population structure, *Murraya koenigii*, ISSR

SII/P-35

Micropropogation of *Momordica charantia*

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The present investigation is to access the *in vitro* response of various explants of *Momordica charantia*. *Momordica charantia* is a tropical and subtropical vine of the family Cucurbitaceae, widely grown for edible fruit, which is among the most bitter of all vegetables. It is an important medicinal herb for organogenesis, multiple shoot regeneration and callus formation. The response recorded during the period of my work elucidates the potential of this medicinal plant for *in vitro* propagation studies. *In vitro* plant development of *Momordica charantia* was established on Murashige and Skoog's (MS) medium give (100%) germination of the seeds with normal hypocotyls using different concentrations of auxins (5.890 ± 0.190 root number and 5.890 ± 1.473 (X ± SE) root lengths best result was obtained in 0.1mg/l) and in cytokinins (achieved at 1.453 ± 0.290 shoot number best result in basal media and 0.268 ± 0.012l shoot length (X ± SE) best result was obtained in 4mg/l). Shoot as well as root differentiation was obtained on medium containing BAP+IBA. Multiple shoots with roots were formed on MS medium without hormones (MSO).

Key words: *Momordica charantia,* Micropropogation, Murashige and Skoog's (MS) medium

SII/P-36

Standardization of Micropropagation Protocol of *Atropa belladona* for Agro-Climatic Zones of the Kashmir Valley

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Atropa belladonna, commonly known as belladonna or deadly nightshade, is a perennial herbaceous plant belonging to the family Solanaceae. The drug atropine is derived from the plant. With limited distribution and important medicinal values in *vitro* propagation protocol standardization of *Atropa belladonna* is best way to conserve and propagate it. This was tried to establish employing auxiliary buds by altering carbohydrate, both quantitatively and qualitatively, in Murashige and Skoog (MS) medium. For standardization different concentrations, 1%, 2% and 3%, of sucrose and commercially available normal sugar respectively were tried keeping other integrants in MS medium constant. In almost all other parameters, media made up of MS+commercially available sugar with 5% concentration showed on par results. The plantlets thus obtained were successfully acclimatized and transferred to field trials with 83% survival rate in agro-climatic environment of the valley.

Key words: *Atropa*, Micropropagation, Standardization, Sugar and acclimatization

SII/P-37

Phytoplankton Diversity in Relation to Abiotic Factors at Toranmal Nandurbar District, Maharashtra

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In the present study water samples from different habitats of Toranmal were collected from July 2008 to June 2009. Phytoplankton diversity was studied in relation to physio-chemical variables. Chlorophyceae was the most dominant class of phytoplankton followed by Cyanophyceae and Bacillariophyceae. A total of 67 sps. of phytoplankton were identified under class Chlorophyceae, Bacillariophyceae and Cyanophyceae. These classes of phytoplankton showed considerable fluctuatipns with water quality parameters.

Key words: Diversity, Phytoplankton, Toranmal, Environmental variables, Maharastra

SII/P-38

In vitro Plant Regeneration through Enhanced Axillary Shoot Multiplication for Sustainable Utilization and Conservation

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Medicinal plants have been reckoned as valuable therapeutic aids for alleviating various ailments of human kinds. With ever increasing human population along with growing demand during the last two decades for herbal drugs and because of their proven efficacy with little or no reported side effect has resulted in ruthless exploitation of medicinal plants, thus creating a gap between supply and demand. Therefore, there is an urgent need to develop reliable strategies for conservation and sustainable management. Advanced Biotechnological methods including plant cell, tissues or organ culture have provided new means of rapid propagation and conservation of valuable, rare and endangered medicinal plant species. In the present study, attempts have been made to establish micropropagation protocol in selected *Vitex* species (*V. negundo* and *V. trifolia*) using nodal explants in Murashige and Skoog's Medium supplemented with different plant growth regulators (BA, Kn and 2-iP). In both the species, BA was found to be the best for multiple shoot regeneration and the order of effectiveness was BA > Kn > 2-iP among all the tested cytokinins. *Ex- vitro* rooting was successfully induced using Indole-3-butyric acid (IBA) in the regenerated shootlets which combines the additional steps of *in vitro* rooting and hardening. Properly rooted and acclimatized shootlets were transferred to soil under natural light. The regenerated plants showed normal morphological appearance as mother plant. The present protocol can be used to raise any number of clones of selected species of *Vitex* at any time round the year.

Key word: Medicinal plant, Micropropagation, *Ex vitro* rooting, Nodal segments

SII/P-39

Studies on Occurrence and Diversity of *Euastrum* Species in Lentic Water Bodies of Chhattisgarh State, India

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Desmids represent a group of advanced green algae that are commonly found in Planktonic communities of fresh water bodies. Desmids secrete significant amounts of extracellular polymeric substances that form an extensive mucilaginous sheath external to the cell wall and function in adhesion, gliding-based movements and ultimate ensheathment within the Planktonic complex. Desmids are green microalgae that play an important role in aquatic ecosystems. Their occurrence provides information on environmental conditions such as pH, conductivity, assessment of water quality, trophic status of water bodies and also baseline data for future environmental monitoring studies. In the aquatic environment desmids can also make a considerable part of the unicellular algal biomass and it is likely important as a food source for various aquatic fauna.

Genus *Euastrum* had been reported for the first time from Britain (Ralfs,1848) This is one of the placoderm desmids, belonging to family Desmideaceae order Zygnematales, in the class Chlorophyceae. Cells of *Euastrum* are found in variable size, longer than broad, compressed, deeply constricted, sinus generally linear with dilated extremity, rarely open, semi-cells usually truncate pyramidate, apex with shallow and broad or deep and narrow. Cell wall with or without hemi-spherical and variously disposed protuberances, smooth, punctuate or granulate, sometimes with spines on the outer margin, top view generally elliptic with rounded angles.

During the course of present investigation on the occurrence of genus *Euastrum* from Chhattisgarh state. We found a total of 8 species i.e. *E. ansatum, E. ceylanicum, E.denticulatum, E. holoscerum, E. sinuosum, E. spinulosum, E. substellatum, E. quadriculatum*, and 2 varieties *E. sinuosum var. capitatum, E. spinulosum* var. bellum. These all taxa have been reported for the first time from Chhattisgarh state of India. Systematic enumeration, occurrence and diversity of *Euastrum* along with the microphotographs of taxa have been discussed in detail in the present communication.

Key words: Desmids, *Euastrum*, Diversity, Chhattisgarh, India

SII/P-40

Histochemical Apects of Pollinium Development in *Rhynchostylis retusa* Blume (Epidendreae, Orchidaceae)

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The anther wall comprises an epidermis, endothecium, three middle layers and glandular tapetum with uninucleate cells. Cytokinesis is simultaneous resulting in tetrahedral, isobilateral, linear, decussate tetrads held together to form pollinia. The pollinia are shed at 2-celled stage.

Total Insoluble polysaccharides, ascorbic acid (AA), cellulose, callose, RNA and total protein contents were localized histochemically during pollinia development in *Rhynchostylis retusa.* The early sporogenous cells are rich in RNA, proteins and moderate content of AA. The cell walls are cellulosic and callosic positive. The cells are devoid of PAS positive storage. The common wall around each group of late sporogenous cells and meiocytes reacts strongly for PAS, cellulose, callose, and also for AA. In the meiocytes RNA decreases in the cytoplasm but no such drastic decline in protein content is observed. Same concentration is continued to be present in the meiocytes until meiosis

completes. Subsequent to this a gradual increase of PAS, RNA and protein contents in the cytoplasm of microspores is noticed. In the 2-celled pollen, RNA, proteins. AA and PAS positive stain appear to increase. Pollen wall is PAS and AA positive, exine is not deposited around each pollen. However, the common wall around each group of pollen and also around the pollinia strongly reacts for cellulose and callose and exhibit green colour with azure B stain. The tapetum is secretory and reacts strongly for AA, RNA and proteins. At tetrad stage tapetum begins to degenerate and while degenerating also the tissue reacts strongly for RNA and proteins.

Key words: Pollinia, Histochemical, Cellulose, Callose, Sporogenous tissue, Endothecium

SII/P-41

Organogenesis from Immature Embryos of *Pinus wallichiana* A.B.Jackson (Blue Pine)

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The immature embryos of *Pinus wallichiana* were cultured on MS/LV media supplemented with various Phytohormonal regimes.Non- embryogenic friable callus formation was recorded on various BAP+Glutamine+casein hydrolysate/BAP+NAA fortified media.However,multiple shoot regeneration was observed on BAP(5µM)+ NAA(5µM) augmented half salt strength LV medium. In another experiment, multiple shoot regeneration was favoured on BAP (4.4µM)+Glutamine(500mg/l)+Casein hydrolysate(1000mg/l) fortified Half salt strength MS medium. Transfer of primary cultures bearing microshoots to basal media promoted shoot elongation. Rooting of invitro raised microshoots was achieved on MS(x1/2) +NAA(0.5µM)+IBA(15µM) combination.The deflasked plantlets were transferred to pots containing peat and vermiculite mixture for hardening.

Key words: *Pinus wallichiana*, Phytohormones, Shoot regeneration, Microshoots

SII/P-42

Impact of ONGCL Drilling Operation on Phytodiversity of Galekey and Sola Reserve Forest of Sivasagar District

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Sivasagar district one of the biologically worm area of upper Assam comprised with three subdivisions viz. Sivasagar, Nazira and Charideo. It lies between $94^0 8'$ and $95^0 4'$ East longitude and $26^0 7'$ and $27^0 2'$ North latitude. Seven reserve forests viz. Abhoypur, Sola, Sapekhati, Rangoli, Panidehing and Galekey reserve forests and more than 25 grazing land in the district. Sivasagar district falls under North East Biogeographic zone and Brahamputra valley endowed with luxuriant vegetation and rich in biodiversity. Abhoypur reserve forest is the transition area in between Assam- Nagaland and Assam-Arunachal Pradesh. Total area covered by the district is 1060 square Kilometer. ONGCL and Tea cultivation are the chief sources of employment opportunity and income generating industry. Rudrasagar, Galekey and Lakowa including other minor oil fields. Leakage of crude oil is a common phenomena in ONGCL operation areas. It has adverse effect on the rich diversity of forests. Moreover, by the GGS continuous burning of natural gas inside the reserve forest is a major threat to the biodiversity.

Soil degradation is also caused by leakage of crude oil, sludge and other chemicals. As a result of which soil health become unfavorable for growth of Phtyodiversity. Therefore an attempt has been made to asses the impact of drilling operations on the Phytodiversity of the area and their management.

Keywords: ONGCL, Phytodiversity, Sivasagar

SII/P-43

Diversity and Present Status of Medicinal Plants in and around Tehri Dam Hydroelectric Power Project in Garhwal Himalaya, India: Needs for Conservation

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The present study has been carried out in Tehri Dam Hydroelectric Power Project in Garhwal Himalaya, India, to document the medicinal uses of plants and their status of availability in the area. A list of plant species along with their local names, plant part(s) used and mode of administration in different ailments has been given which can be utilized in the future for technological advancement, economic prosperity and providing employment opportunity to the local people. A management plan for conservation of medicinal plants in the hydroelectric power project area is also suggested.

Key words: Medicinal Plants, Diversity, Tehri Dam, Conservation

Session SIII

Environmental Biotechnology

SIII/L-1

Genetically Modified Food Crop: Opportunities, Effects and Challenges

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SIII/L-2

Gene Expression Responses of Paper Birch to Elevated O_3 and CO_2 during Leaf Maturation and Senescence

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Forest trees are exposed to increasing concentrations of O_3 and CO_2 simultaneously. Long-term field experiments studying the effects of these greenhouse gases are essential especially for trees because of the differential responses of young saplings from mature trees and the acclimation of trees. Gene expression responses of paper birch (*Betula papyrifera*) leaves to elevated O_3 and CO_2 concentrations were studied with microarray analyses during leaf maturation and senescence at Aspen FACE experimental site, in Wisconsin, USA (http://aspenface.mtu.edu/). In order to detect similar gene expression patterns within samplings and treatments, the data was analyzed with multivariate methods; clustering with Self-Organizing Map, finding optimal cluster grouping by K-means clustering and visualizing the results with Sammon's mapping. Most of the alterations in the gene expression were caused by O_3, alone and in combination with elevated CO_2 concentration. O_3 reduced photosynthesis and carbon assimilation and induced defensive reactions to oxidative stress resulting in earlier leaf senescence. Transport and proteolysis gene expressions were activated, indicating that at least some remobilization of nutrients for storage was completed. The effects of elevated CO_2 reflected surplus of carbon that was directed to synthesis of secondary compounds. The combined CO_2+O_3 treatment resembled the O_3 treatment, indicating that elevated CO_2 is not able to totally alleviate the harmful effects of elevated O_3. Some specific gene expression changes in the combined elevated O_3+CO_2 treatment showed that experiments with O_3 or CO_2-exposure alone are not sufficient to predict plant responses to these gases together, and that field experiments with multiple variables are essential in order to understand responses to future environmental conditions.

Key words: *Betula papyrifera*, Elevated CO_2, Gene expression, Leaf senescence, Multivariate analyses, Ozone

SIII/L-3

Genomics of Plants' Responses and Adaptation to Global Climate Change and Air Pollution

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Unprecedented rapid global climate change and anthropogenic environmental pollution have become prominent driving forces of evolution in plant ecosystems and continue to subject our planet's plants to significant abiotic stresses. This can affect plants' fitness, adaptation, productivity and evolutionary potential. Northern boreal and temperate forest trees/ecosystems are considered to be the most vulnerable to global climate change. There is an urgent need to understand the genomic basis of responses and adaptation of plants/forest tree to climate change and air pollution in order to develop and use genetically improved plant varieties and to conserve and sustainably manage well-adapted, genetically diverse and healthy plant/forest genetic resources. We are using structural, functional and population genomics approaches to address this very important issue in economically and ecologically important North American boreal and temperate spruce (*Picea*) species. We have identified and mapped quantitative trait loci (QTLs) for growth, biomass allocation and water-use-efficiency traits in spruce grown under normal and drought conditions. We are identifying and mapping genes and QTLs for traits related to growth and adaptation to climate change in spruce grown under ambient and elevated CO_2 conditions. We have sequenced the transcriptomes of two spruce species grown under normal, elevated CO_2, drought and their combined conditions. Differentially expressed genes in response to elevated CO_2 and drought conditions and their relationships with physiological traits were discovered. Furthermore, signatures of recent selection driven by anthropogenic sulfate deposition on several candidate genes were identified in natural spruce populations. I will discuss how genomics research and applications can assist in understanding plants' responses and adaptation to climate change and air pollution by presenting highlights of our own spruce genomics work and its significance to other plant systems.

Key words: Transcriptome sequencing, Differential gene expression, Genome and QTL mapping, Selection signatures, Spruce, Climate change and air pollution

SIII/O-1

Arsenic in Rice: Recent Advances in Rice Genomics

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Arsenic is present commonly in subsoil and is a human carcinogen. Rice takes up arsenic and accumulates in different plant parts; including grains at levels several fold higher than the soil. In high arsenic regions, rice can contribute substantially to arsenic intake by human population. Arsenic in rice grains is present in the carcinogenic inorganic or relatively safer organic (methylated) form. A wide variation is noticed in different rice genotypes with respect to the proportion of arsenic in grains in these forms. Mechanisms involved in arsenic uptake, efflux from roots, loading into xylem, transport, partitioning, arsenate reduction, arsenic sequestration in vacuoles, volatilization from leaves, accumulation in grains etc. are poorly understood. Selection of low inorganic arsenic accumulating cultivars is an important trait to be used by breeders to develop rice varieties safer for cultivation in arsenic contaminated regions. Systematic efforts have not been made to screen rice genotypes for mining the genes involved in arsenic uptake, transport and accumulation in grains. Identification of rice germplasm with varying arsenic uptake and partitioning, and development of mapping populations with contrasting grain arsenic are required for association studies and QTL mapping for accelerating rice improvement. Efforts on gene expression profiling, deep transcriptome sequencing, high throughput metabolomics and phenotyping of contrasting arsenic accumulating lines need to be increased for developing strategies to design safer rice varieties. Network research projects need to be developed along these approaches to accelerate the development of crop varieties safer for farming in arsenic – contaminated environments.

Key words: Arsenic, Arsenic sequestration, Rice genomics

SIII/O-2

Apomictic Seed Formation in *Allium tuberosum* Rottl. ex Spreng. and its Possible Implications in Crop Improvement

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The state of India's food security is worsening day by day; key problem underlying being the extremely low productivity. To provide solution to this malady, hybrid varieties for important plant species are being produced and used regularly. Such varieties, though are generally more vigorous than the parents involved in their production, vigour tend to break after generations on account of sexual reproduction. Nevertheless, there exists the possibility for fixing hybrid vigour by harnessing apomixis.

Allium tuberosum, a major vegetable crop in south-east Asia, is known to set seed via apomixis. To fully understand the phenomenon of apomixis and for isolating highly apomictic lines, a progeny comprising of 32 plants was raised and studied for meiosis in female track. Meiotic division on the female side was peculiar in having two kinds of embryo sac mother cells (EMCs). While majority of EMCs had 64 chromosomes which paired to form 32 bivalents at metaphase I, a few cells had 32 chromosomes associating to form different configurations. Degree of diplospory was estimated as percentage of EMCs with double the zygoid number of chromosomes. Taking maximum frequency of octaploid cells as a criterion, five plants were selected as parents. Subsequent seed progenies were raised and analyzed for meiosis in female tack for two consecutive years. These studies led to isolation of two highly diplosporous lines. Besides, discovery of aneuploids from the seed progeny of plants with 2n= 32 chromosomes, detection of variants amongst the seed progeny of aneuploids and RAPD analyses pointed towards the facultative nature of apomixis. In addition to these findings, possible implications of apomixis in crop improvement will be highlighted during the presentation.

Key words: Apomixis, *Allium tuberosum* Rottl. ex Spreng., Aneuploidy, Diplospory

SIII/O-3

Deciphering the Transcriptome of Drought Tolerant and Susceptible Tea Plants using Suppression Subtractive Hybridization

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Tea *(Camellia sinensis),* the 2nd most popular beverage in the world next to water and one of the most important cash crop of India. Its cultivation and production is limited by a number of biotic and abiotic factors. Drought is one of the most prominent abiotic stress that limits the tea productivity both in terms of quality and quantity upto 40%. Although drought has been extensively studied, the details of molecular mechanisms regulating response of plant genes to drought stress remains to be discovered.

We have used a SSH approach in order to compare the transcript profiles of drought tolerant and susceptible tea plants. Two SSH libraries (forward and reverse) were constructed from leaf tissues collected from drought tolerant and susceptible tea cultivars under artificial induced drought conditions.

A total of 5250 recombinant colonies were randomly picked up and sequenced. More than 40% of these include transcripts that had previously been reported in the public database as responsive to drought and other abiotic and biotic stresses in other plants and tea as well. The rest 60% include proteins previously identified as putative or hypothetical (40%) and with no nucleotide or substantial protein homologies (20%).

While comparing the transcripts of drought tolerant and susceptible tea cultivars under mild and severe drought conditions by RT-PCR we have identified several transcripts showing many fold up-regulation or down-regulation in drought tolerant cultivar as compared to susceptible one.

Important among them are Glutathione peroxidase, DNA J, Elicitor responsive gene 3, Ethylene induced esterase, Cinnamoyl CoA reductase, Aquaporins etc. We hypothesize that these drought induced upregulated genes may be involved in water stress signalling pathways and could contribute to water stress tolerance in tea plants.

A substantial number of transcripts which has no significant protein homology in the public database or identified as putative may also play an important role in drought tolerance. Therefore, it is important to monitor their expression and get their corresponding full length genes to analyze precise functions during drought stress which will enrich our understanding of molecular mechanism of water stress tolerance and help devise strategies to develop water stress tolerant tea.

Key words: *Camellia sinensis*, Drought, Suppression subtractive hybridization, Transcriptome

SIII/O-4

Comprehensive Structural and Expression Analyses of Rice Sulphate Transporter Gene Family during Stress

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Sulphur, an essential nutrient required for plant growth and development, is mainly taken up by the plants as inorganic sulphate from the soil and assimilated into sulphur reductive pathway. The uptake and transport of sulphate in plants is carried out by transporters encoded by sulphate transporter gene family. Plant sulphate transporters have been classified with respect to their protein sequences, kinetic properties and tissue-specific localization in *Arabidopsis*. Though sulphate transporter genes from few other plants have also been characterized, no detailed study with respect to structure and expression of this family from rice has been carried out. Here, we present genome-wide identification, structural and expression analyses of rice sulphate transporter gene family. Our analysis using microarray data and MPSS database suggests that fourteen rice sulphate transporters are differentially expressed during growth and development, in various tissues and during biotic and abiotic stresses. We have also studied expression of this gene family in response to different sulphate concentration and heavy metal stresses. Results suggest that members of this gene family are differentially regulated with varying sulphate concentrations. Our analysis also suggests that apart from transcriptional regulation, an unusual alternative splicing of one of the member of this family, OsSultr1;1 takes place with respect to sulphur demand and stress conditions.

Key words: Alternative splicing, Biotic and abiotic stress, Gene expression, Rice, Sulphate transporter gene family

SIII/O-5

Involvement of OsNRAMP6 in Intracellular Heavy Metal Trafficking in Rice

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Natural Resistance Associated Macrophage Proteins (NRAMPs) are membrane spanning integral proteins found in both prokaryotes and eukaryotes. Foremost functions of NRAMPs are assigned in iron translocation in mammals during invasion of pathogens. In general, NRAMP proteins are considered as wide range transporters, involved in acquisition of essential metals (Fe, Mn, Zn and Ni) required for optimal growth and development of plants. Besides these metals, some heavy metals like Cd are also shown to be transported via NRAMPs. Though different members of NRAMPs have been characterized from Arabidopsis, very little efforts have been made to elucidate their role in rice. In this study, through expression in Arabidopsis, yeast mutant (*fet3fet4*) as well as complementation of Arabidopsis mutants (*nramp3:nramp4*), we demonstrate that one member of rice NRAMP family, OsNRAMP6, plays role in Fe as well as heavy metal transport. Complementation of *fet3fet4* yeast mutant defective to high affinity iron transport (IRT) system by OsNRAMP6 rescued iron uptake by mutant. Transformation of Arabidopsis mutant by OsNRAMP6 restored the ability to survive at low iron availability of knockout double mutants (*nramp3:nramp4*) of Arabidopsis suggesting that OsNRAMP6 might be an integral component of iron transport. The heterologous expression of *OsNramp6* into Arabidopsis conferred tolerance and enhanced accumulation of arsenic and cadmium into root and shoot tissue of transgenic lines. Together, our results suggest that OsNRAMP6 helps in iron as well as heavy metal transport in rice.

Key words: NRAMP6, Arabidopsis mutant, Cadmium, Arsenic, Yeast mutant

SIII/O-6

Molecular Characterization of Mango Hybrids using STMS Primer

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The mango (*Mangifera indica* L.) belonging to family Anacardiaceae is called as "the king of fruit" for its excellent taste and flavour and is one of the most popular and choicest fruit of India so called the "National Fruit of India". The mango is native to southern Asia, especially Burma and eastern India. It spread early on the Malaysia eastern Asia and eastern Africa.

Mango has been cultivated for more than 4000 years and a wide genetic diversity, exists in this crop in the sub continent. Allopolyploidy (2n=40), outbreeding and wide range of agroclimatic condition prevailing in this country continue to contribute to the genetic diversity of this crop, In addition there has been wide spread hybridization leading to recombination of character in mango over the thousand years

of its cultivation and domestication the wide genetic diversity of the plant has been fixed in many verities.

Twenty one hybrid varieties of mango and their respective parent landraces Amrapali, Vanraj and Janardan Pasand which are maintained at Central Institute of Subtropical Horticulture, Lucknow, have been selected for the present study and used for analysis. Total genomic DNA was isolated from above mentioned plants.

Genomic DNA was isolated from all the mango hybrids and their parents taken for the study using CTAB method. After isolation of genomic DNA, it was purified further by RNase treatment followed by chloroform isoamyl extraction as described in materials and method. The quality and quantity of isolated genomic DNA were estimated by UV Spectrophotometery as well as Argose gel electrophoresis. All the DNA showed absorption ratio at A_{260}/A_{280} ratio between 1.8:2.2. These spectrophotometeric readings confirms that total yield of genomic DNA isolated were sufficient for PCR analysis. The isolated DNA was electrophoresed through 0.8% Agarose gel and after electrophoresis gel was stained with ethidium bromide. High molecular weight DNA with minimal shearing confirms that isolated DNA was of good quality for PCR analysis.

The above twenty one hybrid progeny and their respective parents were also considered for STMS profile resolution. 14 STMS primers were screen out of which 5 primers give the best results in terms of allelic variation. The 5 primers yielded heteromorphic profile for parents versus hybrids. 5 out of 14 primers (37%) showed stable polymorphism. Of all the primers HMID 04 and HMID 019 produced highly polymorphic patterns yielding 4 bands among hybrids and parents. As these primers are polymorphic, hence they can be selected as critical primers for fingerprinting hybrid combinations and their parental lines. This fingerprinting could be used in variety authentication, protection through pedigree analysis and linkage analysis for various traits.

5 primers have been selected as effective set of markers for detecting hybridity at 5 loci. Based on complementary banding patterns between hybrids and parents, feasible methods can be developed to monitor hybridity in generated hybrids. The present study was able to differentiate true hybrids as opposed to self or open pollination progeny. As mango hybridization is laborious and hybrid confirmation cannot be done by morphological markers, thus molecular tools are important for hybridity testing.

Key words: STMS primer, Mango, Hybrids, CTAB method

SIII/O-7

Cloning and Expression of Artificial Genes Encoding Synthetic Phytochelatins (ECs) in Plants

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Metallothioneins (MTs) and phytochelatins (PCs) are two classes of naturally occurring, cysteine-rich products that are synthesized for binding a wide range of heavy metals. PCs, with the general structure $(Glu–Cys)_{2-11}$–Gly, are synthesized enzymatically from reduced glutathione (GSH) by phytochelatin synthase. Overexpression of *phytochelatin synthase* has been attempted by different groups to develop transgenic plants for phytoremediation. This led to enhanced synthesis of PCs but phenotypes of plants were contrasting, ranging from enhanced metal tolerance and accumulation to hypersensitivity. These paradoxes have been linked to limitation of glutathione for PC biosynthesis and other growth related parameters. As PCs are small peptides, analogs for these can be synthesized through artificial gene, which might serve the same purpose as PCs. These synthetic PCs encoded by artificial genes denoted as EC will differ on the basis of peptide bond between the amino acids. In this study, we present synthesis of three artificial genes encoding synthetic EC_{14}, EC_{16}, EC_{20} and analysis of transgenic plants expressing these genes. We developed artificial genes by designing overlapping forward and reverse primers depending on length of desired gene and amplifying it through PCR. PCR fragments were cloned, sequenced and used for developing constructs for plant transformation. These constructs carrying artificial genes under CaMV35S promoter were transformed into tobacco. Transgenic lines expressing artificial genes exhibited growth retardation which was inversely parallel to length of synthetic EC. Transgenic lines were grown in hydroponics system in the presence of different heavy metals. Responses of transgenic lines to different heavy metals will be discussed during the meeting.

Key words: Artificial gene, Synthetic phytochelatins, Transgenic tobacco, Heavy metals

SIII/O-8

Molecular Genetic Diversity in Sugarcane

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Genetic gain in any crop plant depends on the use of genetically diverse parents in the pedigree during breeding. Furthermore, measuring the genetic variability within gene pool of elite breeding material could make crop improvement more efficient by the directed accumulation of favorable alleles. Conventionally, the identification of genetically distinct genotypes is accomplished by using morphological characteristics. With the availability of large number of DNA marker techniques in many crops, the morphological characteristics are supplemented with the molecular markers. These DNA markers not only have better genomic coverage, which is essentially required for diversity analyses, but also provide more reliable genetic estimates. Among the available DNA markers, simple sequence repeats (SSR)/ microsatellite markers are considered one of the most

popular genetic markers for mapping and population genetics. In the present study 30 sugarcane cultivars/genotypes including interspecific hybrids and some basic species of *Saccharum* were fingerprinted using 32 SSR markers. Out of the 32 SSR primers, 7 were monomorphic generating one allele each and the rest were polymorphic (78.1%). The number of alleles detected by the polymorphic loci varied from 2-7 with an average of 3.46 alleles/locus. The polymorphism information content ranged from 0.120 to 0.623 with an average of 0.315. The average genetic diversity for all possible 435 pairs of genotypes was 42.6 % with a range of 12.7 % and 66.7%. Analysis of molecular variance was performed by grouping the populations differing in response to red rot. AMOVA did not show much variation among the groups. Dendrogram prepared on the basis of presence or absence of amplified alleles using UPGMA method clearly distinguished all the genotypes from each other. The two accessions namely SES594 and ISH150, which are resistant to red rot, emerged out to be most distinct genotypes whereas the rest of the genotypes could be grouped in two broad clusters. Clustering pattern was highly supported by Mantel's test (r = 0.947) and high bootstrap value (71.0 %). The results indicated that the genotypes ISH150 and SES 594 would be potential germplasm resource for broadening the genetic base of cultivated sugarcane for red rot.

Key word: Genetic diversity, PIC, SSR marker, ***Saccharum,*** UPGMA

SIII/O-9

Occurrence of Microcystin Producing *Nostoc*, a Toxic Cyanobacterium from India

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Microcystin (MC) is the most prevalent cyanotoxin with more than 70 congeners. We, for the first time have identified and isolated a microcystin producing *Nostoc* sp. from India. The cyanobacterium *Nostoc* was isolated from the agricultural pond of Banaras Hindu University campus. Morphological and molecular characterization using 16S RNA sequence analysis established it as a new strain *Nostoc* sp. BHU001. Toxin profile of *Nostoc* sp. BHU001 was developed using MALDI-TOF MS, HPLC and LC-MS analyses. The cyanobacterium produces more than ten peptides including five MC variants; MC-LR, -WR, -AR, -LA and methylated MC-LR, and a new peptide similar to cyanopeptolin. Total microcystin content was quantified by ELISA, and it was 28.3 µg g^{-1} dry wt of the cyanobacterium, 9.8 µg L^{-1} of the spent medium and 5.5 µg L^{-1} of pond water. Allelopathic interaction of *MC-LR* was checked on six cyanobacteria, i.e., *Nostoc muscorum, Nostoc commune, Nostoc* 7120, *Anabaena fertilissima*, *Anabaena doliolum*, and *Cylinderospermum majus*. MC-LR inhibited the growth of all the strains except its producer. Growth inhibition was maximal in the case of *A. fertilissima* and minimal for *C. majus.* However, MC-LR has stimulatory effect on the growth of its producer. MC-LR at a concentration of 50 µg L^{-1} was the most effective and has significant ($p<0.001$) inhibitory effect on the vital biological pathways such as nitrogenase activity, respiration, and photosynthesis of *A. fertilissima.* All the components (PSI, whole chain and PSII) of electron transport system were affected. Maximal inhibition was observed for PSI, followed by whole chain and PSII, indicating dose and time dependent inhibition of the processes. MC-LR also appeared to produce energy constrain (ATP) resulting in overall inhibition of cyanobacterial growth.

Key words: Cyanotoxin, Toxin profile, Microcystin, Allelopathic interactions, Growth inhibition

SIII/O-10

Genome Characterization and Single Nucleotide Polymorphisms (SNPs) Discovery through the Reduced Representation of the Genome of *Jatropha curcas* on High Throughput Sequencing Platform

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The increased demand of *J. curcas* as a biofuel requires further improvement of this crop, which has been tremendously advanced by the application of high throughput molecular markers. Molecular markers are used for understanding the genome dynamics as well as applied aspects of crop breeding. Several next-generation sequencing (NGS) technologies and high throughput marker technologies have emerged as powerful tool for understanding genome variation in crop species at DNA, RNA and protein level. The massively parallel pyrsoquencing technology, commercialized by 454 life technologies has been successfully employed on the complexity reduced genome of *J. curcas*. This principle of the genomic complexity reduction was followed for genome characterization and maximum single nucleotide polymorphism (SNP) discovery. SNPs are the single base differences between haplotypes. Secondly, SNP-based markers provide allele-specific variations among the genotypes which will be further helpful in the marker assisted selection programme.

Complexity reduced genomic DNA was sequenced on the 454 GS-FLX sequencer (Roche, Basel, Switzerland). A total of 2,482 candidate SNPs were identified out of a total of 871 contigs, at an average frequency of 1 SNP per 100 bp. The candidate SNPs were categorized according to the nucleotide substitutions as either transitions (C/T or A/G) or transversions (A/C, C/G, A/T, G/T). There was a relative increase in the proportion of transitions (70.54%) over transversions (29.54%). A total of 757 insertion/deletions (indels) were observed. Since there are 4 types of transitions (T_s) and 8 types of transversions (T_v), the expected ratio of transition and transversion (T_s/T_v) is 0.5. The (T_s/T_v) ratio for *J. curcas* was calculated to be 2.3. This indicated that, a transition bias existed in the analysed sequence data of *J.*

curcas genome. This may be due to methylated cytosines in CpG dinucleotides changed into thymines during the genesis of the SNPs. A similar abundance of SNPs has been reported in Maize. The present study revealed that the frequency of InDels was much lower than that of SNPs. These results suggest that, for fine mapping of a gene in *J. curcas* the use of SNPs rather than InDels as markers appear to be a good choice.

Key words: *Jatropha curcas*, Biofuel, Molecular marker, Single nucleotide polymorphism

SIII/P-1

Role of Sterol Glycosyltransferase Gene Family under Abiotic Stress

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Sterol glycosyltransferases (SGTs) are enzymes involved in sterol modifications and play important role in metabolic plasticity during adaptive responses, changed sensitivity to stress hormones and changed tolerance to biotic and abiotic stresses. *Arabidopsis thaliana* contains two genes, UGT80A2 and UGT80B1, that encode UDP-Glc:sterol glycosyltransferases, enzymes that catalyze the synthesis of SGs. Lines having mutations in UGT80A2 (At3g07020) and UGT80B1(At1g43620) were characterized. The UGT80A2 lines were viable and exhibited relatively minor effects on plant growth. On the contrary, UGT80B1 mutants displayed an array of phenotypes that were pronounced in the embryo and seed. The sterol content of plant membranes has been observed to change in response to environmental conditions and it has been suggested that alterations in the sterol composition of the plasma membrane may play a role in the cold acclimation process. Moreover, gene expression data from available microarray experiments suggested that UGT80B1 (At1g43620) transcripts are 5 fold and 3.4 folds up-regulated by 24h of cold stress in shoots and roots, respectively. The mutants described here provided an opportunity to test this hypothesis with respect to SG and ASG. We investigated the adaptive response to temperature stress but were unable to detect a significant difference between mutants and wild type. Thus, although sterol content of membranes in *Arabidopsis* was modulated in part by SG and ASG synthesis, loss of these membrane components did not appear to adversely affect growth or viability at low temperatures. The slightly reduced growth rate of the mutants at all temperatures indicates that SGs are important for growth and development, as might be expected from their widespread presence in plants. However, this role appears to be beneficial rather than crucial.

Key words: Adaptive responses, Plasma membrane, Sterol modification

SIII/P-2

Cloning and Characterization of *Salt Overly Sensitive 1* (*Sbsos1*) Gene from *Salicornia brachiata* Roxb. and its Differential Expression under Salt Stress

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The *Salt Overly Sensitive 1* (*SOS1*) gene encodes a plasma membrane Na^+/H^+ antiporter that plays an important role in germination and growth of plants in saline environment. Here, we report the cloning and characterization of *SOS1* gene from *Salicornia brachiata*, an extreme halophyte. The ***SbSOS1*** gene is 3774 bp long, and contains 90 bp 3' UTR region, 204 bp 5' UTR region and 3480 bp ORF which encodes a 1159 amino acids protein with an estimated molecular mass of 128.4 kDa and isoelectric point of 6.24. The predicted protein sequence aligns closely with *SOS1* homologs of *Suaeda japonica*, *Mesembryanthemum crystallinum*, *Chenopodium quinoa,* and *Populus euphratica*. The ***SbSOS1*** protein contains two putative domains, a Nhap cation-antiporter and a cyclic-nucleotide binding domain. Real Time PCR based expression profile of *SbSOS1* gene confirmed that it plays key role to combat the salinity. The constitutive expression of *SbSOS1* is significantly 4.5 times higher in root tissue as compared to shoot tissue. *SbSOS1* expression increases 7.4 folds in root tissue at 100 mM NaCl, thereafter it remains constant up to 2.0 M. In shoot tissue increase range is 1.5 to 4 folds with increasing NaCl concentration. The functional characterization of *SbSOS1* gene is being tested by transgenic approaches.

Key words: Na^+/H^+ antiporter, *Salicornia brachiata*, Nhap cation-antiporter domain, Cyclic-nucleotide binding domain, Real Time PCR

SIII/P-3

Isolation, Characterization and Heterologous Expression of a Type-2 Metallothionein Gene *Sbmt2* from an Extreme Halophyte *Salicornia brachiata*

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Metallothioneins (MTs) are cysteine-rich polypeptides that are involved in metal detoxification and homeostasis in both prokaryotes and eukaryotes. MT gene was isolated through 5' RACE from EST database generated at CSMCRI Bhavnagar. *In silico* analysis reveals that *SbMT* gene belongs to the class II, type-2 metallothionein-like genes. The *SbMT2* gene is 421 bp long, and contains 237 bp ORF region encoding 78 amino acids protein with an estimated molecular mass of 8.5 KDa. For expression analysis, *SbMT2* gene was cloned into bacterial expression vector PGEX6p-3. The SbMT2 protein was purified, analysed on SDS-PAGE and further confirmed by MALDI-TOF-TOF. BL21(DE3) cells transformed with *SbMT2* gene

showed tolerance to 0.5 mM $ZnSO_4$ and 1.0 mM $CuSO_4$, but not significant to 0.5 mM $CdSO_4$ as compared to PGEX6p-3 vector only.

Key words: Metallothioneins, Metal detoxification, GST, SDS-PAGE, MALDI-TOF-TOF

SIII/P-4

Optimization of Protein Extraction by Aqueous Two-Phase System (ATPS) using Response Surface Methodology (RSM)

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Aqueous two phase systems (ATPS) have been reported in literature to be a successful technique for separation, concentration and purification of protein and pharmaceutical products. This work will attempt to study and optimize ATPS made of polymer/salt systems. Five factors, polymer molecular weight, polymer concentration, pH, salt concentration and phase forming salt which affect the protein partition will be studied. A two level fractional factorial will be initially carried out. An effective statistical design is the basis for response surface optimization and the reported designs include central composite design and which is the most popular among RSM designs and has the characteristics of orthogonality, uniform precision and rotatability. However, the performance of the better polymer/salt studies will be carried out using central composite rotatable design (CCRD) in Response Surface Methodology (RSM). The validity of the response model will be verified by comparing the predicted and experimental results. The optimal condition giving max "K" value for protein partitioning will be determined.

Key words: Aqueous two-phase systems, Composite rotatable design, Response surface methodology

SIII/P-5

Physicochemical Analysis and Evaluation of Genotoxic Potential of an Agricultural Soil Sample of Nangli Village of Amritsar

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Nowadays, the problem of soil pollution is increasing at alarming rates not only in developed countries but in developing countries as well. A number of genotoxic compounds have been discharged on to the lands which directly or indirectly find their way into various biological systems including the human beings. Upon reaching the human systems, these pollutants can not only cause direct toxicity but can also potentially damage to the gene pool. Keeping this in mind, the present study was planned to evaluate the genotoxic potential of an agricultural soil sample collected from Nangli village of Amritsar employing *Allium cepa* root chromosomal aberration assay (*Al*RCAA). Two types of treatments *viz. i*n *situ* and root dip treatment were followed. *In situ* conditions were simulated by allowing the bulbs directly into the soil contained in small pots whereas for root dip treatment, onions were allowed to root in different concentrations (100, 80, 60, 40 and 20%) of the soil extract (1:2, w/v; soil: water). After the roots germinated to approximately 1 cm, the root tips were washed, cut and fixed in Farmer's fluid (3 : 1 :: ethanol : acetic acid glacial). The root tips were squashed in aceto orcein to prepare slides and slides were observed for various types of chromosomal aberrations. Both the treatments resulted in different types of aberrations like Laggards, vagrants, c-mitosis, delayed anaphase, stickiness (physiological aberrations) and chromosomal breaks, chromatin bridges (Clastogenic aberrations). Among the two types of treatment studied, root dip treatment was found to be more effective producing 12.7 % of total aberrant cells at highest concentration (100%) as compared to *in situ* treatment where maximum of 12.03 % cells showed chromosomal aberrations. For physico-chemical analysis, soil extract was prepared in 1:5 ratio (soil: distilled water : w/v). Various physico-chemical parameters *viz*. pH, alkalinity, soil texture, calcium, magnesium, nitrate, phosphate, potassium and sodium content were analyzed.

Key words: Soil pollution, Physicochemical analysis, Pollutants, Genotoxicity, Allium cepa

SIII/P-6

Assessment of Genotoxicity of Soil of an Agricultural Field (Verka Block) of Amritsar, Punjab

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Many chemicals in both particulate and gas phase are directly or indirectly released into the environment due to different industrial, domestic and agricultural activities. Soil acts as a fundamental material for agricultural production. Various chemical fertilizers and pesticides are applied to the agricultural fields to increase yield and control various pests and diseases. Due to their excessive use, pollution of agricultural areas is becoming a global problem. Keeping this in mind, the present study was conducted to evaluate the genotoxic potential of soil of an agricultural field (Verka Block) of Amritsar, India by employing *Allium cepa* root chromosomal aberration assay. The soil sample was extracted by using distilled water (soil: water, 1:2 w/v). The soil extract was filtered through Whatman filter paper no.1 and different concentrations (20, 40, 60, 80 & 100%) of the extract were prepared for treatment of root tips of *A. cepa* for 3 hrs. Treatment of *A. cepa* roots with different concentrations of soil extract resulted in dose dependent decrease in MI (Mitotic index) and induction of different types of chromosomal aberrations. The spectrum of chromosomal aberrations included C-mitosis, delayed anaphase/s, stickiness, laggard/s, vagrant/s, chromatin bridge/s and chromosomal break/s.

Key words: Genotoxicity, Pesticides, Soil contamination, Root dip

treatment, *Allium cepa* root chromosomal aberration assay

SIII/P-7

α-Amylase from Soybean Seeds: A Potential Enzyme for Use in Detergent Industries

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Industrial applications of enzymes have been receiving attention throughout the world. One of these industrially applicable enzymes are α-amylases having enormous potential for commercial applications as for e.g. in textile, pharmaceutical, food and beverage industries, etc. Nowadays, an expanding area in the application of α-amylases is in improving the performance of enzymatic liquid detergents, being the second important group of enzymes after proteases used for the purpose. However, the use of α-amylases in detergent formulations is problematic since the enzyme usually does not offer stability and an optimal level of activity in commercially utilized formulations due to the presence of various metal ions, metal ion chelating agents, surfactants, etc. Moreover, the inability of the enzyme to resist the working temperature employed is another important factor.

It was found that α-amylase extracted from soybean seeds and purified to homogeneity (by affinity precipitation with 84% recovery and 20-fold purification) showed an optimum temperature of 75^{0}C, being thermally stable at this temperature for hours. The enzyme showed good residual activity even in the presence of metal ions like Al^{3+}, Cu^{2+}, $Ni^{2+}$and Cd^{2+} (at a concentration of 5 mM). The enzyme maintained more than 80% residual activity in the presence of the chelating agent EDTA (12.5 mM). The surfactant SDS also didn't show any inhibitory effect on enzyme activity. Thus, the enzyme's good thermostability and resistance to the effects of various metal ions, chelating agents as well as surfactants makes it advantageous for its economical application in detergent industry

Key words: α-amylase, Soybean, Thermostability, Surfactant, Chelating agent

SIII/P-8

Efficacy of *Jatropha curcus* Leaf Extracts against Termite

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Crude aqueous, ether, butanol and hexane extracts of *Jatropha curcas* leaves were tested against termites (*Odontotermes obesus*) in laboratory conditions. Cold aqueous extract was prepared by shaking the Jatropha leaves in water for 6 hours whereas to get hot water leaf extract, the leaves were boiled in distilled water for 30 minutes. Three different concentrations (1, 5 and 10 %) of water extracts were tested for mortality of termites. Ether, butanol and hexane crude extracts of Jatropha leaves were obtained by using soxhlet extraction method. The yield of crude extract in ether, butanol and hexane was found to be 7, 12.4 and 15.6% respectively. Termite mortality experiments were done under controlled conditions (28^0 C temperature and 80% relative humidity) for 48 hours and mortality percentage were recorded. Maximum mortality (73%) of termites was observed with 0.35 g/ml ether extract followed by 0.39 g/ml butanol extract (67%) and 0.62 g/ml hexane extract (60%) after 48 hours. Aqueous extracts were not very effective against termites. However, hot water extract (27% mortality) was found to be better than cold water extract (20%). Present study suggests that Jatropha plant could be an economic, effective and safe biopesticide. However its efficacy can further be improved to achieve 100% termite mortality within a short period with some other botanicals or chemical additives.

Key words: *Jatropha curcas,* Termite, *Odontotermes obesus,* Mortality, Extract

SIII/P-9

Statistical Optimization of Production Parameters for Endoglucanase by *Trichoderma ressei* Rut C-30 Employing Agro-Residue

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Response surface methodology (RSM) involving central composite design (CCD) was employed to optimize the physico-chemical parameters for the production of endoglucanase by *Trichoderma ressei* Rut C-30 under solid state fermentation using a novel mixture of waste paper and wheat bran. Most effective variables for the endoglucanase production in screening experiments were incubation day, substrate ratio, solid: liquid ratio and pH of the medium. A quadratic model was developed through RSM in terms of related independent variables to maximize the endoglucanase production as the response. Incubation day and solid: liquid ratio were found to be the most significant factors. The predicted optimal parameters were tested in the laboratory and the final endoglucanase activity obtained was very close to the predicted value (22.93 IU/g, predicted; 25.43 IU/g, tested). After the optimization, endoglucanase activity increased by ~1.77 folds. Our result shows that optimization of enzyme production is the most useful way to obtain concentrated enzyme extracts from solid state cultivation and that *T. ressei* Rut C-30 using cheap agro-residue can be an attractive source for endoglucanase production.

Key words: Endoglucanase, Response surface methodology, Solid-state fermentation, *Trichoderma reesei* Rut C-30, Agro-residue

SIII/P-10

Screening of Potential Gallic acid - Equivalent Allelochemicals from Various Plant Part Leachates

of *Jatropha curcas* Effective against *Vigna mungo* Seedlings

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For exploring active allelopathic compounds, dried roots and leaves of *J.curcas* were soxhlet extracted followed by screening and identification of compounds by HPLC. Gallic acid (GA) with some unknown compounds was recorded in all the samples with highest amount in roots. For confirming potent allelochemical, effect of GA (0.25-1.0mM) on the test crop *V. mungo* var. PU-35 was tested along with laboratory bioassays for assessing the allelopathic effect of 1-10% rhizospheric soil leachate, fruit shell leachate and senescent leaf litter leachate of *Jatropha curcas* (L.) (JRSL, JFSL and JLL respectively), on germination, seedling growth, vigour index, germination speed, root shoot length and chlorophyll content of the test crop *Vigna mungo* var. PU-35 were carried out. Germination % and germination speed were recorded to decrease under all concentrations of JFSL, JRSL and JLL expect 1-2% JLL where germination % increased compared to distilled water treated control sets. Root length and vigour index were observed to increase in JFSL and JLL but decrease under JRSL. Chl. a, Chl. b and total chlorophyll decreased under all treatments of JRSL and increased under all concentrations of JLL while moderate effect was observed under JFSL treatment. % germination, root shoot length, vigour index, germination speed, chl. a, chl. b and total chlorophyll was found to decrease under all treatments of GA as well. The results of GA and JRSL resembled owing to the high concentration of GA in roots compared to fruit shell and senescent leaf of *J.curcas*. The negative effect of allelochemicals on *V.mungo* seedling growth was recorded to be in the order of GA>JRSL>JFSL>JLL.

Key words: Allelochemicals, Gallic acid, HPLC, *Jatropha curcas*, Leachate

SIII/P-11

To Study the Impact of Light Intensity on Biomass Production of *Spirulina* in Different Conditions

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The cost of protein rich food like pulses and animals products is escalating and deficiency of protein in diet is a common feature of Indian dietaries. In order to overcome the problem of protein malnutrition, alternative protein source were explored. Among various sources *Spirulina* was found to be one of the better alternatives. It has been dominating the world scenario because of its unconventional and renewable source of protein (60-70%) and other metabolites. *Spirulina* is an aquatic, photoautotrophic, multicellular and filamentous algae characterized by long tricomes with many spirals, short S-shaped tricomes and circularly coiled tricomes with a length of 300-500µ and a width of 80µ. Due to non toxic habit S*pirulina* mainly being utilized as a source of protein in food and feed. For solving the purpose of food and feed it is required to reproduce *Spirulina* at domestic level.

The *Spirulina* production system can be broadly divided into three phases i.e. culturing, harvesting and drying. Each of this process is important in the production of high quality *Spirulina.* The factors affecting the production of *Spirulina* have been the subject of extensive study. The culture of *Spirulina* is being affected by different factors i.e. nutrient component, pH, light intensity, temperature, culture depth, agitation. Light intensity is one of the most important factors because of photosynthetic nature of *Spirulina* for reproduction and multiplication. In the present study the maximum production was found in summer season due to favourable condition with the light intensity of 25-35 Klux where as the minimum production was found in rainy season due to warm humid climate this condition provides the bacterial contamination.

Spirulina has certain advantages over other best studied algae like *Chlorella*, *Scenedesmus* viz. its amenability to a low level of technology and to a system fully devoid to electrical energy input. A high protein content is still another important attribute of *Spirulina* that has got a PER (protein efficiency ratio) higher than other vegetables cereal protein and soya proteins.

Key words: Spirulina, Cynobacterium, Biomass production, Growth factors, Light intensity

SIII/P-12

Quantitative Characterization and Disease Progression of Gray Leaf Spot in a Susceptible Line in Forage Sorghum [*Sorghum bicolar* (L.) Moench]

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The parental materials including ICSV-700, CSV-17, IS-10284, IS-26866, BJ-248, Pantchari-5, 27-B, SPV-462, SPV-1616, HC-308 and PVK-809 were sown in RBD with three replications in February, 2008. The experiment was repeated in the rainy season of 2008. The observations were recorded on 5-10 competitive plants in each treatment in summer and rainy season on six characters. The statistical analysis for earlier trial was conducted in RBD whereas in the latter trial using, 't' test for difference in means. Results indicated that expression of quantitative traits was much better in summers as compared to rainy season. In summers Pantchari-5 could respond better than the check but in rainy season there was hardly a difference of any variety with the check. For no. of leaves two varieties IS-26866 and IS-10284 appeared to be better than the check in summer while in rainy season Pantchari-5 and ICSV-700 showed better performance than the check. For stem girth seven parents showed greater diameter but in rainy season only Pantchari-5 could repeat its performance excelling significantly the check, HC-308. BJ-248 and Pantchari-5 proved its superiority for dry stover percentage than the check in summer. Observations for incidence of gray leaf blight

disease (*Cercospora sorghi*) were recorded at weekly intervals. A variety, IS-10284, appeared to be highly susceptible. Ten randomly selected plants in variety IS-10284 were tagged in each plot for periodical observation. Gray leaf blight scoring was carried out on 0-5 rating scale and percent disease index (PDI) was calculated. Area under disease progress curve (AUDPC) and apparent infection rate (IR) was calculated for the entire disease progress period. The correlation and regression coefficients between PDI and different weather parameters were analyzed and multiple regression equations were fitted to work out combined effects of sets of different independent variables on PDI. The disease first initiated from lower leaves. The observation revealed that gray leaf blight initiated in the 3rd week of June and continuously progressed upto last week of July. The percent disease index (PDI) was 21.3 in 25 SMW and reached to maximum of 99.3 in 29 SMW. The maximum temperature 29.9°c and minimum 23.8°c, maximum relative humidity 93% and minimum relative humidity 29% along with 320mm rainfall was found favorable for disease initiation period. During entire disease progress period 25 SMW to 29 SMW the rainfall occurred with very low sunshine duration (1.1 to 4.1 hours) which appeared to be optimal for the gray leaf spot progress. The AUDPC value was 1825.2 which was very high indicating its high susceptibility to disease and prone to epiphytotic. Results of correlation coefficients indicated a negative correlation between PDI and rainfall (-0.81) and positive correlation between PDI and minimum temperature (0.92). This revealed a low to moderate rainfall and low temperature in summers at the initiation of rainy season stage appeared to be optimum for spread of the disease. On fitting a regression equation it could be evident that only two characters namely minimum temperature and minimum RH contributed substantially for increase of PDI.

Key words: Forage sorghum, Quantitative characterization, Disease

SIII/P-13

Role of Lichen in Weathering of Rocks

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A large number of microbial communities grow on rock surfaces and play active role in rock weathering. Most bacterial and fungi occur in associations in a biofilm on the rock surface. Lichen is a group of living organisms which have developed the capacity to cope with the hostile environment of extreme temperature and dehydration on barren rock surfaces. In this process lichen alters the rocks chemically and physically. We have studied different rocks with lichen growing on their surfaces using scanning electron microscopy (SEM) to observe the physical changes due to their growth. Specific pattern of alteration is found in most of the rocks with presence and penetration of hyphae inside rock pores in some cases. The surface of rocks becomes pitted and oxalate crystals were found scattered in most of the samples. The chemical changes caused by lichen growth on rock surface are under study. Iron shows signs of mobility due to lichen activity.

Key words: Biological weathering, Lichen, SEM, Hyphae

SIII/P-14

Evaluation of Antifeedant Effect of some Medicinal Plant Extracts against Tobacco Caterpillar, *Spodoptera litura* (Fab.)

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The use of conventional insecticides has raised some concern about their threat to the environment and development of insecticide resistance in insects. Therefore, there is an imperative need for the development of safer, alternative crop protectants such as botanical insecticides and antifeedants. Botanicals have long been touted as attractive alternatives to synthetic chemical insecticides for pest management because botanicals reputedly pose little threat to the environment or to human health. In the present study we report the antifeedant activity of petroleum ether extracts of three medicinal plants viz., *Jatropha curcas, Syzygium cumuni* and *Ocimum basilicum* at a concentration of 5 percent assessed against the seven day old larval of tobacco caterpillar *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae). All extracts exhibited a significant antifeedant activity. Maximum antifeedant activity and feeding inhibition activity was noticed with *Syzygium cumuni* (82.93% and 78.91% respectively) followed by *Ocimum basilicum* with antifeedant activity of 53.41% and 36.44% feeding inhibition. *Jatropha curcas* exhibited least antifeedant activity (49.10%) and feeding inhibition (32.54%) among the medicinal plant extracts tested. However all the three plants extract exerted a significant antifeedant activity over control.

Key words: Jatropha curcas, Syzygium cumuni, Ocimum basilicum, Spodoptera litura (Fab.)

SIII/P-15

Ethylamine Induced Tall Mutants in Jute (*Corchorus olitorius* L.)

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Presoaked seeds of jute (*Corchorus olitorius* L. Variety JRO-632) were treated with 1% Ethyl amine for 6 hours. Tall mutants were screened in M3 in contrast to the normal plants. Tall mutants otherwise looked normal excepting the nature of palmate leaf habit. A number of yield component growth parameters were recorded like plant height, basal diameter, plant spread, root length, pod per plant, seeds per pod, pod length/ breadth ratio, number of

primary branches per plant, number of secondary branches per plant, leaf angle, branching angle, first flowering date, 100% flowering date, total duration, % of pollen sterility and weight of 100 seeds which were found to vary from the control plant. Chromosome analysis revealed a number of aberrations like stickiness, fragmentation, clumping, polyploidy, and laggard and bridge formation etc. at very low frequency. This tall mutant plant gives more fiber yield than the control plants with superior quality.

Key words: Ethyl amine, *Corchorus olitorius* L., Tall mutant, 6 hours, Chromosome, Concentration 1%

SIII/P-16

Induced Palmate Leaf Mutant in Jute (*Corchorus olitorius* L. var. JRO-632)

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Presoaked seeds of jute (*Corchorus olitorius* L. var. JRO-632) were treated with 2% Ethylamine (EA) for 24 hours. Palmate leaf mutants were screened in M3 in contrast to the normal looking fruit plants. A number of yield component parameters were recorded including plant height, basal diameter, plant spread, root length, pod per plant, seeds per pod, pod length/breadth ratio, number of primary branches, number of secondary branches, leaf angle, branching angle, first flowering date, 100% flowering date, total duration, percentage of pollen sterility, and weight of 100 seeds which were found to vary from the control plant. Chromosome analysis revealed aberrations like stickiness, fragmentation, polyploidy, clumping, laggard and bridge formation etc. Multiple cropping has been possible with the availability of irrigation water and a number of early maturing varieties have introduced in case of various other crops. There should be a suitable palmate leaf mutants of jute also to be best fitted in the multiple cropping patterns. With this objective in view the work on induction of mutation with chemical mutagen Ethylamine (EA) was initiated.

Key words: *Corchorus olitorius* L., Chromosome, Palmate leaf mutants, Ethylamine, 24 hours concentration 2%

SIII/P-17

Functional Characterization of One of the Lambda Glutathione- S-transferase Gene from Rice

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Glutathione-S-transferases (GSTs) are the ubiquitous enzymes that are involved in plant growth and development as well as cellular detoxification mechanism by conjugating glutathione to endobiotic and xenobiotic compounds. GSTs are encoded by large gene families and are divided on the basis of sequence identity into phi, tau, theta, zeta and lambda classes. Although, different classes of GSTs have been functionally characterized in various plant species, not much information is available for lambda GSTs from rice. We have characterized one of the rice lambda GSTs, OsGSTL1, which is similar to intrinsic-like proteins (In2-1) and shows homology to human omega GSTs known to be involved in the biotransformation of arsenic in humans. Our analyses using microarray data suggest that OsGSTL1 is differentially expressed during growth and development, in various tissues and during biotic and abiotic stresses. The overexpression of OsGSTL1 in *Arabidopsis* showed slow germination rate, which was regained by supplementation of glutathione. Analysis of transgenic plants for elucidation of role of OsGSTL1 in metal response is underway and will be presented in the conference.

Key words: Glutathione-S-transferases**,** Gene expression; OsGSTL1, Rice

SIII/P-18

Ex situ conservation of Gardenia resinifera Roth. and Gardenia latifolia Ait.

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Gardenia resinifera Roth. and Gardenia latifolia Ait. are related to Rubiaceae family, which parades a long list of plants of medicinal importance. Present investigation was taken up to establish a protocol for mass production of better quality plant material, using nodal explants. The protocol will help in *ex situ* conservation of the plant. When MS medium supplemented with NAA (0.1 mg/l) maximum number of shoots (3) were observed in *Gardenia resinifera* and maximum number of shoots (2) were observed in *Gardenia latifolia*. After elongation, regenerated micro-shoots were rooted in MS + IAA (0.5 mg/l) in both species. The rooted plantlets showed 80% field survival.

Key words: *Ex situ, In vitro, Gardenia resinifera, Gardenia latifolia*

SIII/P-19

Genetic Transformation of Sugarcane with *Cry1Ab* Gene for Stalk Borer Resistance

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Sugarcane, a major industrial crop, is widely cultivated in tropical and subtropical countries for sugar and ethanol production. Insect pests constitute a major biotic stress for production and productivity of sugarcane. Among insect pests, stalk borer is a serious sugarcane pest in India whose endophytic lifestyle hampers effective chemical and biological controls. The genetic pool of sugarcane does not posses resistance to many diseases and pests. High ploidy, low fertility, large genome and complex environmental interactions make conventional breeding and genetic studies

arduous for this crop. Therefore, development of transgenic plants resistant to this pest is one of the alternative control methods. Genetic transformation through *Agrobacterium* is considered more efficient than biolistic method in sugarcane because *Agrobacterium* mediated transformation offers several advantages, such as technical simplicity, minimal genome rearrangements in transformants, low copy number and ability to transfer long stretches of DNA. In the present study *Agrobacterium* mediated genetic transformation was carried out using **e**mbryogenic calli of sugarcane cultivar CoLk 8102. *Agrobacterium* strain, EHA105 harboured a binary vector pCAMBIA3301 carrying *Cry1Ab*, bar as selectable marker and an intron containing *GUS* gene as a reporter marker in the T-DNA region. The transformants were put on selection pressure to remove chimeras. Transformation was confirmed by a histochemical GUS assay and PCR amplification of the *bar* and *Cry1Ab* gene. PCR amplification results showed successful integration of *Cry1Ab* gene in plant genome. Hardened transformed plants have been transferred in the earthen pots containing mixture of sand, vermicompost and soil (1:1:1) for their further evaluation and to measure the endotoxin protein expression.

Key words: *Agrobacterium, Cry1Ab* gene, Genetic transformation, *GUS,* Stalk borer, Sugarcane

SIII/P-20

Expression of *Ceratophyllum demersum* Phytochelatin Synthase (*CdPCS1*) in Tobacco Plants Leads to Increased Metal Accumulation

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Contamination of soil and water by toxic heavy metals constitutes a major environmental hazard to plants and animals. Plants respond to heavy metal toxicity in a variety of different ways. One general mechanism for heavy metal detoxification in plants is the chelation of the metal by cysteine-rich peptides such as phytochelatins (PCs) and metallothioneins (MTs) and subsequent compartmentalization of the ligand metal complex. The PCs is a family of peptides with the general structure $(\gamma Glu–Cys)_n$–Gly where n is in the range of 2–11. These are synthesized enzymatically from reduced glutathione (GSH) by *phytochelatin synthase*. Recently, phytochelatin synthase have been used to develop transgenic plants for phytoremediation, which resulted into contrasting plant phenotypes, ranging from enhanced metal tolerance to hypersensitivity. These differences in metal response have been linked to the gene used for plant transformation. Here, we present characterization of *phytochelatin synthase* gene (*CdPCS1*) from *Ceratophyllum demersum,* a rootless aquatic plant. Full-length *CdPCS1* of 1757 bps contain an open reading frame of 1506 bps encoding a polypeptide of 501 amino acid residues. The deduced polypeptide contains sequence elements typical for *phytochelatin synthase*, most of which are present at conserved position with respect to sequences of other plants. Expression of *CdPCS1* in *E. coli* provided heavy metal tolerance as measured by its growth. Transgenic tobacco plants have been developed after transformation of construct carrying *CdPCS1* under CaMV35 promoter. Transgenic lines expressing *CdPCS1* synthesize increased amount of PCs and accumulate more heavy metal than wild-type plants during cadmium and arsenic stress. Detailed data analysis of the transgenic lines will be presented in the conference.

Key words: *Ceratophyllum demersum*, Heavy metals, Phytochelatin synthase, Phytoremediation, Transgenic tobacco

SIII/P-21

Identification of Arsenic-responsive microRNAs (miRNAs) in Rice

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MicroRNAs (miRNAs) are novel class of short (21-24 nucleotides), single-stranded, endogenous non-coding small RNAs that hybridize with their target messenger RNAs (mRNAs) to repress their translation or induce their degradation in both plants and animals. Studies suggest that miRNAs mediated regulatory networks plays crucial role in controlling developmental morphogenesis and environmental adaptation to the plants. Recently, involvement of miRNAs has been suggested in heavy metal stress through sequencing of small RNA libraries of *Arabidopsis* and *Brassica* under cadmium stress. Since, arsenic contaminated groundwater for irrigation in rice fields has elevated its concentration in surface soil and eventually into rice plants and grains causing chronic and epidemic effects on human health, there is need to understand regulatory steps involved in arsenic transport and accumulation in rice. Here, we present identification of differentially expressed miRNAs during arsenic stress in rice for detection of arsenic-responsive miRNAs. We hybridized Affymetrix GeneChip® miRNA Array containing 7,815 probe sets from 71 organisms to RNA isolated from root tissue of arsenate (100 μM) and arsenite (25 μM) treated rice plants. Out of total 275 miRNAs of rice present on the chip, 95 miRNAs were differentially expressed during arsenic stress. Members of miR528 and miR444 families revealed significant up-regulation whereas of miR164, miR166, miR171and miR1432 families were down regulated in both arsenite and arsenate treatment. Nonetheless, members of miR156, miR820, miR169, miR396 and miR528 families were differentially responsive to arsenite and arsenate indicating a split mechanism of transport and tolerance to these forms of arsenic, inside plants. A detail expression analysis of these miRNAs and their targets during arsenic stress is underway.

Key words: Arsenic stress, Gene regulation, miRNA

SIII/P-22

Plasmid Mediated Transfer of Antibiotic Resistance and Heavy Metal Tolerance in Thermotolerant

Coliforms

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The antibiotic resistance pattern of 201 thermotolerant coliforms isolated from rural areas and their tolerance to heavy metals were studied. Most of the isolates showed resistance to one or more antibiotics tested and expressed tolerance to multiple metals. Twenty four Strains representing different resistance combinations were tested for plasmid transfer to an *Escheria coli* K-12 recipient strain. Plasmid transfer was detected in all 24 strains studied for conjugation. Among antimicrobials, bacitracin and ampicillin and among metals nicklel, copper, cadmium, cobalt, chromium and arsenic were transferred most frequently. Linked transfer of antibiotics and metals was demonstrated in 12 strains. Thirty three cultures of thermotolerant coliforms were studied for curing of R-plasmid using curing agent acridine orange. Among antibiotics, curing of resistance was observed for streptomycin, cephaloridine and kanamycin. Curing of resistance to heavy metals such as nickel, copper, mercury, chromium, copper and arsenic was also observed. The study revealed that the resistant traits are plasmid borne and are able to transfer their resistance to the sensitive strains.

Key words: Antimicrobials, Curing, Linked transfer, Plasmid transfer, Thermotolerant

SIII/P-23

Arsenic Affects Mineral Nutrients Status and Selenium Accumulation in Indian Rice (*Oryza sativa* L.) Genotypes grown on Arsenic-contaminated Soils of West Bengal

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The exposure of paddy fields to arsenic (As) through groundwater (GW) irrigation is a serious concern that may not only lead to As accumulation to unacceptable levels but also interfere with mineral nutrients status in rice grains. In the present field study, profiling of the mineral nutrients [iron (Fe), phosphorous (P), zinc (Zn) and selenium (Se)] was done in various rice genotypes with respect to As accumulation. A significant genotypic variation was observed in elemental retention on root iron plaque and their accumulation in various plant parts including grains, specific As uptake (SAU; 29-167 mg kg^{-1} dw) as well as As transfer factor (TF; 4-45%). Grains contains inorganic As species being the dominant forms. In all tested varieties, the level of Se was low (0.05-0.12 mg kg^{-1} dw), whereas that of As was high (0.4-1.68 mg kg^{-1} dw) also a negative correlation was observed between As and Se, considering their safe/recommended daily intake limits, which may not warrant their human consumption. Hence, their utilization may increase the risk of arsenicosis, when grown in As contaminated areas.

Key words: Arsenic, Mineral nutrients, Rice (*Oryza sativa*), Specific As uptake, Selenium

SIII/P-24

Arsenic Stress Activates MAP Kinase in Rice Roots and Leaves

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The toxic metalloid arsenite has become a potential threat to rice growing regions leading to serious contamination in food chain. In the present study effect of different physiological concentration of arsenite that is toxic and triggers the molecular events were evaluated in rice seedlings. Along with severe effect on the growth of rice seedling, production of reactive oxygen species (ROS) and nitric oxide (NO) in arsenite treated rice roots was also observed. Activation of a 42 kDa mitogen activated protein kinase (MAPK/MPK) by arsenite was observed in rice leaves and 42 and 44 kDa in roots in dose dependent manner. The activated MAPK could be immunoprecipitated with anti phospho tyrosine antibody, 4G10. The kinetic of MAPK activation by arsenite was found to be dose dependent. Transcript analysis of MAPK family in arsenite treated rice seedling revealed significant level of induction in *OsMPK3* transcripts in leaves and *OsMPK3, OsMPK4* transcripts in roots. Among MAPK kinase (MKKs) gene family, *OsMKK4* transcripts were found to be induced in arsenite treated rice leaves and roots. The data indicates that arsenite stress is transduced through MAPK signaling cascade in rice.

Key words: Arsenic, Mitogen activate protein kinase (MAPK), Nitric oxide, Reactive oxygen species, Rice

Session SIV

Plant Response to Environmental Pollution

SIV/L-1

Northern Forest Trees (Birch and Aspen) are Affected by Increasing Tropospheric Ozone and Warming Climate

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Northern forest trees are exposed to increasing load of oxidative stress, e.g. due to continuously increasing tropospheric ozone concentrations. Simultaneously, the forests are affected by climate warming, which is more intense in northern latitudes as compared to global means. The proportion of deciduous trees species, e.g. *Betula* and *Populus* sp. is expected to increase in northern forests with climate warming. Unfortunately, we have growing evidence that the vitality and the carbon sink strength of birch and aspen trees are weakened under chronic ozone stress. In this paper we present negative correlations of the main growth responses of Finnish birch (*Betula pendula, Betula pubescens*) and aspen species *Populus tremula* and *Populus tremuloides* x *P. tremula*) with ozone exposure. Data are derived from 23 different laboratory, open-top chamber and free-air fumigation experiments. Our results indicate that these species are sensitive to increasing ozone concentrations and that the roots are the most vulnerable targets for ozone stress. These growth reductions were accompanied by visible foliar injuries, increased carbon allocation towards defensive compounds (phenolics, in particular), reduced carbohydrate contents of leaves, impaired photosynthesis processes, disturbances in stomatal regulation, earlier leaf senescence and shorter leaf duration. We also present recent results from a co-exposure of birch and aspen genotypes to ozone and increasing temperature using our novel open-field facility. In addition to growth and phenological measurements, these plants have been studied for changes in gas exchange profiles, metabolite and gene expression profiles and emissions of volatile organic compounds (VOC). In many measured parameters, antagonistic action of ozone and warming treatment were observed. Even a small increase in temperature tended to increase photosynthetic assimilation and VOC emissions, while ozone stress suppressed these processes, and modified VOC emission and gas exchange profiles.

Key words: Ozone, Increasing temperature, Open-field exposure, Birch, Aspen

SIV/L-2

Understanding the Ozone response in Indian crops: An Integrated Approach

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Tropospheric ozone (O_3) has long been convicted as a major phytotoxic gas, and a component of global climate change. This secondary air pollutant is also identified as a prime cause behind the loss in agricultural productivity worldwide. According to the available reports; India, like other rapidly industrializing countries of northern hemisphere, is under severe threat of O_3 pollution, because of its rapid industrialization and growth in transportation sector along with prevailing favorable environmental and socio-economic conditions, which lead to higher production of O_3. Even the projected values for the future O_3 levels are critically alarming. Our studies with major crops, i.e. rice, wheat, soybean, linseed etc., (under ambient and elevated levels of O_3) clearly established the damaging effect of O_3 on agricultural production. Yield of all the crops were significantly decreased under ambient levels of O_3; however, the reduction was increased by many fold with elevated levels of O_3 just by 10 and 20 ppb. Distinct foliar injury symptoms were also observed in O_3-exposed plants. Different growth parameters, like – shoot height, root height, total number of leaves, leaf area, NAR, RGR, etc. were also severely affected. Plants, generally posses a vast array of anti-oxidants; however, under O_3 stress, the amount and activity of these anti-oxidant molecules were induced by many times, irrespective of nature of plants. RAPD analysis demonstrated that O_3 severely affected the 'genome template stability' (GTS) in all the studied plants, and acted as a potent mutagen. In-depth proteomics analysis; through 1-DGE, 2-DGE coupled with protein sequencing, and immuno-blotting again revealed that major photosynthetic proteins, like – RuBisCO, RuBisCO activase, O_2 evolving protein; primary metabolism related proteins were highly affected under O_3 stress; whereas, defense /stress related proteins were induced. Application of ethylene diurea (EDU) as soil drench helped the plants to alleviate the O_3 stress up to a certain extent and recommended as a monitoring tool for the area having high concentrations of O_3. Physiological traits; especially stomatal conductance acts as a very important parameter under O_3 exposure and controls the overall gaseous exchange; hence, controlling the rate of photosynthesis. In conclusion, O_3 vastly affects the dynamic metabolism of various crops, which ultimately resulted in severe yield losses. If the present trend continues, O_3 would prove a major threat to Indian agricultural productivity.

Key words: Tropospheric ozone, Indian crops, Open top chamber, Ethylene diurea, RAPD, Proteomics

SIV/L-3

Reactive Nitrogen and Thiolic Species during Arsenic Stress in Higher Plants: *Arabidopsis* and Rice

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Arsenic (As) accumulation in food crops generates a potential health problem for humans. Nitric oxide, reactive nitrogen species (RNS) and thiolic ligands have been described to be involved at different levels in the mechanism of response against environmental stress in higher plants. In an experiment using *Arabidopsis* seedlings exposed to different arsenic concentrations, some physiological and biochemical parameters were studied to determine the status of RNS and reactive oxygen species (ROS) metabolism in these plants. The parameters analyzed included the activity of antioxidative enzymes (catalase, superoxide dismutase, and the ascorbate-glutathione enzymes), the NADPH oxidase and *S*-nitrosoglutathione reductase (GSNOR) activity, lipid peroxidation, and accumulation of hydrogen peroxide (H_2O_2), superoxide radicals ($O_2^{\cdot-}$), nitric oxide (NO), and peroxynitrite ($ONOO^-$).

Arsenic at 500 and 1000 µM produced a significant reduction in fresh weight and length of roots and affected the membrane integrity. On the other hand, the RNS homoeostasis was imbalanced, with the GSNOR activity being clearly altered. In a parallel experiment, rice (*Oryza sativa L.*) seedlings were exposed to As^{5+} (10µM, 50µM) and As^{3+} (10µM, 25µM) in hydroponics to screen out contrasting (low and high) arsenic accumulating cultivars and to investigate the thiol metabolism in selected rice cultivars. The major route of arsenic detoxification is through reduction of As^{5+} to As^{3+} and complexation of As^{3+} with glutathione and phytochelatins followed by sequestration of these complexes in vacuoles. In rice seedlings exposed to arsenic, non-protein thiols (NP-SH), cysteine (Cys), reduced and oxidised glutathione (GSH and GSSG) and phytochelatins (PCs) along with enzymes involved in thiolic metabolism were analysed. Thiolic species (Cys, NP-SH and PCs) increased significantly on exposure to arsenic and were found to be positively correlated with the metalloid concentration. In both low and high arsenic-accumulating cultivars exposed to arsenite and arsenate, the GSH content was increased. [Supported by the MICINN (project ACI2009-0860), Spain and project DST-GAP 255925, India]

Key words: *Arabidopsis*, Arsenic, Nitric oxide, Reactive nitrogen species, RNS, Rice, Thiols

SIV/O-1

Impact of Environmental Aerosol Deposition on Plants Growth

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Peri-urban agriculture is vital for the urban populations of many developing countries. Increase in both industrialization and urbanization, and associated air pollution threaten urban food production and its quality. In Botswana, urban air pollution has increased rapidly with urban populations, numbers of motor vehicles, use of fuels with poor environmental performance, badly maintained roads and ineffective environmental regulations. As a result, agricultural land adjacent to urban areas is exposed increasingly to air pollutants of urban origin. A major threat to crop production is gaseous air pollutants. The study was conducted in the peri-urban environment of Gaborone, the capital city of Botswana. Botswana is a land-locked country in southern Africa surrounded by Namibia to the west, South Africa to the south-east and Zambia and Zimbabwe to the north. The Country lies between longitudes 20 and 30 degrees east of Greenwich and between the latitudes 18 and 27 degrees approximately south of the equator. There are approximately 125 motor vehicles for every 1000 people. The total number of registered vehicles has increased from 31684 in 1980 to just over 200000 in 2006. This increase in vehicle population also contributed to enhance the particle concentration in the atmosphere of Gaborone. The country is also popular with mines such as copper mine in selebi-phikwe where sulphur dioxide is emitted as a pollutant. The present experimental and theoretical study was conducted to monitor the aerosol deposition in plants and its effect on crop yield. The number concentration of aerosols was measured with automatic particle counter which were capable of monitoring aerosols in the range of 0.1 – 5 µm. The deposited aerosol mass on the leaves of variety of plant was found to vary from 0.1 mg cm^{-2} to 11 mg cm^{-2} on guava (*Psidium guajava*) and cauli flower (*Brassica oleracea*) leaves. The study concluded that air pollution in plants could negatively influence crop yield. The possible cause may be the pollutant deposition on plant leaves which inhibit photo-synthesis process. The radiative forcing due to pollution may adversely affect the plants growth. The scavenging processes may bring pollutants like heavy metals to the plants through soil.

Key words: Atmospheric particles, Crop plants, Peri-urban agriculture, Yield

SIV/O-2

Antioxidant Potential of Strawberry (*Fragaria vesca*) Species: Role of Genotypes

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The nutritional traits of fruits have been widely investigated by consumers, especially for protection against cardiovascular disorder, cancer and other diseases, as well as for general health benefits. The health benefits can be ascribed to the antioxidant potential of the fruit. Antioxidants from fruits are considered an important protection factor against oxidative stress and its deleterious consequences to human health. Strawberry is a popular berry with high visual appeal and desirable flavor. It is also considered as a good

source of antioxidants, mainly given to its high vitamin C and phenol contents. In the present investigation five genotypes of strawberry grown in the same region/ season were selected and fruits were harvested in full ripe stage. Fruit pulp was analyzed for variation in anthocyanins, total phenols, ascorbic acid, trolox equivalent antioxidant capacity (TEAC) and ferric reducing antioxidant potential (FRAP). In fresh ripe fruit pulp anthocyanins ranged from 550 – 620 mg kg^{-1}FW, total phenols 1510 – 2909 mg kg^{-1} FW, ascorbic acid 231 – 535 mg kg^{-1} FW, TEAC value 37 – 54 µmol TE g^{-1} FW, FRAP value 39 – 48 µM FRAP g^{-1} FW. TEAC values were found to be correlated with anthocyanin content and total phenols. Findings report that variability in antioxidant potential of strawberry germplasm is irrespective of region/ season. These genotypes may be used as rich source of antioxidants.

Key words: Strawberry, Antioxidants, Anthocyanin, FRAP, TEAC

SIV/O-3

Glasswort (S*alicornia herbacea* L.) Responses to Salinity

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One of the most important problems, that limits plant growth and productivity, is salinity. Glasswort (*Salicornia herbacea L.)* is one of the native halophytic plant of Iran that is widely spread in salt areas. The purpose of this study was to determine the physiological and growth responses of *S. herbacea* to salinity stress. Plastic pods (15 cm diameter, 20 cm height) with the silica sand bed were used for the experiment. The solution used for the study consisted of 0 (control), 100, 200, 300, 400, 500 mM of NaCl and Na_2SO_4. *S. herbacea* seeds cultivated at five pots for each treatment in green house condition. Plants were irrigated with half strength Hoagland's nutrient solution for 6 months. Salt treatments were applied for 45 days. Shoot and root dry weights, proline, glucose, ion concentration, osmotic potential (OP), relative water capacity (RWC), water use efficiency (WUE), Net Assimilation Rate (NAR), Specific Leaf Area (SLA) and Leaf Area Ratio (LAR) were measured. Data analysis showed that Mg^{2+}, Ca^{+2} and K^{+} decreased when salinity increased but Na^{+} increased. Cl^{-} increased when NaCl incresead, but significantly inhibited at higher Na_2SO_4. Dry weight, WUE, SLA, NAR and LAR increased up to 100 to 300 mM NaCl and Na_2SO_4 but decreased with a further increase in salinity. *S. herbacea* uptakes more ions in chloride soil than that of sulfate soil. WUE, NAR and dry weight are more in sulfate soil. It is also assumed that salt tolerance mechanism of *S. herbacea* changes in different salts. Measurement of osmotic potential showed that it did not significantly increase when salinity increased. In addition, glucose did not increase up to 400 mM. Therefore, *S. herbacea* L. is a highly tolerant halophyte which grows well up to 500 mM of NaCl and Na_2SO_4 salt. Salinity enhances the growth of *S. herbacea* and its optimum growth occurs at 100 – 300 mM. Proline, glucose and osmotic potential remain unchanged at moderate salt concentrations. It also tolerates salinity via uptake of ions in presence of NaCl and increasing WUE when Na_2SO_4 is present. *S. herbacea* grows better in sulfate than chloride.

Key words: *Salicornia herbacea L.*, Salinity, Physiological responses

SIV/O-4

Differential Chronic Responses of Rice, Soybean and Bush bean Plants under Ozone Stress

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Ozone is one of important major air pollutants and a secondary photochemical product from nitrogen oxides and volatile organic chemicals (VOCs). Current background concentration of tropospheric ozone has a potential threat for crop production as well as natural vegetation in the world. Recent increasing fossil fuel consumption for an energy demand in the Asian countries may accelerate to raise surface ozone concentration. Acute responses such as visible injury development in plant leaves caused by ozone are well studied, however chronic responses such as biomass production or grain yield are few studied in the Asian countries. Forty six rice cultivars including joponica and indica types, two soybean cultivars, and two bush bean cultivars were cultivated to test their sensitivity to ozone using glasshouse type open-top chambers (OTCs). Mean hourly ozone concentration was calculated from the seven year monitoring results at CESS, Saitama, Japan, located in the north-western downwind from the center of Tokyo and the highest ozone dose area in Japan. All OTCs were supplied with char-coal filtered clean air (CF) and electrically generated ozone from oxygen was added to CF air for maintaining the designated ozone concentration, twice mean concentration (x2.0). Plants were planted in the 15L of pots filled with volcanic ash soil. Each OTC has 5 blocks and one pot was arrayed in each block and each treatment has 2 OTCs. After harvesting grains, relative grain yield and biomass of above ground parts were analyzed. Our previous study (Sawada and Kohno, 2009) clarified that occurrence of visible injuries did not coincide with rice grain yield reduction. Current results suggested rough rice yield and biomass was not directly correlated. However, most of japonica types except for Kirara 397 were relatively tolerant to ozone stress than those of indica ones. Among the tested cultivars, Kirara 397 and IR 36 were very sensitive to ozone. These two cultivars showed about 30% yield reduction. Ozone exposure treatments except climate conditions were almost same in the year of 2008 and 2009, however, results varied in year by year. Probably climate conditions might affect results significantly.

Contrast to rice cultivars, ozone-tolerant bush bean cv. R123 had less visible injury symptoms than that of ozone-sensitive cv. S156, however, both cultivars significantly reduced seed yields under the ozone stress and those relative

yields were about 20% or less of the CF. Soybean cultivars also significantly reduced seed yields under the ozone stress. However, those relative yield were around 50 to 70%. These results suggested that (i) japonica rice cultivars were relatively tolerant to ozone than indica ones. However, japonica Kirara 397 was significantly sensitive and some of indica was tolerant to ozone in the combination with biomass and seed yield responses. (ii) Soybeans were moderately sensitive to ozone in yield responses. (iii) Bush beans were significantly sensitive to ozone. Estimated ozone dose as AOT40 in the cropping season of Japan will reach about twice of the current level in 2030. These results will help to develop new genotypes tolerant to ozone and to monitor air quality by the performance of indicator plans such as a combination with sensitive and tolerant cultivar.

Key words: Crops, Yield response, Ozone stress, Sensitivity, Chronic plant response

SIV/O-5

Effect of Light Crude Oil Contaminated Soil on the Growth and Germination of S*orghum bicolor*

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The leakage of crude oil into the soil during transportation, refining and extraction causes damage to environment. Light crude oil has volatile components that can be toxic to living organisms of the soil. The use of plants to phytotreatment of crude oil contaminated soil has been a particular interest in environmental cleansing. Some plants such as grasses and legumes have been demonstrated to have better capacity in biodegradation of oil in the soil. In this study the growth and germination of *Sorghum bicolor* was studied in the presence of different concentrations of light crude oil (1- 10%) in the soil during 90 days. Our results showed that the germination number and dry biomass of the plant decreased by increasing heavy crude oil concentration in the soil. The number of germination and total biomass (root + shoot) was higher in the control (86% and 0.74 g respectively) while it was lower in 10% sample (6% and 0.05 g). The length of leaves reduced in higher crude oil concentration in comparison with the control. Total colony and oil-degrading colony count in soil showed that the microbial population in 7% and 10% samples was higher than the control and also it was higher than lower concentrations of crude oil samples. The reduction TPH (Total Petroleum Hydrocarbon) was studied in the samples after 90 days. Both soil microorganisms and the plant played the role to bioremediate the oil in the soil. The TPH reduction was higher in 1% sample (50%) while the reduction was lower in 7 and 10% samples (25 and 10%). In conclusion, light crude oil could delay the germination and affect the normal growth of *Sorghum bicolor* which caused untimely chlorosis in plant.

Key words: Crude oil, Soil contamination, Plant, Phytotreatment, *Sorghum bicolor*

SIV/O-6

Morphological and Physiological Changes Induced by Cadmium Toxicity in Legume-Microsymbiont System

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Heavy metals are important environmental pollutants and their toxicity is a problem of increasing significance from ecological, evolutionary and environmental reasons. Cadmium (Cd) is a non-essential heavy metal that does not have any metabolic use and can be harmful even at low concentrations. A pot study was conducted to investigate the toxicity of cadmium on chickpea (*Cicer arietinum* L.) rhizobium as well as on the morphological and physiological response of chickpea. 12 pots grouped into 4 sets of 3 each containing a mixture of soil and compost were treated with 0, 50, 100 and 150 mg Cd kg^{-1} soil as $CdCl_2$. The parameters like number of leaves $plant^{-1}$, mean leaf area, plant chlorophyll a, chlorophyll b, total chlorophyll content, carotenoid content, nitrate reductase activity (NRA), carbonic anhydrase activity (CA) and proline content were recorded at 30 and 60 days after sowing. It was a general observation in both the samplings that all the given parameters (except proline content) decreased, whereas proline content increased in both the samplings. Maximum significant reduction in morphological and physiological characteristics was observed with 150 mg Cd kg^{-1} soil at both the sampling stages.

Key words: Cadmium, Chickpea, Carbonic Anhydrase Activity, Nitrate Reductase Activity, Proline, Chlorophyll

SIV/O-7

Effect of Salinity and Silicon Application on Oxidative Damage of Sorghum (*Sorghum bicolor* L.)

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Production of crops using saline waters and soils is one of the most sustainable methods of conservation in saline ecosystems, but crops in this ecosystem grown under stress. Applying Si suggested as an alternative approach to alleviating salinity stress in crops. Therefore, a field experiment was conducted to investigate the effects of silicon application (control (without Si)), 1.44 and 1.92 g kg^{-1} soil) on membrane stability index (MSI), relative water content (RWC), proline, soluble sugar, ascorbate peroxidase (APX), catalase (CAT), superoxide dismutase (SOD), peroxidase (PRO), glutathione reductase (GR), total antioxidant, total phenol, Na, K and dry matter of tow sorghum (*Sorghum bicolor* L.) cultivars (CV) under three levels of salt stress (5.2, 10.5 and 23.1 dS m^{-1}). Leaf proline content, APX and GR activity and Na concentration significantly increased only at high levels of salinity and RWC and dry matter accumulation was significantly decreased with increasing salinity. Supplied 1.44 g kg^{-1} soil Si

cause increased activity of APX, CAT, SOD, PRO, GR, total antioxidant and total phenol concentration and 1.92 g.kg^{-1}soil Si caused an increase in MSI, soluble sugar and total phenol concentration, CAT, SOD and total antioxidant activity. Soluble sugar, total phenol and K concentration, SOD and total antioxidant activity and dry matter accumulation in Omidbakhsh was higher than Sepideh. In conclusion, the results of the present experiment showed that alleviation of salinity stress by supplying exogenous Si obtained in high levels of salinity by expression of antioxidant activity.

Key words: Antioxidant enzymes, Silicon, Salinity, Sorghum

SIV/O-8

Effect of Heavy Metals on Growth and Development of *Pisum sativum* Linn.

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Heavy metals have various harmful effects on the plants if they are present in higher concentration than the requirement. Some of these metals like Copper, Zinc, etc, in actual amount are essential for plant growth and development. Heavy metals present in the soil can effect plants by changing their metabolic activities and thus can change the chlorophyll content, amino acid content in the body, which ultimately affects the growth and development of the plant. In the present study, the responses of *Pisum sativum* to different concentration of Copper, Zinc, Lead and Mercury were examined in soils artificially contaminated with these heavy metals. A wide range of soil concentrations of these elements were studied (100 mg kg^{-1}, 200 mg kg^{-1} and 400 mg kg^{-1}for Cu, Zn and Pb; and 50 mg kg^{-1}, 75 mg kg^{-1}and 100 mg kg^{-1} for Hg). For each treatment, 20 replicates were taken. Survival and growth, chlorophyll content and Proline content were assessed. Rate of germination of seeds was poor in the Cu, Zn and Pb treated soil as compared to that of the control. The results suggested that, there is a decrease in the plant height as well as in terms of the number of leaves in all the treatments as compared to the control except in Pb 200 mg kg^{-1} treated soils. Severe chlorosis and senescence were observed in most of the plants growing in treatment soils. Regarding the Chlorophyll content, it has been observed higher (highest 4.124 mg chlorophyll/100 g of fresh leaf weight in Cu 200 mg kg^{-1}) in the different treated plants compared to the control (0.951mg chlorophyll/100 g of fresh leaf weight) after the 30 days of germination. After 60 days of germination, the chlorophyll contents were found to be decreased (lowest 0.46 mg chl/100 g of fresh leaf weight in Hg 100 mg/kg) in different treated plants. In case of Proline, the amounts increased (highest 10.88 µ mol proline/g tissue in Pb 400 mg kg^{-1}) than the control (5.6 µ mol proline/g tissue) after the 30 days of germination of seeds, and after 60 days of germination of seeds the amounts were increased (highest 10.6 µ mol proline/g tissue in Hg 100 mg kg^{-1}) more than the 30 days of observation except in few of the treatments. Thus these heavy metals in the higher concentration are found to be more toxic to *Pisum sativum.* The results showed an increase in concentration of heavy metals as the concentration increased from lower to higher. Results confirmed the necessity to consider species- specific and element-specific toxicity safety ranges, and that low concentrations of these heavy metals in the soil may be even harmful to the plants.

Key words: Heavy metals, *Pisum sativum*, Chlorophyll, Proline content, Toxicity, Absorption

SIV/O-9

Magnetic Field as a New Tool to Enhance Salt Tolerant Soybean

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Salinity is limiting the plant growth and productivity. Nearly 20 per cent of the world's cultivated land and nearly half of all irrigated lands are affected by salinity. Drought and salinity are two major environmental factors determining plant productivity and plant distribution. The desertification and salinization are rapidly increasing on a global scale and they are declining average yields (more than 50 %) of most major crop plants. Despite the fact that research in the area of salinity stress has been carried out for decades, the mechanisms of salt tolerance in plants are still unresolved. Soybean is an important economical and medicinal plant and is generally considered as salt-sensitive. However, the yield of the plant is reduced by the saline condition. For many years, *in vitro* culture of plant tissues has been used as a tool to study salt tolerance mechanisms at the plant cell level. The positive effect of low-strength magnetic field (MF) on living systems was demonstrated on both *in vitro* and *in vivo* studies. The present investigation was an attempt to study the influence of different frequency of low intensity magnetic field on *in vitro* regeneration system of soybean under saline condition.

The *in vitro* seedlings were raised from seeds pretreated with 0.1, 1.0, 10.0 and 100.0 Hz MF. The magnetic field exposed and unexposed cotyledonary nodal explants were cultured in the different concentrations of NaCl. Increasing concentration of NaCl strongly decreased the regeneration and development of shoots and roots. Plant-lets were regenerated only on medium containing 0, 10, 20 and 30 mM NaCl. Although the higher dose of NaCl (40 mM) failed to induce the shoots, but it initiated and developed the least number of roots with reduced length. Among the different frequency of magnetic field used, 1.0 Hz increased the shoots and roots regeneration frequency, number of shoots and roots, length of shoots and roots from cotyledonary nodal explants cultured in the 10, 20 and 30 mM NaCl. In 40 mM NaCl salt, cotyledonary nodal explants induced more number of roots in the presence of all the frequencies of magnetic field, but regeneration rate was reduced than other low levels of salt stress. 1.0 Hz magnetic field subjected cotyledonary nodal explants significantly increased the frequency of regeneration, number of roots and length of

roots even in 40 mM NaCl. We concluded that the magnetic field could help the regeneration of soybean even under salt stressed condition.

Key words: Magnetic field, Salinity, Soybean, Regeneration

SIV/O-10

The Effect of Lime and Compost on the Revegetation Ability of Soils Affected by Atmospheric Deposition from a Copper Smelter

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The semiarid Mediterranean ecosystem of the Puchuncaví Valley, in the coastal area of central Chile, was exposed to atmospheric deposition of sulfur dioxide and metal-rich particles from a copper smelter for 35 years. The soils surrounding the smelter accumulated copper and other elements at high concentrations, were acidified and strongly eroded, and lost much of their native vegetative cover. Reduction of environmental risks posed by acidic and metal-contaminated soils, such as the ones presents at the Puchuncaví Valley, requires affordable and effective remediation alternatives, particularly at large spatial scales. In this scenario, *in situ* immobilization, defined as the reduction of the concentration of bioavailable metals in the soil solution by adding amendments without altering the structure of the soil, has been suggested as a cost-effective alternative for metal-contaminated soils. The amendments do not remove the metals from the soil, but transform them into less soluble or insoluble forms by the way of adsorption, complexation or co-precipitation mechanisms. Phytostabilization is another *in situ* metal immobilization technique that considers the use of plants which are able to store metals in underground tissues, thus reducing their movement from contaminated soils to the air and groundwater. Achievement of phytostabilization on metal-contaminated sites can lean on spontaneous revegetation of native plants from the seed bank that is present in the soil or it can be by assisted revegetation, employing seeding and/or planting of exogenous resistant plant species.

In the present study, spontaneous and assisted revegetation and changes in the physico-chemical properties of the soil were evaluated in field plots that were amended with lime or lime + compost. Treatment with lime and lime + compost decreased Cu^{2+} activity in the soil solution, thus showing effective immobilization of this element in studied contaminated soils. Plant productivity (cover and aerial biomass) was the same under assisted and spontaneous revegetation regimes, at least for the planting/sowing rates used in this study, suggesting that plant cultivation may be unnecessary. Under both assisted and spontaneous revegetation, treatment with lime had no effect on plant productivity, in comparison with control, whereas treatment with lime + compost was effective in increasing plant cover and aerial biomass. Simple and multiple regressions showed that this effect was due to the increased organic matter content and not to the increase in pH. Neither treatment was effective in decreasing Cu accumulation in the shoots of the cultivated plants, with exception of one species. [This study was funded by the FONDECYT project 1085005]

Key words: Spontaneous revegetation, Assisted revegetation, Organic matter, Phytostabilisation, Phytoremediation

SIV/O-11

Heavy Metals Accumulation in Fruits Collected from Road Side Fruit Markets in a Dry Tropical Environment: A Case Study of Varanasi City, India

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The heavy metal concentration of Cadmium (Cd), Copper (Cu), Iron (Fe), Lead (Pb) and Zinc (Zn) were analyzed using atomic absorption spectrophotometer in fruits of Apple (*Malus domestica* Borkh.), Pear (*Pyrus communis* L.) and Banana (*Musa paradisiacal* L.) collected from road side Fruit Markets of Varanasi city. The results showed that urban consumers are at greater risk of purchasing fresh fruits with high levels of heavy metals (Cd and Pb) beyond the legally permissible limits PFA Act 1954. Higher levels of Cd, Fe and Zn were recorded in Banana while Pb in Apple and Pear. Concentration of Cu in fruits tested was below the PFA limit, but was significantly higher than the present EU and WHO standards. The study concludes that the transportation and fruit market location play a significant role in elevating the contaminant (heavy metals) levels which may pose a threat to the quality of the fruits with consequences for the health of the consumers.

Key words: Heavy metals, Fruits, Varanasi

SIV/O-12

Application of Photoacoustic Spectroscopy in Studies of Environment Contamination Effect on Plants

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In the present paper we describe the application of photoacoustic spectroscopy (one of the photothermal spectroscopy versions where a quantity of energy deactivated into heat is evaluated) to quantify the environmental pollution effect on different plants. When a sample is exposed to modulated light, a part of the absorbed light energy is emitted in the form of modulated heat, resulting from thermal deactivation of pigments. The rest of the energy is predominantly dissipated in photochemical processes leading to modulated O_2 emission. The photothermal part of the signal is reduced by a fraction equal

to that part of the absorbed energy which is stored by the photosynthetic process as chemical energy. By measuring heat emission in the presence or absence of a nonmodulated saturating light background, the photosynthetic energy storage (ES) is evaluated. For all the plants selected as bioindicators (green algae - *Scenedesmus armatus*, dandelion – *Taraxacum officinale*, Scots pine – *Pinus silvestris*) energy storage values obtained for plants exposed to contamination are lower than or equal to, within the experimental error, those for the reference unaffected ones. The best correlation was obtained for a batch culture of green microalga *Scenedesmus armatus*. After a 24 h culture growth, with increasing contaminant (AFOE – aqueous fuel oil extract) concentration in the culture ES decreased. In these algae, ES is lowered by 41% if a 90% contaminant concentration is used. A similar relation between a degree of environment pollution and ES variations was already obtained for plants in field conditions. The dandelion and Scots pine selected for studies were collected from places where the concentration of atmospheric contaminants such as NO_2, SO_2 and flying dust have been measured for several years (Provincial Inspectorate of Environment Protection in Gdańsk). ES values obtained for *Taraxacum officinale* leaves collected in Tri-city (big cities with a high pollutant's concentration) (ranging from 42 ÷ 54%) are lower than those for leaves collected in a small village (Sominy) (65%). For needles of Scots pine collected in the village, the energy yield of trapping reaches 54% and decreases with the age to 23% for four-year old needles whereas, for these collected in the municipal areas, the corresponding values are equal to 28÷30% for fresh needles, and about 15÷17% for the 2-3-year old needles. It seems that the determination of the energy storage yield by means of the changes in temperature (photothermal signal) may become one of the standard and simple tools sensitive enough for studying the effect of pollutants on plants.

Key words: Photoacoustic spectroscopy, Bioindicator, Photosynthesis, Light energy conversion

SIV/O-13

Cultural Studies and Pigment Analysis of Non-heterocystous Filamentous Cyanobacterial Isolates Having Acidic Properties from Manipur, India

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Total seventy five non-heterocystous filamentous cyanobacterial strains available in germplasm of IBSD, Imphal, fifteen strains primarily screened and selected on the basis of pigment production and their growth potential. These strains are Phormidium angustissimum, Phormidium tenue, Limnothrix vacuolifera, Limnothrix redekei, Oscillatoria acuta, Oscillatoria simplicissima, Oscillatoria willei, Hydrocoleum lyngbyaceum, Microcoleus chthonoplastes, Spirulina platensis, Lyngbya truncicola, Lyngbya laxespiralis, Plectonema nostocorum, Plectonema notatum and Plectonema boryanum. All these strains were isolated from Indo Burma biodiversity hotspots from both aquatic and terrestrial ecosystems of Manipur and some parts of Myannmar having acidic properties. Pigment analysis in the respect of chlorophyll-a, carotenoids, phycobiliproteins such as, phycocyanin, phycoerythrin, allo-phycocyanin were investigated. Five strains namely *Spirulina* IBSD-173 (chl.a: 3.14 μg ml^{-1}; carotenoids 0.07 μg ml^{-1}; phycocyanin 23.0 μg ml^{-1}; allo-phycocyanin 15.5 μg ml^{-1}; phycoerythrin 9.3 μg ml^{-1}), *Limnothrix* IBSD-120 (chl.a: 4.38 μg ml^{-1}; carotenoids 0.22 μg ml^{-1}; phycocyanin 17.4 μg ml^{-1}; allo-phycocyanin 2.00 μg/ml; phycoerythrin 5.90 μg/ml), *Limnothrix* IBSD-105 (chl.a: 0.95 μg ml^{-1}; carotenoids 0.23 μg ml^{-1}; phycocyanin 9.6 μg ml^{-1}; allo-phycocyanin 2.20 μg/ml; phycoerythrin 7.5 μg ml^{-1}), *Phormidium* IBSD-42 (chl.a: 1.33 μg ml^{-1}; carotenoids 0.06 μg/ml; phycocyanin 7.8 μg ml^{-1}; allo-phycocyanin 3.1 μg ml^{-1}; phycoerythrin 1.7 μg ml^{-1}), *Hydrocoleum* IBSD-104 (chl.a: 0.90 μg/ml; carotenoids 0.04 μg/ml; phycocyanin 2.8 μg ml^{-1}; allo-phycocyanin 2.40 μg ml^{-1}; phycoerythrin 3.40 μg ml^{-1}) were selected on the basis of their specific attributes for commercial exploitation as natural colourant materials.

Key words: Acidic habitat, Cultural studies, Cyanobacteria, Phycobiliproteins

SIV/O-14

Comparative Biochemical Study on Three Dominant Trees Growing Around Aluminum Production Factory

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Human activity has continuously increasing the level of aluminum (Al) pollution of the biosphere and soil, leading to toxic effects on plant growth and development. In this investigation we study Al pollution effects on *Salix carmanica*, *Ceris siliquastrum* and *Ulmus motana* as three dominant trees around Al production factory in Arak city, Iran. Results showed 518, 119 and 42 mg/kg dw Al in their leaves respectively that were lower than 1000 mg to be considered as Al-accumulator. Significant increases in Superoxid dismutase and Catalase activities were observed in *S. carmanica*, and *C. siliquastrum* with respect to the same plants from control zone. Glutathione peroxidase and Ascorbate reductase were significantly higher in *U. motana* as compared with controls. Al exposure inhibited growth by decreasing in fresh and dry weight of leaves of these three species. The vacuoles of leaves of *U. motana* stored all 2.5 to 4.3 folds higher than two other species and controls. Phytochelatins and Glutathione were also significantly higher in these species with maximum levels in *U. motana* as compared with controls. As conclusion, plants in this study tolerated against Al-toxicity by mechanisms that differed in species including: elevation in antioxidant activities, Al sequestration in vacuoles and its mobilization by Phytochelatins and Glutathione.

Key words: Aluminum pollution, Vacuoles, Antioxidant enzymes, Phytochelatins, Glutathione

SIV/O-15

Effect of Crude Oil-contaminated Soil on Peroxidase Activity of *Festuca arundinacea*

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Peroxidases are a group of enzymes that occur especially in plant cells and catalyze the oxidation of a substance by peroxide. They are classified as oxidoreductases and for many of these enzymes the optimal substrate is hydrogen peroxide. Peroxidases can contain a heme cofactor in their active sites, or redox-active cysteine or selenocysteine residues. Toxic molecules such as superoxide and hydroxide radicals can be found in cells due to the presence of oxygen. These are byproducts of aerobic respiration. Some oil producing countries may encounter the risk of soil pollution by oil, during transportation, extraction and refining of crude oil. Oil-contaminated soil can be hazardous to plants and soil microorganisms. Among the plants, grasses such as *Festuca arundinacea* (Tall fescue) and legumes have high potential on removal of oil from contaminated soil. In the process of phytoremediation of crude oil, some morphological, enzymatic and physiological changes were observed in plants. In this study the effect of light crude oil (5% v/w) in soil on the activity of peroxidase was studied and compared with control. Our results showed that in both roots and shoots, the Km and Vmax of enzyme have changed. The contaminated soil caused delay of germination and chlorosis in plants. In the contaminated soil the Km of root peroxidase was determined to be about 55.5 µM while it was 91 µM in control. The Vmax of root's enzyme was 2 and 6 nmol/mg protein/min in contaminated soil and control respectively. The Km of enzyme in shoots was determined to be about 36 and 42 µM in contaminated soil and control respectively, while the Vmax in control was about 1.4 nmol/mg protein/min and it decreased to 1 nmol/mg protein/min in contaminated soil. The specific activity of enzyme in root control was 21×10^{-3} U mg^{-1} protein while it was 14×10^{-3} U mg^{-1} protein in contaminated roots. The specific activity of enzyme in shoots was 7.2×10^{-3} and 6.8×10^{-3} U mg^{-1} protein in control and contaminated soil respectively. Our results propose that in the root the plant grown in contaminated soil, the plant uses peroxidase isoform in comparison with control roots, while in the shoots the same peroxidase was used in plant in both contaminated and control.

Key words: Light crude oil, Peroxidase, Enzyme, Pollution, *Festuca arundinacea*

SIV/O-16

Comparative Evaluation of Accumulation, Growth and Antioxidants of Two Cultivars (Sona and SRHM 445) of *Zea mays* L. towards Cr (VI)

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Zea mays is one of the most important crops for animal, human nutrition and agro-industrial purposes worldwide. There are reports that these plants are commonly grown on contaminated soil. Thus, the studies involving effects of toxic metals on *Z. mays* are of particular interest as it has direct implication on the human health and loss of agricultural production. The present study was conducted on two cultivars of *Z. mays* L. namely cv. sona and cv. SRHM 445 treated with Cr (VI) in order to compare the accumulation, growth and biochemical responses. The seedlings were treated with Cr (2.5, 5 and 10 µg g^{-1} dw) under sand culture for 7 and 14d. The two varieties have shown different response in its growth and antioxidant parameters. Besides high accumulation of Cr in cv. sona, percentage reduction in shoot, root length and fresh weight of cv. sona was less than cv. SRHM445. After 14d, the decrease in the shoot length, root length and fresh weight of the cv. SRHM 445 was observed as 26.67, 26.37 and 51.66%, respectively and 6.32, 7.69 and 46.83% respectively in cv. sona as compared to their respective controls. Similarly antioxidant parameters were less affected in cv. sona, is indicative of the fact that it is a relatively tolerant cultivar than cv. SRHM 445. As compared to respective controls, there was significant increase in APX and GPX activities of cv. sona, and maximum increase of 114.53 and 30.65% was recorded after 14d in 10 µg g^{-1} dw, respectively as against 152.48 and 38.30% in cv. SRHM 445. Thus, cv. sona may be suitable to grow on contaminated sites. However, the level of Cr in the edible part needs to be checked before its consumption.

Key words: *Zea mays*, Chromium, Tolerant, Sensitive, Antioxidants, Lipid peroxidation

SIV/O-17

Heavy Metal Accumulation by Rice Grains Cultivated in an Industrial Area

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The heavy-metal contamination in soils has posed a potential threat to safe crop production worldwide. Higher accumulation of toxic heavy metals in rice grown in agricultural soil may lead to health disorder. The sources of metals in natural waters are dissolution of natural sediments, and discharging domestic, industrial and agricultural wastewaters. Surface water receives various contaminants such as heavy metals salts during their movement. Metallic salts are partially soluble in water, and in high concentration could be harmful. The present study was confined to understanding the impact of a textile mill, owned by Assam Polyester Co-operative Society Limited (APOL), at Rangia Kamrup, Assam. The mill is located amidst agricultural land the effluent discharged from the mill to the vast agricultural land in the western direction. Significant impact is expected in rice grown in that area. In the present work, surface soil samples and rice grain were collected from different

directions from the mill and were characterized with respect to pH, total nitrogen, total phosphorus, organic matter, potassium, Al, Cd, Cr, Ni and Pb. The correlation studies of total N, total P, organic matter and potassium of soil show good positive relationship with some of the heavy metal in rice grains. A relationship also exists between heavy metal content of soil and rice grains. The results were compared with those obtained for a 'Control' sample and significant degradation of the soil as well as rice grains could be observed.

Key words: Rice grains, Metal accumulation, Toxic metals, Soil quality

SIV/O-18

Effect of Glucose and Lactose on Uptake of Phenol by *Lemna minor*

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Previous researches have demonstrated that presence of some carbohydrates in the culture medium will cause callus induction and frond regeneration in *Lemna minor*, and it is expected that presence of carbohydrates will affect the uptake of organics by this plant. However, limited studies have investigated the uptake of organics by this plant. The aim of this study was to clarify the effect of conventional carbohydrates such as glucose and lactose on uptake of phenol by *Lemna- minor*. Experiments were carried out in the presence and absence of glucose and lactose in the growth solution. The growth solution was fresh water collected from river and phenol was added to it. The initial concentrations of phenol were 20, 50 and 100 mg l^{-1} and density of *Lemna minor* (fresh weight) were 50, 100 and 150 grams per square meter. The plants were contacted with growth solutions for 4 weeks. Control bottles (without plants) were examined with the same manner. The culture vessels were placed under white cool light with 12 h photo periods at room temperature. Every four days sample was taken and the concentration of phenol was determined by spectrophotometer. Uptake of phenol by *lemna-minor* increased with increasing the contact time and decreased by increasing phenol concentration. In the presence of glucose and lactose in the growth solutions, uptake of phenol was decreased. Phenol uptake was dependent to plant density and when *Lemna minor* completely covered the surface of the water, uptake decreased. In the presence of glucose and lactose, uptake of phenol by *Lemna minor* was decreased. Uptake of phenol by lemna minor was affected by density of plant.

Key words: Phenol, Lemna-minor, Glucose, Lactose, Organics uptake

SIV/O-19

Assessment of the Toxic Effect of Copper and Cypermethrin using French Bean Plant

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Pesticides such as copper oxychloride, Bordeaux mixture (copper sulphate and hydrated lime), cypermethrin, etc., are frequently used to control fungal and insects borne diseases in vegetable crops for the production of adequate food supply for the increasing population in north-western Himalaya. The continuous uses of such pesticides may increase Cu concentration in soil and consequently in edible crops. The accumulation of Cu in soil either singly or in combination with other soil contaminants may affect negatively the growth, biochemical and physiological activities of plants resulting to the economic yield loss. Therefore, a preliminary short term study on the toxicological effects of single and joint action of CPM and Cu on growth and biomass accumulation in French bean (*Phseolus vulgaris* L.) was carried out under the local field conditions of north western Himalaya. The obtained result showed that number of leaves and nodules in the tested plant were not significantly ($p<0.005$) affected by any of the treatments of Cu and CPM either singly or in combination. Copper significantly decreased numbers of leaves and nodules, length and biomass of roots, shoots and total plant as compared to the control plant. However, the reduction in these parameters due to CPM was found insignificant as compared to the control. The results further showed that Cu and CPM jointly had less toxic effects on each tested parameter in bean plant as compared to their single treatments. Thus the present study concludes that CPM had less toxic effects as compared to the Cu on tested plant. The application of CPM can modified the Cu induced toxic effects in plant grown on Cu contaminated soil.

Key words: Copper, Cypermethrin, Toxicity, Growth, Biomass

SIV/O-20

Survival and Early Growth of Ipil (*Intsia bijuga* Colebr.) Seedlings in Different Concentrations of Mine Tailings

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The boom of mining industries in some parts of the country, has left some areas with poor physical and chemical properties of the soil. Hence, making rehabilitation effort difficult. In an attempt to restore mine waste area, an initial study was conducted to test Ipil (*Intsia bijuga* Colebr.) as candidate species to be used in the rehabilitation activities. It is one of the trees recommended for reforestation not only for its high quality timber but also it is one of endangered species as cited by CITES. It is on this premise that an initial nursery experiment was performed to determine the growth response of ipil in different concentrations of mine tailings for possible restoration activity in the future.

An experiment was conducted and laid out in a completely randomized design (CRD) to determine the survival and early growth of ipil seedlings in different concentrations of mine tailing mixed in potting media. The

following were the treatments used: T1 - pure soil, T2 - soil and mine tailings (2:1 ratio), T3 – soil and mine tailings in (1:1 ratio), T4 – soil and mine tailings (1:2 ratio), T5 – pure mine tailings. Parameters used were height, root collar diameter, root length, ovendry shoot biomass, ovendry root biomass and total biomass of seedlings. Results of the study showed that survival of ipil seedlings was affected by the different concentrations of mine tailings. Lowest survival of ipil (38%) was recorded in seedlings grown in pure mine tailings while the highest (79.33%) in pure soil. Growth responses of ipil seedlings in different potting media gave significant differences in height, root collar diameter, root length, ovendry shoot biomass and ovendry total biomass. Increasing volume of mine tailing mixed in pure soil resulted in inferior growth of seedlings. However, ipil seedlings survived in a ratio of 2:1 pure garden soil and mine tailings. Beyond that amount, Ipil seedlings growth was retarded. Finally, it was found out that ipil seedlings can be planted and grown in mine tailings if is properly mixed with sufficient amount of soil.

Key words: *Intsia bijuga*, Mine tailings, Seedlings, Pure soil, Rehabilitation, Early growth

SIV/O-21

Studies on the Foliar Ecophysiology of *Populus deltoides* Growing under Ambient Field Conditions Around a Cement Kilin in Kashmir Valley

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Air pollution has become a serious problems in recent times due to the rapid growth of thermal power stations, cement factories, steel and coal industries and due to vehicular pollution. Like in other parts of the country some regions of Kashmir valley are facing environmental pollution due to dust emanating from cement factories. Agricultural land around the industrial units has been a worst victim causing considerable damage to several crop species. The use of plants as natural sinks of various air pollutants has long been established and this concept has been backed by the proponents of the green belt as an aid in protecting and phytoremediation of the industrial and urban environment from different types of the pollutants. In the present study which has been carried out under ambient field conditions on the foliar ecophysiology of one of the common tree species of Kashmir Himalayas viz., *Populus deltoides* Marsh., it has been observed that the various photosynthetic pigments (chlorophyll-a, b, and total chlorophyll) suffered severs loses in the population growing at the polluted site. Other biochemical parameters like carbohydrates, ascorbic acid, and macro nutrients like N, P and Fe also recorded losses in the affected population. On the other hand foliar proline contents and elements like K, Ca, Mg and Al exhibited remarkable increase in the population growing in the same environmental set-up. Leaf area as well as their biomass suffered severe losses due to particulate pollution. The study also shows that *Populus deltoides* also possess a significant dust filtering capacity. Soil pH, Ec and the contents of various soil nutrients viz., P, K, Ca, Mg, Fe, Al recorded elevated levels in the samples collected from polluted site though more in autumn compared to spring. However the N contents of the soil recorded decreased levels in the polluted soil.

Key words: Particulate pollution, *Populus deltoides*, Photosynthetic pigments, Physiological parameters

SIV/O-22

Impact of Distillery Spentwash Irrigation on the Yields of Herbal Medicinal Plants in Normal and Spentwash Treated Soil

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Cultivation of some herbal medicinal plants namely, *Tulsi (Ocimum sanctum)*, *Kama kasturi (Ocimum basilicum) and Thumbe (Leucas asper)* was made by irrigation with distillery spentwash of different proportions. The spentwash i.e., primary treated spentwash (PTSW) and 33% spentwash were analyzed for their plant nutrients such as nitrogen, phosphorous, potassium and other physical and chemical parameters. Experimental soils i.e., normal soil (plot-1) and spentwash treated (plot-2) soils were tested for their chemical and physical parameters. The seeds of medicinal plants were sowed in the prepared land and irrigated with raw water (RW) and 33% spent wash in both soils. The yields were recorded at their respective maturity. It was found that the yields of all medicinal plants were high in 33% spentwash irrigation than raw water irrigation. Further, the yields were very high in spentwash treated soil (plot-2) than normal soil (plot-1) and raw water irrigations for all plants. It concludes that, the subsequent use of diluted spent wash for irrigation enriches the soil fertility and hence the diluted spentwash (33%) is an effective, eco-friendly irrigation medium for cultivation of herbal medicinal plants without any adverse effect on soil and environment.

Key words: Distillery spentwash, Herbal medicinal plants, Yields, Normal soil, Spentwash treated soil, Irrigation

SIV/O-23

Does Potassium Alleviate Salinity Stress in Mustard (*Brassica campestris* L.)?

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Salinity is a major abiotic factor that limits crop productivity, whereas mineral-nutrient status of plants plays critical role in determining plant tolerance to various stresses. A pot experiment was conducted on mustard (*Brassica campestris*) to study the protective role of added potassium (40 mg kg^{-1} soil) against the salinity (0, 40 ad 80 mM NaCl)-

induced changes in plant growth (dry mass and leaf area), photosynthetic traits (net photosynthetic rate, stomatal conductance and intercellular CO_2), ion (Na+ and Cl-) accumulation, oxidative stress [thiobarbituric acid reactive substances (TBARS) and H_2O_2], enzymatic antioxidants [superoxide dismutase, ascorbate peroxidase, glutathione reductase] and non-enzymatic antioxidants (ascorbate and glutathione) at 30 days after sowing. Increase in NaCl level decreased the growth, photosynthetic traits and the leaf ascorbate and glutathione contents but increased the leaf Na+, Cl-, H_2O_2 and TBARS contents, and the activity of SOD, APX and GR. On the contrary, K nutrition improved plant growth, photosynthetic traits, activity of APX and GR, and the ascorbate and glutathione contents, and reduced the contents of Na+, Cl-, H_2O_2 and TBARS, as well as the activity of SOD in the leaves, more appreciably at 40 mM than at 80 mM NaCl. The study illustrates the physiological and biochemical basis of K-nutrition-induced NaCl tolerance in mustard.

Key words: Indian mustard, Potassium nutrition, Soil salinity, Oxidative stress, Antioxidant defence system, Crop yield

SIV/O-24

Bloom Formation in Cyanobacteria and Influence of Iron on Growth and Pigmentation

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Bloom formation is ubiquitous in Indian temple ponds, lakes and other water bodies. Cyanobacteria are one of the species behind these obnoxious blooms. Toxic blooms are very harmful for the health of human beings, animals and aquatic organisms. The toxins released by these cyanobacteria are hepatoxic, neurotoxic and dermatotoxic in nature. Eutrophication and global warming are the major stimulators of bloom formation. We have isolated bloom forming cyanobacterial strains from natural blooms of Northern India belonging to genera *Synechococcus elongates, Synechocystis aquatalis*, *Merismopedia glauca*, *Microcystis aeruginosa, Microcystis aeruginosa (O), Arthrospira (=Spirulina) platensis*, *Nostoc paludosum*, *Anabaena iyengarii, Anabaena variabilis* and *Cylindrospermum muscicola*. The strains were purified and enriched in the laboratory by serial dilution and solid liquid transfer technique and enriched in BG-11 medium. We have studied the effect of iron on the growth and pigmentation of bloom forming cyanobacteria. Experimental findings show that cyanobacterial strains show maximum growth and pigmentation at different iron concentration. Cyanobacterial strains namely *Synechocystis aquatalis, Merismopedia glauca*, *Anabaena variabilis* and *Anabaena iyengarii* attain maximum growth at low iron concentration while some species like *Cylindrospermum muscicola*, *Synechococcus elongates*, *Microcystis aeruginosa* and *Microcystis aeruginosa* (O) and Arthrospira *platensis* optimum growth is attained at higher concentration of iron while *Nostoc paludosum* shows maximum growth at 100 µM concentration of iron. Iron influences the growth and pigmentation of bloom forming cyanobacteria significantly. Understanding the factors, that effect growth of bloom forming cyanobacteria will help in designing methodology for treatment of water bodies affected by cyanobacterial blooms.

Key words: Bloom, Cyanobacteria, Hepatoxic, Neurotoxic, Dermatotoxic, Eutrophication

SIV/O-25

Decolourization of Textile Dyes and Paper Industrial Effluent Treatment using White Rot Fungi *Agaricus bisporus*

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A study was designed to see the efficiency of Agaricus bisporus to decolourize the various synthetic dyes and effluents. The dyes used for the study are Reactive blue, Reactive yellow, RBBR, Crystal violet, Brilliant green Congo red. The synthetic and reactive are widely used particularly in textile industries in and around Coimbatore, Tamilnadu, India. The dyes were monitored at their absorbance maxima at 620nm, 401nm, 597nm, 589nm, 623nm,and 486nm (All the dyes were from Sigma chemicals, USA) Effluents like textile and Paper effluent were also monitored at their absorbance maxima at 220 nm. The black liquor obtained from Seshhasayee paper Mills, Erode, Tamilnadu, India was from bagasse and wood chip based newsprint manufacturing unit. As per the data provided by the paper mill, the effluent had COD of 400 mg l^{-1} and BOD of 170 mg l^{-1}. An ecofriendly, biological treatment method using laccase produced by *Agaricus bisporus* was tried out for the effective decolourization of wastewater containing dyestuffs and effluents. The treatment was carried out using crude laccase and a consortium of microorganisms that produces dye-degrading enzymes. The efficiency of these crude extract to decolourize the dyes and effluents were monitored by change in their respective absorbance maxima every alternate day after the addition of dye/effluent for a period of 6 days. The final concentration of the dye on day 0 was considered to be 100%. The crude filtrate of *Agaricus bisporus* without any inducers showed activity of laccase (0.65 U/ml), Mn-independent peroxidase (0.020 U/ml), Mn-dependent peroxidase (0.06 U/ml) and lignin peroxidase (0.15 U/ml). Aryl alcohol oxidase activity was found to be negligible in this species. Another fungus, *Pleurotus ostreatus* showed a greater extent of tyrosinase activity (1.6 U/ml), which plays an important role in the oxidation of phenolic compounds (Duckworth & Co-leman 1970; Karam & Nicel 1997) was also selected for the study. In the study, the crude filtrate of *Agaricus bisporus* decolourized the reactive yellow dye (94%) to a greater extent on the third day of incubation than the reactive blue (45%). The experiment was conducted in duplicate. Decolourization of dyes was carried out using 1%- 5%(w/v) concentrations. About 1.5 ml of crude laccase of *Agaricus bisporus* and *Pleurotus ostreatus*

extract *was* used (1:1 v/v). *Agaricus bisporus* filtrate when used individually in a crude form or in a combination with *Pleurotus ostreatus* extract completely decolourized both paper and textile effluents (>90%) within a day. The low cost of *Agaricus bisporus* and *Pleurotus ostreatus* extracts containing various enzymes as a cocktail may prove to be an alternate source of decolourization and an efficient method of treating waste water containing dye stuffs, textile and paper mill effluents.

Key words: White rot fungi, Laccase, Decolorization, Effluents

SIV/P-1

Differential Response to Oxidative Modification of Proteins in Rice Seedlings Differing in Water Stress Tolerance Subjected to Increasing Levels of Water Stress

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Seedlings of two rice (*Oryza sativa* L.) cultivars differing in drought tolerance, Malviya-36 (drought-sensitive) and Brown gora (drought-tolerant) were raised for 10 days in sand cultures and subjected to water stress levels of 15% PEG-6000 (-1.0 MPa) and 30% PEG-6000 (-2.1 MPa) for 48h. Imposition of water stress level of -2.1 MPa led to about 30-40% increase in the production of superoxide anion ($O_2^{\cdot-}$), 70-89% increase of hydrogen peroxide (H_2O_2) content and about 80-90% increase in the content of thiobarbituric acid reactive substances (TBARS) in the shoots of the drought sensitive *cv.* Malviya-36. The extent of production of reactive oxygen species (ROS) and lipid peroxidation due to water stress level was less in the seedlings of tolerant rice cultivar compared to the sensitive. In order to examine the modification of proteins caused by ROS, we analysed the protein thiol content, protein carbonyl content and protease activity in both the cultivars. Protein thiol content showed a decline in roots and shoots of *cv.* Malviya-36 (drought-sensitive) as well as in *cv*. Brown gora (drought- tolerant). Malviya-36 showed protein carbonylation of maximum increase of about 70 percent in roots and 101 percent in shoots under high stress levels as compared to the control seedlings. Whereas in the case of Brown gora the increased of protein carbonylation was about 30 percent in roots and 40 percent in shoots. Immunochemical detection with an antibody against 2,4-dinitrophenyl hydrazine (DNPH) also showed that the intensity of reactive bands was higher in shoots of drought-sensitive cultivar than the shoots of drought-tolerant under high stress level (-2.1 MPa). Malviya-36 (drought-sensitive) showed increased protease activity of about 60-70% in roots and 30-40% in shoots when compared to controls. Whereas in the case of the tolerant cultivar, a negligible increase in the activity of protease in both roots and shoots under high stress level (-2.1 MPa) was observed. Results suggest that water stress tolerance in rice seedlings appears to be associated with less production of ROS resulting in less protein oxidation and less protease activity under water stress condition.

Key words: Water stress, Rice, Lipid peroxidation, Polyethylene glycol

SIV/P-2

Salicylic Acid is Better Alleviator of Aluminium Toxicity in Rice Seedlings Compared to Magnesium and Calcium

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Aluminium (Al) is one of the most abundant metals of the earth crust. Toxicity due to Al is major cause of decreased crop yield in acid soils. The objective of the present study was to look for the possible role of Ca, Mg and salicylic acid (SA) in alleviating Al toxicity in rice (*Oryza sativa* L.) plants grown in hydroponics. When rice seedlings raised for 5 days were treated with 0.5 mM $AlCl_3$ for 12 days in hydroponics, nearly 15% reduction in length of roots and 30-45% in shoots and nearly 15-45% reduction in fresh biomass was observed. Imposition of Al toxicity caused increased production of reactive oxygen species (ROS) $O_2^{\cdot-}$, H_2O_2 and increased content of thiobarbituric acid reactive substances (TBARS) showing increased lipid peroxidation in stressed seedlings. When either Mg (0.25 mM) or Ca (1 mM) or salicylic acid (30µM) was added in water culture alongwith 0.5 mM $AlCl_3$, a significant alleviation of Al toxicity was observed marked by restoration of growth of the seedlings. The alleviating effect was associated with inhibition in the accumulation of ROS as well as decreased lipid peroxidation in Al-stressed rice plants. This suggests that treatment of rice seedlings with Ca, Mg and SA is beneficial in alleviation of Al toxicity due to increase in antioxidant defense. The alleviating effect of Ca, Mg and SA was also confirmed by histochemical analyses of $O_2^{\cdot-}$ and H_2O_2 in excised leaf tissues from stressed plants using nitroblue tetrazolium (NBT) and 3,3'diaminobenzidine (DAB) stains. 2D-proteome generated from control and Al-stressed plants indicates expression of many novel proteins under Al toxicity. Results indicate that salicylic acid is potent alleviator of Al toxicity in rice seedlings followed by Mg and Ca.

Key words: Calcium, 2-D electrophoresis, Magnesium, Rice, Salicylic acid

SIV/P-3

Moderate Lead Induced Responses in Brazilian Medicinal Plant: *Pfaffia glomerata*, under *In vitro* Culture

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In vitro grown plantlets of *Pfaffia glomerata (Spreng.) Pedersen* were exposed for 30 d to different lead (Pb) concentrations (0-400 M) to analyze the effects on growth, responses of various antioxidants vis-à-vis Pb accumulation. The plantlets showed significant Pb accumulation in roots (1532 µg g^{-1} DW); however, a low root to shoot Pb translocation (ca. 3.6%). The growth of plantlets (analyzed in terms of length and dry weight) was negatively affected by various Pb treatments. In addition, plantlets suffered from oxidative stress as suggested by the significant increases in malondialdehyde levels in root and shoot tissues with increasing Pb treatments. However, the level of photosynthetic pigments did not alter significantly in response to any Pb treatment. In response to the imposed toxicity, an increase in the activities of catalase and superoxide dismutase was observed, however the levels of non-protein thiols and ascorbic acid were, in general, not affected significantly in both roots and shoots. In conclusion, *P. glomerata* plantlets could not cooperatively activate various enzymatic and non-enzymatic detoxification mechanisms and hence suffered from significant toxicity with increasing Pb accumulation.

Key words: Lead, *Pfaffia glomerata*, Phytoremediation

SIV/P-4

Protein and Mineral Analysis for Nutritional Quality in Grain Amaranth (*Amaranthus hypochondriacus* L.) - A Nutritionally Underutilized Crop

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Amaranth is protein-rich pseudocereals may be used as an alternative source for non-allergenic food products. Twenty five accessions of *Amaranthus hypochondriacus* L. were analysed for seed composition (Protein analysis and mineral composition) as an aid to help in identification of genotypes with superior nutritional quality. Amaranth seeds contain high protein ranged from 6.57 to 14.01%. Beside protein the mineral composition in twelve accessions having high protein content were also analyzed. The mineral content ranged as Magnesium (152-176 mg 100 g^{-1}), Nickel (nil), Manganese (0.23-6.8 mg 100 g^{-1}), Iron (9.6-29.6 mg 100 g^{-1}), Zinc (3.2-11.8 mg 100 g^{-1}) and Copper (0.5-34.6 mg 100 g^{-1}). The Nickel is injuries for human well being but its absence in the present study is beneficial for sound health. The other minerals such as Magnesium, Iron, Zinc, Manganese and Copper are concerned exhibited wide range of variation in their contents indicating thereby, chances of their improvement. The present study revealed high potential of amaranth seeds in human diet utilization. Healthy human daily needs 400 mg Magnesium, 18 mg Iron, 15 mg Zinc, 2 mg Manganese and 2 mg Copper which can be easily obtained by consuming 250-300 g amaranth seed daily. Genotypes N-17, N-19, N-25 and N-26 were found superior than other genotypes for protein and mineral content of which protein ranged from 13.13 to 14.01, Magnesium (170-176 mg 100 g^{-1}), Nickel (nil), Manganese (1.7-6.8 mg 100 g^{-1}), Iron (18.2-29.6 mg 100 g^{-1}), Zinc (4.6-9.5 mg 100 g^{-1}) and Copper (0.50-13.75 mg 100 g^{-1}). It is quite obvious that these genotypes can be used for healthcare edible products and also as base material for developing nutraceuticals which will certainly help in establishing cottage or small-scale industries which will create more jobs to villagers for improving their economic status highly dependent on agriculture. The highly nutritious genotypes of this crop show high promise for supplementing nutritive food and ameliorating protein deficiency, strictly in the vegetarian diet people.

Key words: Amaranth, Mineral, Nutrition, Protein, Seed

SIV/P-5

Histological and Cytological Bioassay in Eichhornia crassipes for Evaluation of Tannery Effluent

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Water hyacinth [*E. crassipes* (Mart.) Salms.], a prolific free-floating aquatic macrophytes has been widely studied for phytoremediation of waste water. In this context the plants of *E. crassipes* were treated with tannery effluent collected from waste water treatment plant, Jajmau, Kanpur (India) under laboratory conditions. The phytoremedial ability of the plants was assessed in terms of their water quality improvement, Cr removal and accumulation from tannery effluent. While toxic impact of the effluent was studied on growth and anatomical structure of *E. crassipes*. To assess genotoxic impact of tannery effluent on plants mitoic index (MI) and micronuclei (MNCs) were studied as an endpoint. The results showed that *E. crassipes* effectively improved the physico-chemical properties and reduced Cr content in the effluent (71.0%). The plants accumulated significant amount of Cr in their roots and shoots. In response to effluent treatment, it was observed that mitotic index significantly reduced in root meristematic cells of the plant, whereas micronuclei increased significantly as an indicator of cytological endpoint. The light microscopic studies of root, shoot, petiole and leaf showed variations like reduction in cell size in the epidermal, cortical and stellar region. Vascular bundles were highly reduced and heavily stained. Results thus proposed *E. crassipes* as a good candidate for biomonitoring of heavy metal pollution in tannery effluent.

Key words: *Eichhornia crassipes,* Tannery effluent, Genotoxicity, Anatomical variations

SIV/P-6

Interaction of Magnesium with Metal Toxicity in Wheat (*Triticum aestivum*)

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Heavy metal toxicity in the environment depends on variety of factors, especially availability of Ca^{2+}, Mg^{2+}, Na^{+} etc. in the metal-contaminated soil. Hence, the present work demonstrates the influence of magnesium (Mg) on copper (Cu) and cadmium (Cd) toxicity on Triticum aestivum (Wheat). We measured a range of parameters related to oxidative stress in wheat exposed to Cu or Cd toxicity in media with increasing concentrations of Mg. Increasing Mg concentrations significantly alleviated Cu and Cd toxicity as evidenced by improved growth and decreased toxicity-induced oxidative stress (a substantial decline in the amount of H_2O_2 in root and shoot tissues). An increase in proline concentration in roots and shoots that was triggered by Cu and Cd exposure was partly reversed by increasing Mg concentrations in the growth medium. In conclusion, increasing supply of Mg effectively alleviated toxicities of Cu and Cd in wheat.

Key words: Metal, Toxicity, Oxidative Stress, Proline, Magnesium

SIV/P-7

Uptake of Heavy Metals by Four Important Plant Species from Petroleum Contaminated Soils of Lakowa Oil Field, Assam

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Plants can take up metals from air, water, soil and sediments. The aim of this investigation was to study the plant uptake of seven heavy metals (Cd, Cu, Fe, Mn, Ni, V, and Zn) from petroleum contaminated soil. Plant samples of commonly available fruits and vegetables (*Ziziphus jujuba* Lamk., *Musa paradisiaca*, *Solanum melongena* Linn., *Brassica juncea,* Hk. F. & Th.) were collected from petroleum contaminated as well as uncontaminated private gardens or agricultural fields. Two Group Gathering Stations (GGSs) namely GGS3 and GGS9 of ONGCL at Lakowa Oil Field (Assam) were chosen for the study. Composite samples were collected at the following two ranges of distances from a GGS: (a) Between 0-200m from a GGS and (b) Between 200-400m. Soil samples were also collected (at 0-45cm depth) from the corresponding growth sites for the measurement of heavy metals as well as some important soil parameters. Determination of heavy metals in the plant and soil samples was carried using standard procedures. Results indicated that heavy metal accumulation in the plant parts increased with the increase in heavy metal contents in the growth sites. It was found that soil samples as well as plant samples near a GGS (0-200m) contain more heavy metals.. It is interesting to note that a linear relationship exists between Cd in plant material versus Cd in growth soil. Accumulation of Cd in *Brassica juncea,* Hk. F. & Th.) leaves is less though Cd is considered to be absorbed effectively by leaf system. In general, Cd is the least abundant element for all the plant samples. *Solanum melongena* Linn. and *Musa paradisiacal* fruits are important sources of Cu. *Brassica juncea,* Hk. F. & Th. contains Zn in high abundance. Mn and Fe were present in all the plant samples in very high amount. Amongst them *Brassica juncea,* Hk. F. & Th. contains much more Mn and Fe than the other plant samples. From the present study it can be highlighted that plants grown in crude oil contaminated soils contain much more higher concentration of Ni and v than those grown in uncontaminated soil. The uptake of metals by plants was found to be affected by the type of the plant species as well as metal species involved

Key words: Uptake, Heavy metals, Petroleum contaminated soils

SIV/P-8

Effect of Particulates Generated from Automobile Emissions on Some Common Plants

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Plants play a significant role in capturing particulate pollutants from urban air and in improving urban air quality. The present investigation deals with the study of leaf surface ultra-structures in the plants, *Nyctanthes arbortristis* L., *Quisqualis indica* L. and *Terminalia arjuna* (Roxb.) Wt. and Arn., growing along the road sides and intersections with heavy traffic load. The results showed significant changes in leaf surface characters like reduced epicuticular wax, increased frequency of epidermal cells, stomata and trichomes, clogged and slightly risen stomata, due to the stress of automobile exhaust emissions. In comparison to *N. arbortristis* and *Q. indica* the impact of modifications was more pronounced in *T. arjuna*. These changes can be considered as indicators of environmental stress and can, therefore, be recommended in high traffic density areas for the early detection of pollution and for working out suitable remedial measures.

Key words: Ultra fine, Vehicular population, Early detection, Stomata, Epidermis, Trichome, Epicuticular wax

SIV/P-9

Impact of Municipal Sewage Sludge on Productivity of Maize (*Zea mays L.*)

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Field trials were undertaken at the Agricultural Research Farm of Krishi Vigyan Kendra, Shuhama, Srinagar during the kharif seasons of 2008-2009 and 2009-2010 to investigate impact of municipal sewage sludge on productivity of maize and changes in soil fertility. Highest grain and straw yields, crude protein content in grain and nutrient concentrations in grain and straw of maize were observed with the application of 75% NPK + Sludge @ 30 tons ha^{-1} (T_7) followed by 100% NPK + Sludge @ 15 tons ha^{-1} (T_3), 75% NPK + Sludge @ 15 tons ha^{-1} (T_6) and 50% NPK + Sludge @ 30 tons ha^{-1} (T_5). These were statistically identical to each other for all these parameters. Significantly higher uptake of nutrients by grain and straw was registered in T_7

compared to other treatments followed by T_3, T_6 and T_5. Treatments receiving sewage sludge significantly increased the levels of organic carbon, available macro- and DTPA-extractable micro-nutrients in soil compared to 100% NPK (T_3). The study revealed that integration of 100% NPK with sludge @ 15 tons and of 50-75% NPK with sludge @ 30 tons ha^{-1} can be ideal in sustaining maize yield and soil health under climatic conditions of Kashmir valley.

Key words: Sewage sludge, Integrated nutrient management, Yield, Concentration, Soil properties

SIV/P-10

A Comparative Study on Biomass Accumulation, Antioxidant Compounds and Cadmium Accumulation in *Brassica juncea (L.) and Ricinus communis* (L.) Grown in Cadmium Contaminated Tropical Soil

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Two comparatively tolerant cultivars of *Brassica juncea* (Indian mustard) and *Ricinus communis* (Castor) were studied for rate of biomass accumulation, protein, proline and MDA contents and rate of Cd accumulation for 15-60 days during supply of 0-150 mg $CdCl_2$ kg^{-1} soil. A reduction in root and shoot biomass was observed as a function of metal concentration and exposure time, which was more prominent in Indian mustard as compared to that in castor. The soluble protein of leaves was decreased in both plants and the decrease was more pronounced with increase in metal concentration and exposure time. A very significant increase in proline and MDA was observed in leaves of both the plants. Indian mustard showed higher content of proline and MDA at each treatment where as castor leaves had lower level of these components, through the magnitude of increase in proline due to Cd supply in castor was much higher than that in castor. The castor accumulate about four times higher Cd in its roots and about two times more metal in the shoots even then no additional Cd was added to the soil. The garden soil in the University campus contains a trace amount of Cd. The Indian mustard roots accumulated 49 to 51 µg Cd/plant up to 100 mg $CdCl_2$ /Kg soil, where as an application of 150 mg kg^{-1} soil, it accumulate only 41.24 µg Cd/plant. On the other hand the roots of *Ricinus communis*, which are perennial and large in quantity, accumulated/stabilized 92-389 µg Cd/plant during application of 25-150 mg kg^{-1} soil. The Indian mustard and castor plant, on the other hand, accumulated almost similar amount of Cd in its shoots during 75-150 mg kg^{-1} soil Cd supply. The total dry biomass of Indian mustard is 14-15 folds lower than that in castor at 25-50 mg Cd/Kg of soil. When accumulation of Cd in roots and shoots of both the plants were compared at 15, 30, 45 and 60 days in relation to biomass accumulation in per unit area it was observed that *Brassica* roots accumulate 2-3 fold higher Cd than that of castor whereas *Brassica* shoots 2-6 times higher Cd accumulation than that in castor. The rate of accumulation of Cd in both the plants was calculated and it was found that though the amount of the metal accumulated in the shoots of Indian mustard than that in castor. The total removal of metal from soil in castor is much higher due to production of very large amount of underground and aerial biomass by this plant during the same period of cultivation. Since *Ricinus communis* is grown for a year to get its reproduction cycle completed and can be maintained as a perennial shrub whereas *Brassica juncea* is 3-4 months duration crop in winter in tropical agro climatic conditions of north India. Both the plants can be cultivated in combination for phytoremediation of Cd contaminated soil and both are important oil seed crops of this region and no vegetative part of castor is consumed like *Brassica* leaves by castles or human beings.

Key words: *Brassica juncea*, Accumulation, Biomass, Cadmium, *Ricinus communis*

SIV/P-11

In vitro Genotypic Variation in Morphogenic Response of *Vigna mungo* L. Varieties under Herbicide Stress

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In vitro culture conditions represent an unusual combination of factors viz. growth medium, plant growth regulators, culture conditions etc. which can be standardized for comparing the response of explants from different sources. *In vitro* selection thus generates a method for identifying stress tolerant plants in a short time span under controlled conditions. The response varies according to the level of change from differentiated condition of cells to dedifferentiated condition for the manifestation of totipotency.

The effect of increasing herbicide glyphosate (0.01mM, 0.05mM, 0.1mM, 0.2mM, 0.4mM, 0.6mM) on morphogenic response of three *Vigna mungo* genotypes- PU-19, PU-94-1 and Azad-1 is being reported here. These three were selected from 9 genotypes initially screened for tolerance using petridish germination method. Seeds of three genotypes were inoculated on Murashige and Skoog's basal media and 7 days old seedlings were used as source of explants. The explants like epicotyl, hypocotyl, cotyledonary node, shoot apex, leaf were inoculated on medium supplemented with various growth regulators and varying concentrations of glyphosate. The response varied with genotype, type of explant, different plant growth regulator combinations in the medium and concentration of herbicide. It ranged from callusing, to callusing with organogenesis, direct shoot bud induction and somatic embryogenesis. Stress-induced morphogenic responses that have been reported for plant cells are inhibition of cell elongation, localized stimulation of cell division and alteration of the cell differentiation status. A comparative study of the response in the three genotypes will be presented.

Key words: Glyphosate, Genotypic, Morphogenic, Organogenesis, *V. mungo*

SIV/P-12

Ecophysiology and Yield of Soybean under *Populus* Based Agrisilviculture

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The present paper deals with the study of variation in eco physiological parameters *viz.* Photosynthetically active radiation (PAR), transpiration, stomatal conduction, relative humidity, leaf temperature and productivity of soybean grown under five promising clones of *Populus deltiodes* in agri-silvi system at Raipur (C.G) India. The clones *viz.* G3, G48, 65/27, D121 and S77C1 were planted in randomize block design with 3 replication during 1995. Soybean was grown as intercrop and also as sole crop for 2 years under five and six year old clones in kharif. The PAR transmission had decreased by 10-44% under five year clone which was further reduced by 15-49% under six year old clones. The clones G3, G48 and 65/27 greatly reduced PAR, transpiration and leaf temperature in Soybean. Grain yield varied from 9-15.9 qha^{-1} the yield was more in sole crop and reduced under populus clone. The photosynthetic and assimilation parameters considered in the present investigation are indicative of better physiological performance of species. This will not only add to the supply of this important crop but also provide economic support to the farmers.

Key words: Ecophysiology, Prodcutivity, Agrisilviculture

SIV/P-13

Effect of Salicylic Acid on Changes in Growth, Metabolic Activity and Phenolic Profiles in Maize (*Zea mays* L.) under Salinity Stress

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Salinity is a limiting environmental factor for plant production, and is becoming more prevalent as the intensity of agriculture increases. Salicylic acid (SA) plays an important role in abiotic stress tolerance, and considerable interests have focused on SA due to its ability to induce a protective effect on plants under stress. Therefore, the present study was conducted to determine the potential of SA to induce salinity tolerance in maize plants. Pre-soaking treatments of NaCl (0, 50, 100, 150 and 200 mM) were given to maize seeds in presence as well as absence of 0.5 mM salicylic acid and their effects on growth, level of photosynthetic pigments, free proline, lipid peroxidation, total phenol, total protein and qualitative and quantitative chromatographic analysis (HPLC) of phenolic acids fraction in maize plants were studied. Exogenously applied salicylic acid (0.5 mM) increased plant growth significantly in saline conditions. NaCl induced deleterious effects on biochemical changes and phenolic acids fraction in maize plants were significantly encountered by salicylic acid. The present results signify the role of SA in regulating the salt stress response of maize, and suggest that SA could be used as a potential growth regulator to improve plant growth and development under salt stress.

Key words: Lipid peroxidation, Malondialdehyde, Phenolic profiles, Salicylic acid, Salinity

SIV/P-14

Temporal Variation in Ozone Exposure Causes Significant Effect on Growth Phase Specific Sensitivity and Productivity of Rice Plants

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Ozone (O_3), the tri-atomic allotrope of oxygen, is a ubiquitous component of global environment; and provides a crucial barrier at stratosphere against the harmful solar ultraviolet irradiation, hence, protects life on earth. Though, at troposphere, this harmful air pollutant executes serious impact on human and animal respiration, as well as, cause extensive damage to both natural, semi natural and cultivated plant populations. Global agricultural productivity has been severely affected by this pollutant singly; however, the projected data are more alarming. This toxic secondary air pollutant is mainly generated by the interaction of primary pollutants, like NOx and VOCs, in presence of bright sun light; and the later phase of rice (*Oryza sativa* L.) growth periods at the Northern India, provides similar environment. Even the available monitoring data also pointed towards higher O_3 concentrations during the reproductive growth phase of rice plants. So, keeping this specific point in mind, we have designed an experiment to study the 'growth phase' specific sensitivity of rice plants under elevated O_3 stress using open top chambers (OTCs). Experimental setups were prepared as: filtered chambers (FCs) with almost no O_3, non-filtered chambers (NFCs) with ambient O_3, non-filtered chambers with 20 ppb O_3 fumigation for whole life span (NFC20wl), non-filtered chambers with 20 ppb O_3 fumigation for vegetative phase (NFC20vp), and non-filtered chambers with 20 ppb O_3 fumigation for reproductive phase (NFC20rp). Results clearly showed that O_3 exposure suddenly stimulates the amount and activity of some important antioxidants in rice plants. Yield of rice plants, grown in exposed chambers, were also significantly decreased as compared to unexposed plants, and the reduction depends on the exposure amount and duration of O_3. However, the plants which were exposed to O_3 during reproductive phase showed the lowest harvest index. Results of this present experiment, clearly depicted that reproductive growth phase of rice plants were more sensitive towards O_3 exposure.

Key words: Rice, Open top chamber, Ozone, Vegetative phase, Reproductive phase, Antioxidants, Yield

SIV/P-15

Biochemical Changes in *Eichhornia crassipes* Mart. under Chromium Phytotoxicity Stress

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Aquatic plants have paramount capacity to concentrate and accumulate toxic metals from water environment. In the present investigation plants of *Eichhornia crassipes*, acclimatized in 5% nutrient solution medium under laboratory condition, were subjected to different concentrations (0.01, 0.1, 1.0 and 10.0 ppm) of chromium. The exposure resulted in accumulation of chromium and biochemical changes in *E. crassipes* at 24, 48 and 72 hr. At 10 ppm concentration *E. crassipes* accumulated 592.12 $\mu g\ g^{-1}$ dw Cr in root and 298.34 $\mu g\ g^{-1}$ dw Cr in leaves after 72 hr exposure. Accumulation of Cr was dose dependent and found in the order root>leaves. It was observed that pigment content, protein content, catalase and peroxidase activities increased upto 0.1 ppm exposure but at 1 and 10 ppm concentrations these parameters started decreasing. Carotenoids content increased with increasing Cr concentrations. Chromium toxicity symptoms appeared in plants in the form of marginal chlorosis of leaves which finally transformed to necrosis. Thus, the present study may be helpful for the bioindication and removal of chromium like heavy metals from water environment.

Key words: Bioindicator, Heavy metal, *E. crassipes*, Chlorosis, Pigment content

SIV/P-16

Influence of Soil Application of Oxygenated Pepton on Vegetative Growth and Photosynthetic Pigments of Organically Grown Chickpea (*Cicer arietinum* L. cv. Vijay)

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Pot culture experiments were carried out on chickpea (*Cicer arietinum* L. cv. Vijay) at P.G. Research Center, Department of Botany, Tuljaram Chaturchand College, Baramati, (M.S.) India, using oxygenated peptone (2 g/pot) as soil aerator under organic farming condition. Oxygenated peptone contains 100 mg/g oxygen, 650 mg/g peptone and 250 mg/g inert filler compound which appears in the form of white, neutral, ecofriendly, non-toxic powder. The treatment enhanced the morphological parameters like leaf area, leaf area index and biomass. The water relation parameters like relative water content and osmotic potential of cell sap increased while membrane injury decreased. The photosynthetic pigments like chlorophyll a, chlorophyll b, total chlorophylls, carotenoids and xanthophylls showed significant increase along with increase in chlorophyll stability index. The biochemical constituents like soluble proteins, total carbohydrates polyphenols, proline, total free amino acids, ascorbic acid and nucleic acids like DNA and RNA showed significant increase. The activity of oxidative enzymes like catalase, peroxidase, polyphenol oxidase, superoxide dismutase and IAA oxidase as well as activity of enzymes of nitrogenase metabolism such as nitrate reductase and nitrite reductase showed considerable increase. Thus, the treatment led to an overall improvement in the growth of plant. It is concluded that soil application of oxygenated peptone was useful to enhance the vegetative growth and it also improved water relations, photosynthetic pigment content, biochemical constituents and enzyme activity under organic farming condition in chickpea which is an indication of better yield.

Key words: Chickpea, Enzymes, Organic farming, Oxygenated peptone, Photosynthetic pigments

SIV/P-17

Assessment of Tolerance of *Vigna radiata* ML613 to Herbicide Glyphosate

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Glyphosate (N-phosphonomethyl glycine) is a broad-spectrum systemic herbicide used to kill weeds, especially perennials. It is expected to protect crop plants from weed competition without harming the crop plants. The crop should be able to tolerate that level of herbicide, which is lethal to the weeds and plants have evolved several mechanisms through which they can tolerate lethal doses of herbicides. Glyphosate is absorbed into the plant mainly through it leaves. It has been reported to impinge on crop plants also, and the need of tolerant genotypes for meeting the incessant protein demand in the daily meal is being felt by pulse breeders. The persistence of glyphosate varies widely but it does bind strongly to soil and does not leach into groundwater. Its half-life is estimated to be 47 days which makes it moderately persistent. In present investigation 21 days old seedlings of *Vigna radiat*a were given post emergence spray treatment of different concentrations of glyphosate i.e. 0.5mM, 1mM, 2mM, 4mM and 6mM, in three replicates. The growth and vigour of the plants was significantly effected. However at all doses tolerant plants were selected, which had higher vigour and yield as compared to control. Significant difference was obtained for mitotic index and aberration frequency at all treatment doses. Variable number of micronuclei in meiosis I and meiosis II indicated the level of genotoxicity of glyphosate. The glutathione S-transferase activity was significantly increased with increase in glyphosate concentration. Under in vitro conditions, variable response was obtained at different concentrations of herbicide in the optimum growth medium for regeneration of *V. radiata*. The explants showed direct organogenesis without intermediate callus phase and also indirect organogenesis through a callus phase. The details will be presented.

Key words: Glyphosate, Herbicide tolerance, Mitotic index, Micronuclei, *V. radiata*

SIV/P-18

Effect of Salinity on Biomass Production and Antioxidants Activity in Kochia (*Kochia scoparia*)

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Soil salinity is a major constraint to food production due to its negative impact on crop yield. Kochia (*Kochia scoparia*) is a hardy, salinity-resistant plant that can widely use as emergency forage for livestock to using saline waters and soils in desert ecosystems. In order to investigate physiological mechanism, antioxidants activity and potential of production of Kochia in response to different levels of salinity, an experiment was performed in a split plot based on randomized complete block design with three replications. Saline waters (5.2, 10.5 and 23.1 dS m^{-1}) and three Kochia ecotypes (Birjand, Borujerd and Sabzevar) were allocated as main and sub plots, respectively. The results showed that salinity did not impose any significant effect on dry matter production but relative water content (RWC) and seed yield decreased by salinity stress. In general, no positive correlation coefficient observed between dry matter production and physiological and biochemical parameters except superoxide dismutase (SOD) at 23.1 dS m^{-1}. There was no significant difference among ecotypes in dry matter and seed yield. Sabzevar showed the highest proline, total phenol content and peroxidase (POX) activity. Ascorbate peroxidase (APX), catalase (CTA), and superoxide dismutase (SOD) activity was higher in Borujerd ecotype and highest soluble sugar, glutathione reductase (GR) activity and DPPH - radical scavenging activity observed in Birjand ecotype. According to these results, Kochia has a good tolerance to elevated levels of salinities up to 23 dS m^{-1} and seems that can control oxidative stress by continuing growth.

Key words: Salinity, Kochia, Antioxidant, Halophyte

SIV/P-19

Biochemical Responses of Wetland Plants under Metal Stress

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Constructed wetland is novel cost effective carbon negative technology for treatment of water pollution with the help of plants (*Polygonum* sp., *Azolla* sp., *Phragmitis* sp., *Vallisneria* sp., *Hydrilla* sp. etc). Under polluted water many organic and inorganic substance are present, in which heavy metals exert many toxic effects to the plants e.g. disruption of many enzymatic reaction, change in permeability of plasma membrane (peroxidation of lipid in membrane) and tissue damage etc. In response to metal stress DNA repair, antioxidant protection system, and synthesis of low molecular weight substance having stress protector properties are activated in plants. Accumulation of heavy metal causes induction of ROS to develops oxidative stress in the plants. To overcome the toxic level of ROS plants processes antioxidant enzymes (like Catalase, SOD, POD) and non enzymatic antioxidants (Ascorbate, Glutathien). Accumulation of ROS may be consequence of disruption of balance between their production and antioxidative system activity composed of enzymatic and non enzymatic scavenger. Experiments have been performed on the bench scale to check antioxidative activity of antioxidants in response to various heavy metal like Pb, Cd, Hg etc. it has been seen that with increasing metal concentration, SOD concentration decreases sharply in roots of *Polygonum*. Catalase activity also studies in response to H_2O_2 generation. It breaks H_2O_2 into water and oxygen, reducing its toxicity. POD also catalyses H_2O_2 dependent oxidation of substrate. Experimental result indicates that stressed enzymatic and non enzymatic activity play important role in water pollution measures through accumulation and detoxification.

Key words: Peroxidase, Superoxide dismutase, Reactive Oxygen Species

SIV/P-20

Evaluation of Certain Plant Species against Human Dermatophyte (*Microsporum gypseum)*

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The use of plants for medicinal purpose, including treatment of dermatophytic infection is quite common. A study of using *in-vitro* bioassays to validate the effects of traditionally used plant extracts against the most common pathogenic fungi is necessary. Plants have been used for the therapeutic potential in various segments of society for centuries. This use has been supported by the isolation of active antifungal compounds form plant extracts. Hence during the present study carried out on certain plant species i.e. *Emblica officinalis, Ficus bengalensis, Ocimum sanctum* and *Zingiber officinale* collected from natural and polluted habitats, were evaluated for their antidermatophytic nature against human dermatophyte i.e. *Microsporum gypseum.* The antifungal activity of the above plant species was determined by using weight loss method and the percent inhibition in dry mycelial weight was calculated. Highest 82.97% inhibition due to *Ocimum sanctum* in natural habitat and 57.44% inhibition due to polluted habitat were being observed. Hence the present investigation is significant in evaluating certain plant species and determines their therapeutic relevance through standard antifungal tests.

Key words: Dermatophytic, Therapeutic potential, Relevance

SIV/P-21

Antioxidant Response and Amino Acid Profile of an Indian Rice (*Oryza sativa* L.) Cultivar Tolerant to Arsenic

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Arsenic in rice, the staple diet in many areas of the world, coupled with drinking contaminated water is leading to high occurrence of cancers specially in the poorer sections of the society. There is an urgent need for a rice cultivar which tolerates high amounts of arsenic, does not translocate it to seeds and therefore safe to be consumed by humans when grown in arsenic contaminated areas. Keeping this in view an arsenic tolerant rice cultivar has been screened out which, may be grown in contaminated areas and still be safe for human consumption. 303 rice (*O. sativa* L.) cultivars were grown in hydroponics for tolerance against inorganic arsenic species (AsIII and AsV). One cultivar showed exemplary physiological performance and was thus investigated further for antioxidant enzyme response and amino acid profiling. Arsenic accumulation at 10 µM AsV (much higher than naturally present in soil) was consistently very low even on increasing durations of exposure. Even though accumulation of arsenic was high on exposure to arsenite, the cultivar showed tolerance physiologically and biochemically. Antioxidant enzymes Guaicol Peroxidase (GPX), Ascorbate Peroxidase (APX), glutathione reductase (GR) and Catalase (CAT) showed largest stimulations in presence of arsenite. Different amino acids showed differential response to arsenite and arsenate, though not much decline was observed. In response to arsenite the induction of biomass, protein and amino acid content indicates towards production of stress proteins, increased nitrogen uptake and metabolism. The cultivar did not take up arsenic in large amounts and thus may prove beneficial for cultivation in arsenic contaminated areas, consequently, safe for human consumption.

Key words: Amino acids, Antioxidant, Arsenic, Rice

SIV/P-22

Effect of Silicic Acid on Arsenite Uptake and Antioxidant System in Rice (*Oryza sativa L.*) Cultivars in Hydroponics

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Arsenic contamination in paddy rice in the areas of West Bengal has raised much concern as rice is the subsidence diet for millions. Two rice cultivars (Triguna & IET-4786) commonly cultivated in West Bengal region were screened out on the basis of their contrast As tolerance behaviour. These cultivars grown in solution culture to investigate the effect of silicic acid on arsenite (As^{III}) uptake, NP-SH content and antioxidative defence system. Rice seedlings (*Oryza sativa* L.) were cultured in modified Hewitt nutrient solution containing three arsenite levels (0, 10 and 25 µM As^{III}) and four silicic acid levels (0, 0.5, 1 and 2 mM Si). Triguna showed more tolerance which was evident by growth response, NP-SH content and increased activity of all antioxidants, in contrast IET-4786 exhibit its sensitive nature under As^{III} stress. However, addition of Si to nutrient solution significantly enhanced the level of growth parameters, NP-SH content and antioxidant activity in root and shoot part, which was more pronounced in Triguna as compared to IET-4786 ($P \leq 0.05$). Further, best response was observed under lower dose of Si (1 mM Si) which reduces the accumulation of arsenic in root and shoot, and induces the level of thiols and antioxidants in both varieties even at higher dose of As^{III}. The study clearly demonstrated a beneficial role of Si on the antioxidant system and subsequently arsenic reduction in root and shoot parts. Preliminary observation indicates that silicic acid fertilization may reduce the grain As accumulation. Further field experiments are needed to understand the role of silicic acid for arsenic uptake and detoxification in rice.

Key words: Antioxidant, Arsenite, Rice, Silicic acid

SIV/P-23

To Study the Effect of Pb in *Brassica juncea* L. by Chlorophyll, Dry Biomass and Grade of Growth Inhibition Estimation

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Phytoextraction methods can be applied to reach the target of fallow-lands reuse and earn more incomes for farmers. In many studies, Indian mustards (*Brassica juncea*) were planted in the metal-contaminated soils to study their suitability in phytoextraction. In this pot study, *B. juncea* plants were planted in artificially Pb-contaminated soils in different concentration of Pb (0, 5, 10, 15 and 20 mg/kg) and find the effect on chlorophyll content and dry biomass of plant. In the present study we find the significant inhibition between the shoots of the control plants and the plants treated with 15 and 20 mg/kg Pb for the dry biomass, Grade of growth inhibition (G.G.I.), and the day 30 chlorophyll evaluation parameters.

Key words: Phytoextraction, *Brassica juncea,* Lead, Chlorophyll, Dry biomass, Grade of growth inhibition

SIV/P-24

Comparative Mutagenic Effects of Heavy Metals on the Somatic Cells of *Lathyrus sativus L.*

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Environmental pollution due to rapid industrialization has lead to the entry of various heavy metals in the environmental pool. These metal pollutants are non-degradable and readily absorbed by the plants and are one of

the major threats to humanity and environment. Among these, Pb, Hg & Zn were undertaken to test their efficacy on *Lathyrus sativus*. To analyse their mutagenic potentiality, germinated seeds of *L. sativus* were treated with $HgCl_2$, $PbNO_3$ & $ZnCl_2$ at 25, 50, 100, 200 & 300 ppm concentrations for 3 hrs. Mitotic index in the control sets was registered as 13.16%. In the treated sets, mitotic index was found to be reduced at each heavy metal treatment set from 25 to 300 ppm. Maximum mitotic depressive effect was rendered by $HgCl_2$ at 300 ppm which was recorded as 5.29%, while the lowest was depicted by $ZnCl_2$ as 12.99%. Percentage of mitotic abnormalities was seen to increase along with increasing concentrations with the most common abnormality of stickiness followed by scattering, unorientation, precocious movement, fragmentation, bridges, laggards, disturbed polarity, in remarkable frequency. On the basis of the results, $HgCl_2$ can be clearly pointed out as the most toxic metal salt for *L. sativus* followed by $PbNO_3$ & the least genotoxic metallic salt out of the three was $ZnCl_2$. The present results report the harmful effects of heavy metals on the genetic aspects of *L. sativus*.

Key words: Environmental pollution, *Lathyrus sativus,* Heavy metals, Mitotic index, Stickiness, Genotoxic

SIV/P-25

Chromium Induced Changes in Paddy Varieties

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Environmental Pollution has become a major problem all over the world. Among all kinds of Pollution, the problem of water pollution due to industrial effluents is getting more dimensions day by day in India. Heavy Metal is one of major pollutants present in the environment. Chromium is mainly used in various industries such as electroplating, steel works, leather tanning and chemical manufacturing. It is generally discharged along with these industrial effluent and polluted the nearby aquatic bodies. When these polluted water is used for irrigation, it will affect the growth and yield of agricultural crops. So an attempt were made to know the varietal response of paddy on chromium pollution. Ten varieties of paddy (ADT-36, ADT-42, ADT-45, ASD-16, CO-33, CO-43, CO-45, IR-20, and TKM-9) were screened against various concentrations of (2.5, 5, 10, 25, 50, 75 & 100 mg/l) chromium. The seedlings were collected and used for their morphological, biochemical and enzymatic parameters. The results showed that, the morphological growth parameters such as Germination percentage, root length, shoot length, fresh weight and dry weight were recorded. The Chlorophyll contents were estimated and it gradually decreased with increase of Cr concentration. Among the varieties, the tolerant one getting higher chlorophyll and lower proline than the sensitive one. Field experiments were also conducted to know the variation in growth and yield response of the paddy varieties to chromium pollution.

Key words: Heavy metals, Chromium, Phytotoxicity, Germination studies, Morphological parameters, Paddy varieties

SIV/P-26

Amelioration of Chromium Toxicity in *Vigna mungo* (Black gram) through Iron Application

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Chromium is a transition metal and known to stimulate the formation of free radicals, hydrogen peroxide and hydroxyl radicals. Their existence in the medium may cause oxidative damage to bio-molecules. Presence of chromium may cause hindrance in iron availability to plant that may cause deficiency of an essential nutrient along with the phytotoxicity of a heavy metal. The present study was carried out to assess the chromium toxicity on black gram (*Vigna mungo* L. var. T9) and its amelioration through iron application. Plants were supplied with different concentration of chromium (0.5, 1.0 and 1.5mM) along with pots receiving the same chromium treatments along with iron (1.0mM) as an ameliorative with a separate pot receiving iron only and a control. Different plant parameters viz. chlorophyll concentration, proline and antioxidative enzymes activity were studied to analyze the plant responses to chromium and iron. Plants receiving high concentration of chromium showed visible symptoms like chlorosis and necrotic scorches on leaves. Chlorophyll pigment decreased (63.78%) with higher concentration of chromium over control. Proline content was found to accumulate at all chromium concentrations. Iron, when supplied with chromium showed a modulation in its toxicity. An increase in fresh weight, dry weight and chloroplastic pigments (31.9%) was observed. Antioxidative enzymes showed a different trend when iron was supplied along with chromium. Catalase activity increased to 30.4% whereas that of peroxidase increased to 47.1% when iron was supplied with 1.5 mM chromium against the activity found in chromium treatment alone. Proline content was found to accumulate less in case when iron was supplied. The study concludes that black gram plant could adjust itself to grow under chromium stressed environment by regulating their metabolic process and supplementation of iron may prove helpful to plant in recovering from stress.

Key words: Chromium, Iron, Amelioration, *Vigna mungo,* Toxicity

SIV/P-27

Effect of Heavy Metals on *Marchantia paleacea* Bertol. at Different Localities of Kumaon Hills (Uttarakhand)

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Bryophytes are non vascular cryptogams and second largest group of green plants, next to angiosperms, and are considered as pioneer plant colonizers of the terrestrial habitat. These are known as good accumulators of heavy metals due to their simple morphological and physiological attributes. The accumulation of five metals *viz.*, Zn, Mn, Pb, Cu and Ni in *Marchantia paleacea* Bertol. growing at various localities in Kumaon hills has been analyzed in the present study. The concentration of the same metals were also determined in soil samples to evaluate the role of soil composition as a potential source of metals uptake by the plant. Concentration of Pb, Cu, Ni and Zn was found higher in plant samples of disturbed sites as compared to less disturbed sites. Mn concentration was higher in soil samples as compared to plant samples. Correlation analysis (r) was also performed to investigate the relationship between the soil samples and accumulation of metal in the plant. Significant accumulation ($P<0.01$) of Pb, Cu and Ni was recorded at Bhowali taxi stand (Nainital).

Key words: Bryophytes, Heavy metals, *Marchantia paleacea*, Kumaon Hills

SIV/P-28

Comparative Studies on Metal Accumulation, Growth, Antioxidants and Oil Yield of *Brassica campestris* L. exposed to Different Redox Metals(oids)

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The contamination of metals is responsible for limiting the productivity and quality of the crops in agricultural fields. The present study was undertaken to assess the differential response on metal accumulation, toxicity and oil yield of *Brassica campestris* L. exposed to different redox metals(oids) and to study the role of antioxidants. The plants of *B. campestris* grown on contaminated substrates [Cu, Cr(VI), As(III), As(V)] under simulated field conditions till maturity. The results have shown translocation of metals to the upper part and its sequestration in the leaves without significantly affecting on seed weight and oil yield as compared to control. The accumulation of As was below detection limit in the seeds, however, the accumulation of Cr was recorded as 3.15 mg Kg^{-1}. The seeds collected from Cu treated plants have shown no difference in essential metal content as compared to control. Among all the metal treatments, Cr was the most toxic as evident from the decrease in growth parameters and chlorophyll content along with high level of lipid peroxidation product. In view of above findings, it can be recommended that the plants grown on As and Cu contaminated soil can be used for oil cultivation only. The biomass of the As treated plants may be disposed off at safe place in order to decontaminate the soil due to high accumulation of As.

Key words: *Brassica campestris,* Metals, Metalloids

SIV/P-29

Differential Sensitivity of C_3 and C_4 Plants to Supplemental UV-B at Varying NPK Levels

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The metabolic reasons associated with differential sensitivity of C_3 and C_4 plant species to UV-B stress under varying NPK levels are not well understood. In the present study, spinach (*Spinacia oleracea* L. var. All Green) and amaranthus (*Amaranthus tricolor* L. var. Pusa Badi Chaulai), representatives of C_3 and C_4 plants, respectively were subjected to supplemental UV-B (sUV-B: 280-320 nm) under varying soil NPK levels. The NPK amendments were recommended NPK, 1.5 times recommended NPK, 1.5 times recommended N and 1.5 times recommended K. sUV-B caused significant damage to both the plants at all NPK levels. Same level of UV-B stress caused considerably more damage to spinach as compared to amaranthus. This was accompanied by more reductions in photosynthetic rate, stomatal conductance, water use efficiency and chlorophyll content. The reduction in photosynthetic rate was maximum in potassium and minimum in 1.5 times NPK amended plants. The oxidative damage to membranes in terms of malondialdehyde was markedly higher in spinach compared to amaranthus. Amaranthus had significantly higher UV-B absorbing compounds than spinach. Nitrogen use efficiency (NUE) in spinach reduced minimally under sUV-B radiation in N deprived potassium amended plants whereas maximally in amaranthus. Phosphorus Use Efficiency (PUE) of amaranthus reduced under sUV-B at all NPK levels while spinach showed increased PUE under sUV-B except at recommended NPK, with maximum increment at 1.5 times recommended NPK. Potassium use efficiency (KUE) reduced in both the plants grown at 1.5 times recommended K under sUV-B radiation with higher reduction in amaranthus. These findings suggest that the differential sensitivity of spinach and amaranthus to UV-B stress under varying NPK levels are partially governed by their ability to utilize the individual nutrients. Photosynthetic pathway of C_4 plants, amaranthus seems to tolerate UV-B stress more than C_3 plant, spinach under similar UV-B stress and nutrient levels.

Key words: Supplemental UV-B, C_3 and C_4 plants, Nutrients, Photosynthesis, Nutrient use efficiency

SIV/P-30

Variation in Microbial Biomass and Crop Yield in Rainfed Agroecosystems: Impact of Interaction of Herbicide and Soil Amendments of Contrasting Resource Quality

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In rainfed drylands, growth of weeds is one of the major problems where weed infestation is more severe than in the irrigated cropland. Proper weed management can attribute to considerable enhancement in crop yield; however, it posses a great challenge. Herbicides are generally used extensively for control of weeds. In dryland, soils are limited not only by nutrient availability but also by soil moisture, addition of exogenous soil amendments is essential to maintain the crop productivity. When soil amendments are applied with herbicide, interactions may cause alteration in the effectiveness of herbicides on the dynamics of microbial biomass and crop yield.

This study aims to evaluate the impact of interaction of herbicide with soil amendments of contrasting resource quality on soil microbial biomass and crop yield under the rice-wheat-summer fallow crop sequence in rainfed agroecosystems. The experimental design involved the application of the following treatments (having equivalent amount of N) studied were: (1) Recommended dose of herbicide (Butachlor; 2 kg a.i. ha^{-1}; HC), (2) HC+Chemical fertilizer (CF), (3) HC+*Sesbania* shoot (SS), and (4) HC+wheat straw (WS), (5) HC+farmyard manure (FYM) and (6) Control (no input; CO). Throughout the annual cycle, addition of HC increased the levels of microbial biomass C (MBC) marginally relative to control. However, combined application of HC with various soil amendments showed higher increase in the levels of soil MBC throughout the annual cycle. Throughout the annual cycles higher level of MBC was accumulated in HC + SS (+70 % increase over CO). The pattern followed by total crop yield (i.e., rice yield+wheat yield) was found to be: HC+SS>HC+CF>HC+FYM>HC+WS>HC>CO. Variability in crop yield was found to be regulated by the variations in the levels of soil MBC. It is concluded that in these agroecosystems, application in combination with soil amendments of contrasting resource quality could help sustain soil fertility and maintain higher crop yield in rainfed agro-ecosystems.

Key words: Microbial biomass carbon, Crop yield, Resource quality, Soil fertility, Rainfed agroecosystem

SIV/P-31

Mitigating Effects of Salicylic Acid against Herbicidal Stress

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Pendimethalin [N-(1-ethyl propyl)-2,6-dinitro-3,4 xylidine] is one of the most commonly used herbicide. It also induces harmful effect on non-target plants besides controlling the weed emergence. Salicylic acid (SA) is found to play an important role in abiotic stress tolerance. So, the aim of the present study was to assess the comparative efficacy of SA in combination with different concentrations of pendimethalin (P) on black gram (*Vigna mungo*). The seeds of test plant were treated with field relevant concentrations (2.5, 5.0 and 10 ppm) of P and also in combination with SA (0.5 mM) to observe ameliorative effect of SA against herbicide toxicity. Experiment was performed in petri dish as well as in pot culture. The toxic effect of P and SA on seed germination (SG), radicle length (RL) and mitotic index (MI) was evaluated in petri dish culture. However, in pot culture seedling height, average growth rate (AGR), pigments, protein, sugar contents and lipid peroxidation of 15 days old seedling were measured. Total antioxidants (TA) were monitored as plant defence against oxidative stress. Results showed that SG and seedling growth of *Vigna mungo* decreased under P_1, P_2 and P_3 treatment. RL and MI were also reduced significantly ($p<0.01$) in treatments with herbicide but reduction was more pronounced in P_3 treatment. A slight increase of SG and seedling growth was observed in P_2 treatment compared to P_1 treatment. Herbicide treatment remarkably ($p<0.001$) declined pigment, protein and sugar contents of the seedlings when compared with control. TA along with malondialdehyde content increase significantly ($p<0.01$) under P treated seedlings. Combined treatment (P+SA) were found to elevate the growth of the seedlings. As a consequence of herbicidal stress SA enhanced SG, RL, MI, pigment, protein and sugar content significantly. Under combined treatment, LP and TA were observed to decline when compared with P treatment. SA enhanced growth of *Vigna mungo* not only in combination with P but also increased growth when seed treated with SA alone as compared to control. Thus in the present work, the role of SA in protection of *Vigna mungo* plant against herbicidal stress is apparent.

Key words: Pendimethalin, *Vigna mungo*, Salicylic acid, Total antioxidant, Mitotic index

SIV/P-32

Heavy Metal Concentration in Coastal Sediments: Its Impact on Mangroves

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Heavy metals have a great ecological significance due to their toxicity and tendency to accumulate in both sediment and biota. Sediment is an important component of an ecosystem which serves as an excellent archive of past environmental events. Toxic and non-biodegradable heavy metals accumulate in plants through complex physical and chemical absorption mechanisms. However, the nature of the sediment matrix provides a favorable condition for the adsorbed chemical compounds. Textural analysis of a 5m deep sedimentary core retrieved from Gaddilam Estuary, Tamil Nadu, (subsampled at 2 cm intervals) shows the predominance of fine sandy clay with intermittent short clayey zones. The results indicate high salinity (average 2.2

ppt. and maximum 3.0 ppt.) and pH (average 8.0) in the clayey sediment which restricts the thorough percolation of salts through capillary action. Therefore the clayey bands in between the cores show comparatively high concentration of heavy metals such as Ag, Ba, Co, Cu, Fe, Mn, Mo, Ni, Pb, Rb, Ti and Zn. The intermittent sandy clay phases, which are likely to have comparatively larger pore sizes between soil particles, show low salinity (average 1.5 ppt. and maximum 1.8 ppt.) and pH (average 7.3) due to percolation and capillary translocation of salts and heavy metals. Restriction of inland water input to estuaries by damming water for agriculture and various other purposes coupled with weak monsoonal pattern allows excess water evaporation from exposed wetlands. This results into salt accretion and increase in salinity. Low energy Rivers/ streams flowing in gentle relief deposits fine silty/ clayey sediments in the wetlands that act as reservoirs of high salt and heavy metal accumulation which is vulnerable for a mangrove forest. The input of heavy metals could be natural and due to enhanced anthropogenic activity in the coastal zone such as industrial and agricultural expanse.

Key words: Heavy metal, Coastal sediment, Mangroves, Salinity, Salt accumulation

SIV/P-33

A Study on Suitability of Fly-ash and Press Mud for Sunflower Productivity

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This study is aimed to check the suitability of fly-ash (FA) as soil conditioner in the combination of organic amendment with press mud (PM) for a better growth and yield of sunflower. The application of fly-ash and press mud in the garden soil (GS) can help in enhancing nutrient availability in the medium and thus can promote plant growth substantially because of having abundant amount of essential elements required for plant growth. The biomass of sunflower plant was more in 25% and 50% FA treatment with press mud than 25% and 50% FA treatment with soil in pre-flowering stages but in flowering stage the biomass of sunflower plant on FA/GS composition was higher. Therefore growth performance of *H. annuus* was found to be the best in FA/GS compositions. In spite of this the recommendation for the large scale application of fly-ash to the agricultural soils in a region can not be made unless extensive trials are made to find out a proper combination of fly-ash with each type of soil and for each crop to be grown in the region.

The yield of sunflower plants in terms of seed output was better in case of FA/PM composition (10% and 25%) than FA/GS compositions. Following the results as noticed in present study it may be concluded that use of press mud on a large scale doesn't favour the process of pigment content formation in plant and along with fly-ash press mud causes considerable accumulation of metal content in root and leaf of plant. The root, as compared to leaf, accumulates greater amount of metals when lower concentrations (10% and 25%) of fly-ash are mixed with soil but when concentration exceeds to 50% or more, foliar concentrations become appreciable.

Key words: Fly-ash, Press mud, Garden soil, Sunflower, Composition

SIV/P-34

Effect of Nitrogen Addition on Invasive Woody Shrub *Lantana camara* L.

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Nitrogen cycling is greatly affected by anthropogenic activities. Because of anthropogenic N input species from nutrient-poor conditions may be displaced by a few fast-growing and highly competitive species. Further plant invasion is known to be the second most important factor for the species loss after habitat destruction. In the present study *Lantana camara* was exposed to four different levels of exogenous N (0 (N_0; used as control), 30 (N_1), 60 (N_2) and 120 (N_3) Kg N ha^{-1})) to study its performance under global change scenario of excess N. *L. camara* has shown a significant linear increase in the shoot length and biomass with increasing N. At the highest N input 335% increase in plant biomass was observed. In addition RGR and NAR also increased due to N input. Therefore, it may be expected that increased levels of soil N can potentially favour the invasive *L. camara* in near future.

Key words*:* Global change, Plant invasion, Nitrogen, Performance

SIV/P-35

Rhizobium (VR-1 and VA-1) Inoculation Induces an Increasing Growth and Metal Accumulation Potential in *Leguminous Plants Growing under Fly-ash*

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Fly-ash tolerant *Rhizobium* strains were isolated from leguminous plant grown in fly-ash contaminated soil, axenically under laboratory conditions. Saplings of plants were raised in N_2-free Jenson medium and inoculated with 2.6×10^8 cell ml^{-1} and 5.2×10^8 cell ml^{-1} of culture after 10 d of growth. Plants were transferred into 100% fly-ash under natural condition. *Rhizobium* inoculated plants grown on 100% fly-ash showed marked increase in relation to root-shoot length, biomass yield, photosynthetic pigment, protein content and nodulation frequency as compared to uninnoculated plant grown in control (100% fly-ash).

Inoculation of fly-ash tolerant *Rhizobium* increased the accumulation of Fe, Zn, Cu Cd and Cr in different tissue *vis-à-vis* enhanced translocation of metals to the above ground part of plant. Although inoculation of fly-ash tolerant *Rhizobium* strains (VR-1 and VA-1) enhanced the translocation of more Fe to shoot parts However, the amount of *Rhizobium* inoculants supplied to the plant was found to be very important since it has a positive role in increasing plant growth through increased N_2 supply via nitrogenase activity. Our results suggest that an integrated approach employing biotechnological means and inoculation of plants with host specific fly-ash tolerant *Rhizobium* strain may prove a stimulus to fly-ash management programme.

Key words: Fly ash, Rhizobium, Leguminous plant

SIV/P-36

Assessment of Fluoride in Ground Water of an Industrial Areas and Evaluation of Phytotoxic Effect of NaF on the Growth Parameters of *Cucumis sativas*, *Lagenaria Siceraria* and *Abelmoschus esculentus*

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Fluoride and fluorine are the air, water and soil pollutant which are extremely harmful for both humans and plants. Fluoride content was determined in the ground water of an industrial area situated in Asoha Block of Unnao district, it ranged from 0.0064 ± 0.0003 to 5.63 ± 0.06 mg L^{-1}. Almost all the samples assessed showed fluoride content that was found beyond the Maximum Acceptable Concentration (MAC) i.e. 1.5 mgL^{-1} in drinking water due to the percolation and leaching of industrial effluent, which affects the growth parameter. The characteristic symptoms are visible in the seed germination, carotenoids and chlorophylls. The concentration range of NaF (1 mM to 20 mM) suppressed germination index, % phytotoxicity, vigour index, speed germination, root length, shoot length and pigment of *Cucumis sativus Lagenaria Siceraria,* and *Abelmoschus esculentus* plant. The seed of *Lagenaria Siceraria* are more sensitive in higher concentration of NaF than other two crops. The chlorophyll-a, chlorophyll-b and carotenoids showed a NaF induced declining pattern in all the crops.

Key words: Industrial area, NaF, Phytotoxicity, Potable water

SIV/P-37

Salicylic Acid Better Alleviates Cadmium Toxicity than Calcium and Silica by Upregulating Antioxidant Status and Many Constitutive Proteins

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Cadmium (Cd) is potent heavy metal pollutant and drastically affects plant growth and productivity. Attempts have been made by various groups of workers to look for chemical and natural means for alleviation of Cd toxicity. In the present study, we have investigated the comparative ameliorating effect of salicylic acid (SA), calcium (Ca), and silica (Si) on Cd toxicity in rice plants. These chemical substances are involved in various physiological processes and are also associated with stress tolerance in plants. Cd toxicity in rice plants leads to excessive production of ROS (reactive oxygen species), oxidative stress, proteolysis and sharp increase in activity of many antioxidative enzymes. Pretreatment of rice seedlings with 30μM SA, 2mM Ca and 200μM Si reduced oxidative stress as well as proteolytic damage induced by Cd. With high resolution SDS-PAGE, it was observed that SA pretreatment promoted the expression of many such proteins, which were apparently absent or down regulated in Cd stressed plant parts as compared to Ca and Si. CBB (colloidal comassie blue) stained proteomes generated from Cd-stressed and SA-pretreated plants involving isoelectric focusing (pH 3-11) followed by 2-D electrophoresis, revealed many proteins constitutively present in control and Sa-pretreated plants but absent in Cd-treated plants. Protein spot pattern obtained were characterized for their constitutive and inducible expression. It was observed that SA pretreatment regulates many proteins toward their normal level of expression. These results suggest that exogenous application of SA is advantageous in combating Cd toxicity in rice plants compared to Ca and Si.

Key words: Cadmium, Salicylic acid, SDS-PAGE, 2-D electrophoresis, Isoelectric focusing

SIV/P-38

Improvement in Seedling Growth and Nitrogen Use Efficiency in Cucumber (*Cucumis sativus* L.) in Presence of Salicylic Acid

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Plants count on a wide variety of metabolic, physiological, and developmental responses to adapt their growth to variations in mineral nutrient availability. To react to such variations plants have evolved complex sensing and signaling mechanisms that allow them to monitor the external and internal concentration of each of these nutrients, both in absolute terms and also relatively to the status of other nutrients. Recent evidence has shown that hormones participate in the control of these regulatory networks. Conversely, availability of mineral nutrients influence hormone biosynthesis, which regulates nutritional homeostasis under adverse environmental conditions.

Salicylic acid an endogenous growth regulator is involved in the defense mechanism in plants under various stress conditions. Present study was conducted to determine the effects of salicylic acid (10 to 500 μM) on seedling growth, development and nitrogen use efficiency in cucumber (*Cucumis sativus* L.) plants with or without nitrogen nutrient. Salicylic acid increased contents of chlorophyll, total non-structural carbohydrate and total

nitrogen, as well as nitrate assimilation through the induction of nitrate reductase (EC 1.6.6.1) activity in isolated cucumber cotyledons. Accumulation of salicylic acid was 2 folds higher in cotyledons without nitrate supply in comparison to that with nitrate supply. Further, germination percentage, root length, Shoot length and dry mass of cucumber were increased significantly at 50 µM of SA. While, higher salicylic acid concentrations inhibited above physiological characteristics. The present results showed that, field application of salicylic acid need optimum physiological concentration (e.g., 50 µM) to increase nitrogen use efficiency particularly during germination and seedling growth.

Key words: Cucumber (*Cucummis sativus* L.), Cotyledons, Nitrate-nutrition response, Nitrate reductase activity, Salicylic acid

SIV/P-39

Sodium Azide Induced Chromotoxicity and Mutagenecity in Sesbania Pea (*Sesbania cannabina* Poir.)

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Mutation breeding program is used to produce useful variations in quantitatively and qualitatively inherited traits. Chromosomal aberrations caused by mutagen are an important tool in cytogenetical studies. *Sesbania cannabina* commonly known as 'dhaincha' in India is adaptible to different adverse climatic conditions such as water logging, drought etc. and is widely used as green manure crop and may have potential as forage for cattles. The objective of present cytogenetical investigation was to study mutagenic effectiveness and efficiency of sodium azide in *Sesbania cannabina*. Seeds of *Sesbania cannabina* variety ND-1 were treated with 0.5% solution of sodium azide for different time durations viz. 3, 5, 7 and 9 hr and sown to raise M1 generation and its effects on seed germination, survival percentage, pollen fertility and cytological parameters were studied. Pollen fertility was highest in control as compared to treated sets and it decreased as the treatment doses increase. Plants grown from treated seeds of all doses showed diversity among themselves regarding their pollen fertility and cytological characters. The diifferent type of chromosomal abberations included; C-metaphase, precocious movement, unoriention, disturbed metaphase, lagging chromsome, bridge formation, stickiness and desynapsis etc. Meiotic aberrations were also found to be increased as the doses of treatment increase.

Key words: *Sesbania cannabina,* Sodium azide, Chromosome aberrations, Pollen fertility, Meiotic aberrations

SIV/P-40

Alterations in Growth and Physiology of Wheat in Lead-Contaminated soil

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Of the various elements present in the soil, some are without any biological function. Rather, they are absorbed by the plants, and are toxic even at low concentrations. In fact, the contamination of environment by toxic metals has become a worldwide problem. They affect crop yield, soil biomass and fertility, persist in the environment, and bioaccumulate in the food chain to levels that could harm humans. Lead (Pb) is non-essential heavy metal that occurs naturally in earth's surface and is released into the environment from a range of anthropogenic activities. We conducted a series of experiments to evaluate the impact of lead-contaminated soil on the growth and biochemical aspects of wheat plant under soil-culture conditions. Pb (500-2500 μM) was supplied as solution to soil to achieve stress conditions in comparison to unstressed, water treated, control variant. Plants were exposed to Pb solutions for one-month under experimental dome conditions and various morphological and biochemical observations were recorded after 7, 15 and 30 days. Growth parameters, such as root length, shoot length and dry weight exhibited a significant decline with increasing Pb concentrations. In addition, the level of photosynthetic pigments decreased upon exposure to various Pb concentrations in a linear manner. It was accompanied by reduced Photochemical Efficiency of PSII indicating interference with photosynthetic activity. Further, Pb exposures significantly reduced cellular respirations and root oxidizing ability, and enhanced malondialdehyde content and hydrogen peroxide accumulation in wheat plants. These observations indicated a Pb-induced stress in wheat plants. Further investigations revealed a significant alteration in the activities of scavenging enzymes, viz. superoxide dismutases, peroxidases, and catalases. The study concludes that the growth of wheat was severely reduced in Pb-contaminated soil and it involved alteration in the oxidative metabolism of wheat.

Key words: Lead pollution, Wheat, Oxidative metabolism

SIV/P-41

Nickel Inhibits Plant Growth and Causes Oxidative Damage

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Nickel (Ni) being an essential mineral nutrient is required in trace amounts in natural soils; but, it is highly toxic above the critical concentration. However, various anthropogenic activities have resulted in enhanced Ni levels in the soil. It has deleteriously affected a number of physiological and biochemical processes involved in the growth and metabolism of the plants. We conducted a series of experiments to examine the toxic effect of Ni on maize (*Zea mays* L.). Ni treatment (5-50µM) was given to hydroponically grown maize roots from 2 to 6 days. In this study, we investigated the effect of Ni on seedling growth, dry weight, photosynthetic pigments and photosynthetic

efficiency. The observed growth inhibition was explained in terms of reactive oxygen species (ROS)-induced oxidative stress. Ni toxicity was associated with enhanced lipid peroxidation (malondialdehyde and conjugated dienes) and H_2O_2 content in *Zea mays* roots. A significant alteration was also observed in antioxidant scavenging enzymatic machinery upon Ni exposure. The study concluded that Ni inhibits plant root growth through ROS-mediated oxidative damage.

Key words: Nickel, *Zea mays*, Antioxidants

SIV/P-42

Chromium (VI) Induces Oxidative Damage in Rice (*Oryza sativa*) by Damaging Cell Membrane

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Chromium (Cr) is the 7th most abundant metal in the earth's crust and is released into the environment from various anthropogenic activities. Out of various valence states, Cr (III) and Cr (VI) are the most stable. For the present study, Cr (VI, hereafter referred to as Cr) used as $K_2Cr_2O_7$ (potassium dichromate) was selected and its phytotoxicity on rice (*Oryza sativa*) evaluated. Both root and shoot length of rice seedlings decreased with increasing Cr concentrations (100-500 µM). Cr also led to excessive ion leakage and increased amount of malondialdehyde content and generation of reactive oxygen species suggestive of its impact on membrane damage. The biochemical studies were in confirmation with *in-situ* histochemical studies which indicated the interference of Cr with cell membrane. In addition to this, Cr stress altered the activities of various antioxidant enzymes such as superoxide dismutases, catalases, Ascorbate peroxidases, guaiacol peroxidases, and glutathione reductases. The results suggested that Cr retarded the seedling growth of *O. sativa* as a function of increased content of oxidative stress markers and alterations in scavenging enzymatic machinery.

Key words: Chromium, Oxidative damage, Biochemical response, *Oryza sativa*

SIV/P-43

Effect of Chlorides of Cobalt, Nickel and Lead on Saplings of *Acacia nilotica*

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Since the dawn of the Industrial revolution, mankind has been introducing numerous hazardous compounds in to the biosphere but the heavy metals pose severe threats to the environment long-term basis and non-reversible, when they found in the environment beyond the critical point. The entry of metals in to the environment results from either natural processes or human activities particularly disposal of industrial effluents waste and use of agrochemicals. Many of the metallic compounds are retained in soils and do not easily percolate and ultimately pose a threat to ecosystems. There is an urgent need to reduce excess metals present in soil, sediments and water bodies to further check the environmental contamination.

The present study is targeted to work out the capacity of *Acacia nilotica* as bio-pollutant reducing agent to further devolvement of eco-friendly environment of pollution hazard zone like industries, mining, urban etc. Fast growing *Acacia nilotica* member of leguminosae, is a moderate-size evergreen tree of Indian content and can grow on a variety of soils with deep root system and drought-resistant. It is commonly grown along roadsides, canal banks and in agricultural land. It is used as firewood, small timber and for medicinal.

The seven concentrations *viz;* 0, 100, 200, 500, 700, 1000 and 2000 ppm of Cobalt chloride, Nickel chloride and Lead chloride were used on the basis of dry weight of soil filled in the container (1.3kg). Uniform sized and shape of seeds treated with hot water (85^0C) for breaking the hard seed coat dormancy and well soaked three seeds were sown the in each container. After emergence and establishment of seedlings thinning was done to maintain one seedling in each container. Experiment was framed on CRD design and the data were generated for seed emergence and survivorship; growth of shoot and root; nodule formation; with Eco-physiological growth behaviour *viz.;* Relative Growth Rate (RGR), Net Assimilation Rate (NAR) and Leaf Area Ratio (LAR) and discussed in light of different concentration and toxicity of pollutants as well tolerant capacity of most common and indigenous species *A. nilotica*.

Key words: *Acacia nilotica*, Cobalt, Nickel, Lead, Soil pollution, Growth performance

SIV/P-44

Salicylic Acid Induced Changes in Antioxidative Responses in Salt Stressed Wheat Seedlings

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The present study investigates the role of salicylic acid (SA) in inducing plant tolerance to salinity in wheat. The effect of 0.1 and 0.2 mM SA via root was investigated on growth, dry matter yield, membrane stability index (MSI) lipid peroxidation, hydrogen peroxide chlorophyll and carotenoid concentration and antioxidative enzyme activity in NaCl (50 and 100 mM) stressed wheat (*Triticum aestivum* var. UP-2338) seedlings. Compared to salt stressed plants SA treatment decreased the content of H_2O_2 and TBARS. A beneficial effect of SA on antioxidative enzyme activity and decrease in oxidative stress was observed. SA increased chlorophyll and carotenoid concentration, relative water content (RWC), membrane stability index (MSI) and total biomass over salt stressed plants. The result suggests that SA

can mitigate the adverse effect caused by salt stress.

Key words: Salinity, Salicylic acid, Oxidative stress, Membrane stability

SIV/P-45

Involvement of Nitric Oxide in Alliviation of Cadmium Toxicity in Wheat (*Triticum aestivum*)

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The effect of nitric oxide (NO) on cadmium toxicity in wheat plants (*Triticum aestivum*) was investigated. Plants subjected to 0.2 mM cadmium chloride exposure were treated with 0.05, 0.1, 0.2 and 0.5 mM sodium nitropruside (SNP, a NO donor). The results indicated that 0.1 and 0.2 mM SNP alleviated cadmium toxicity by increasing plant growth and biomass production while 0.05 and 0.5 mM were not so effective. Cadmium toxicity caused decrease in plant length, biomass production and chlorophyll concentration. Exogenous NO increased chlorophyll concentration and inhibited lipid peroxidation by decreasing TBARS and H_2O_2 accumulation in leaves of wheat subjected to cadmium toxicity. Cadmium toxicity induced decrease in superoxide dismutase (SOD), catalase (CAT), and peroxidase (POD) activity, resulting in increase in hydrogen peroxide (H_2O_2) concentration and lipid peroxidation. Application of NO donor SNP to Cd toxic plants provided protection from oxidative damage by modulating enzyme activity and lowering lipid peroxidation.

Key words: Cadmium toxicity, Nitric oxide, Oxidative damage

SIV/P-46

Phytotoxic Effect of Boron on Seed Germination and Biochemical Changes in the Cotyledons and Embryonic Axes of Mustard

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Boron is involved in various industrial processes such as glass, ceramic, detergent and soap industries which result in the accumulation of boron in industrial wastes which then permeate into the natural environment. Boron is an essential element for the optimum growth and development of plants but it is phytotoxic if present in excess amounts. Hence it is proposed to study the phytotoxic effect of boron during early germination stage in seeds of mustard (*Brassica juncea* L. var. Varuna). For this seeds were sown in petridishes with varying concentrations of boron (0, 0.33, 3.3, 33, 330 mM) in seed germinator. Germination percentage, vigor index and percentage phytotoxicity in seeds were studied. Concentration of H_2O_2, TBARS, sugars, starch, phenols and activities of antioxidative enzymes were determined in the seedling components. Seed germination and vigor index was found to be decreased and percentage phytotoxicity was increased in seeds with increase in the concentration of boron in germinating solution. There was accumulation of sugars and phenols and decreased starch concentration in cotyledons and embryonic axes of growing seedling with increasing boron stress. Boron toxicity caused accumulation of H_2O_2 and TBARS concentration and also affected the antioxidative enzyme activity in growing seedling components. The result of the present study indicates that toxicity of boron disturbed the mechanism of germination in seeds via influencing the carbohydrate, phenol and oxidative metabolism in seedling components at early stages of growth.

Key words: Boron toxicity, Carbohydrates, Oxidative stress, Phytotoxicity, Phenols, Seed germination

SIV/P-47

Modulation of Antioxidative Responses of Faba Bean (*Vicia faba* L. var. VH-130) by Excess Boron Supply in Sand Culture

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In this study we explored the induction of oxidative stress by excess of boron (3.3 and 33 mM B) in plants of *Vicia faba* L. var.VH-130 under glass house conditions. Plants subjected to excess boron showed retardation in growth along with yellowing followed by scorching of old leaf apices. Excess of boron enhanced lipid peroxidation (MDA), concentration of H_2O_2, proline, total phenols, ascorbate and decreased concentration of chloroplastic pigments in the young leaves. The activities of enzymes polyphenol oxidase (EC 1.14.18.1; PPO), ribonuclease (EC 3.1.1.22; RNase), super oxide dismutase (EC 1.15.1.1; SOD), ascorbate peroxidase (EC 1.11.1.11; APX), catalase (EC 1.11.1.6; CAT) and peroxidase (EC 1.11.1.7; POD) increased in leaves supplied excess boron. However, the activity of glutathione reductase (EC 1.6.4.2; GR) was depressed. Marked accumulation of phenols, MDA and H_2O_2, suggested peroxidative damage to membrane lipids, typical of damage from reactive oxygen species. It is, therefore, concluded that excess B (3.3 and 33 mM) induced oxidative stress despite of increased antioxidant production. There was no correlation between tissue boron concentration and boron supplied to plants.

Key words: Boron, SOD, MDA, Oxidative stress, *Vicia faba*

SIV/P-48

Effect of UV–B on Nitrate, Phosphate and Ammonium uptakes in Protein Rich Microalgae Chlorella and Spirulina

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The increasing incidence of UV-B on the earth's surface due to stratospheric ozone depletion is highly

deleterious to many physiological processes in several microalgae. Nitrate, phosphate and ammonium uptake mechanism were severely affected by long-term UV-B exposure in protein-rich microalgae Chlorella, a green alga and blue-green cynobacterium Spirulina. Chorella is highly sensitive than Spirulina. But, nitrate and phosphate uptake were stimulated by 2.5 Wm^{-2} UV-B exposures for short duration in both microalgae. In contrast, ammonium uptake was inhibited for short periods and later stimulated by UV-B exposure in Spirulina. UV-B enhanced the nitrate uptake stimulation in nitrate deficient media for short periods in both microalgae, higher than photosynthetic active radiation (PAR). Dark incubation to UV-B treated Chlorella and Spirulina culture diminished the nitrate, ammonium and phosphate uptake efficiency. Increasing uptakes stimulation were observed up to certain limit by fluorescent light to UV-B treated cultures which were still higher in cultures exposed to UV-B for longer periods.

Key words: UV-B, Nitrate, Phosphate and Ammonium uptakes, Chlorella, Spirulina

SIV/P-49

Effect of Particulate Pollutant on Chlorophyll of Rice Leaf

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The study was made to assess the effect of stone crusher dust on chlorophyll in rice leaf. The concentration of chlorophyll a, chlorophyll b and total chlorophyll in unit fresh weight of pollutant leaves were always lower than those in control rice plant. An increasing trend of chlorophyll till the flowering of the plant and thereafter reduction in chlorophyll concentration were found.

Key words: Stone crusher dust, Chlorophyll, Rice leaf

SIV/P-50

Ayurvedic Medicinal Plants Response in Seed Germination and Vegetative Growth to Abiotic Stress: Induced Heavy Metal Zinc and its Ayurvedic Preparation i.e. *Yasad Bhasm*

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The aims of this study were to evaluate the growth response and zinc accumulation of selected medicinal plants towards varying concentration of zinc and its translocation to an ayurvedic preparation (i.e. *Yasad Bhasm*). For this, selected medicinal plants (*Triogonella foenum-graceum, Coriander sativum* and *Occimum basilum* were cultured in experimental pots treated with varying concentrations of zinc (0, 10, 25, 50, 100, 200 and 400 mg pot^{-1}) and studied the germination profile, growth response and translocation of heavy metal from vegetative parts to *Yasad Bhasm*. Furthermore, attempts were also made to compare the difference in pharmacological characters of plants grown in zinc treated and non treated soils and heavy metal translocations from harvested plants to subsequent ayurvedic preparations. Differences were observed in total ash, insoluble ash, alcohol extractive alkolids, tannin, carbohydrate, saponin, protein, glycosides oil and flavonid contents of plants grown in varying heavy metal concentration. The study also finds a significant variation in stomatal index, palside ratio and fluorescence and zinc content in Yasad Bhasm.

Key words: Medicinal plants, Zinc, Ayurvedic preparations, *Yasad Bhasm*

SIV/P-51

Effects of Atmospheric Deposition on Organic Farming: Soil Fertility Stability and Heavy Metal Accumulation in *Vicia faba* L.

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Green revolution although substantially enhanced grain production, yet at high environmental cost in terms of eutrophication due to multifold increase in fertilizer use and health risks due to toxic contamination of pesticides and heavy metals. This has led organic farming to emerge as one of the most promising hazard free and sustainable agricultural practice. The aim of this study was to investigate soil fertility stability and accumulation of heavy metals in a dietary vegetable, broad bean (*Vicia faba* L.) under the influence of atmospheric deposition at Varanasi. Pot–culture experiments were conducted using *Vicia faba* grown in earthen pots containing garden soil as control and with following amendments: soil with synthetic fertilizer (recommended dose of N, P, K); soil with farmyard manure (4:1 ratio) and soil with vermicompost (9:1 ratio). Pots were placed at two study sites namely Banaras Hindu University campus receiving low atmospheric deposition of heavy metals, and Ramnagar receiving high level of heavy metal input through atmospheric deposition.

The results indicated that the atmospheric deposition substantially enhanced heavy metal accumulation in test crop and the accumulation appeared maximum in leaves followed by shoots, roots and seeds. Metal accumulation was found to be significantly higher at Ramnagar in comparison to BHU site and the trend appeared as Zn>Pb>Cr>Cu>Cd. At BHU site, however, Cr accumulation in plant parts superceded the Pb. Organic amendment led to decreased heavy metal accumulation especially in roots and seeds of *Vicia faba*. The decreases in vegetable accumulation of Cd, Cr and Pb were more effective for soil amended with farmyard manure in comparison to those amended with vermicompost. Furthermore, organic amendments significantly increased microbial biomass-C (C_{mic}), activity (measured in terms of substrate induced respiration, SIR) and specific respiration of biomass (qCO_2) in cultivated soil. However, between site comparisons indicated that C_{mic} and SIR declined by 7-11% and by 9-17 % respectively at Ramnagar site receiving high atmospheric input of heavy metals. The study indicate that

organic amendment although reduce heavy metal accumulation in *Vicia faba*, induces destabilizing effect on soil fertility stability. This has relevance from agricultural sustainability perspective.

Key words: Atmospheric deposition, Heavy metal, Microbial biomass, Organic farming, Sustainable agriculture

SIV/P-52

Air Pollution Effects on Chlorophyll *a* Content of Deciduous Tree Species - Statistical Analysis of the Relationship

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Effects of air pollution on chlorophyll *a* content of three deciduous roadside trees namely *Cassia siamea*, *Pongamia pinnata* and *Delonix regia* exposed to vehicular emission was assessed at one of the busiest traffic intersection (ITO) in Delhi. Chlorophyll *a* data was collected following the extraction method described by Hiscox and Israelstam (1979) during the vegetative growth period of tree sp. i.e. from June to August, at an interval of 7 days for two consecutive years 2008 and 2009. Air pollution data for the site was obtained from Central Pollution Control Board (CPCB). The air pollution monitoring station was situated in the radius of 500 m from the tree sampling site. Meteorological data was collected with pocket weather station at the same time of each sampling day. Statistical approach of the study was focused to investigate the relationships between chlorophyll *a* content (response variable), air pollutants and meteorological variables (predictor variables). Statistical analysis was conducted using correlation coefficient and regression techniques, which suited best the multiple-stress approach that was used as a theoretical background. The fitted model was based on multiple linear regression equation which helped in selection of significant variables. The method of stepwise forward regression was used to select most influencing variables. Predictor variables used in the stepwise analysis was air temperature, relative humidity, wind speed, dew point, SO_2, NO, NO_2 and O_3. After a first selection of linear relationships, improvement of the relationships was sought in non-linear relationships using curve fitting. According to the correlation coefficient results, less to moderate relationship was established with pigment concentration and pollutants. Leaf samples of *C. siamea* showed significant relationship with NO and SO_2. All models selected by multiple linear regression analysis was significant at $p>0.05$. Results indicate that the response of chlorophyll *a* content in the leaf tissue of each tree species had different association with the predictor variables. Selection of predictor variable for *C. siamea* and *P. pinnata* were very much similar. Behavior of *D. regia* was different from others as no meteorological variable was selected. None of the species select temperature as significant variable. Observing the magnitude of coefficients (*B*), values were not very high but most of obtained coefficient showed significant contribution in the model except for SO_2. NO_2 had significant affect (at $P>.05$) on chlorophyll content of all the species which shows the influence of direct vehicular emission. O_3 had significant contribution in the model when combined with meteorological variables relative humidity and wind speed. Regression curve fit results showed that O_3 fitted cubic model with all the three species. NO_2 showed power fit with *C. siamea* and compound with *P. pinnata* and *D. regia*. NO fitted quadratic with *P. pinnata* and cubic with other two species. SO_2 fitted linear curve with all the species.

Key words: Chlorophyll a, Higher trees, Air pollutants, Correlation, Regression

SIV/P-53

Aluminium Toxicity Leads to Differential Expression of Antioxidative Enzymes in Rice Cultivars Differing in Aluminium Tolerance

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Aluminium (Al) toxicity drastically affects crop productivity in acid soils, with pH below 5.5. In order to examine whether antioxidative defense system is associated with prevention of Al induced toxicity in rice seedlings, production of reactive oxygen species (ROS), extent of oxidative stress generated and activity behaviours of antioxidative enzymes were determined in growing seedlings of rice (*Oryza sativa* L.) cultivars differing in Al tolerance. Experiments were conducted in sand cultures using Al-sensitive rice cv. HUR-105 and Al-tolerant cv. Vandana. Yoshida nutrient solution served as control and nutrient solutions containing 177 µM and 418 µM Al^{+3} served as treatment solutions. Seedlings raised for 5 days in 0.5 mM $CaCl_2$ were transferred to sand cultures containing nutrient and treatment solutions. When rice seedlings were raised for 3,6,9,12 days in presence of Al^{+3}, increased production of the ROS $O_2^{\cdot-}$, H_2O_2 as well as increased lipid peroxidation and protein oxidation were observed in the seedlings. The extent of ROS production and degree of oxidative stress were greater in the seedlings of Al sensitive cultivar than the tolerant. Al tolerant seedlings showed insignificant increase or decline in the levels of ROS when subjected to Al-stress. Rice seedlings differing in Al tolerance showed varying activity levels of the antioxidative enzymes catalase (CAT), superoxide dismutase (SOD), guaiacol peroxidase (GPX) and ascorbate peroxidase (APX) under both control and Al-treated conditions. The level of protein oxidation marked by decline in thiol level greatly increased in Al-sensitive seedlings compared to the tolerants under stress conditions. Al tolerance in rice appears to be associated with high level of induced CAT activity in Al-treated seedlings as well as constitutively higher levels of the antioxidative enzymes SOD, GPX and APX in control and stressed seedlings.

Key words: Aluminium toxicity, Tolerance, *Oryza sativa* L., Reactive oxygen species, Antioxidative enzymes, Rice

SIV/P-54

Ecofriendly Technology of Biocompost from Industrial Waste Inoculated by *Trichoderma viridie* and its Efects on Growth and Yield of *Solanum tuberosum* L.: Waste to Wealth

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Distilling spent wash (DSW)is being discharged by 319+ distilleries in country that is creating environmental pollution in their vicinities composing techniques by heap method (plastics containers) was accomplished with organic industrial waste viz. PMC (pressmud Cake), distillery spend wash, *Azolla* and *Trichoderma* in treatments combination. T_1 (PMC + Azolla), T_2 (PMC +Azolla +DWS), T_3 (PMC +Azolla +DWS +Trichoderma) and control (PMC+Water) were studied. Variations in pH temperature narrowing C: N ratio and decomposition by Trichoderma with other biogeochemical agents (Fungi, Bacteric and actinomycetes) have been observed in temperature based phases psychrophilic, mesosphilic, thermophilic stabilization and poiklothermophilic. The effect of T_1, T2 and T_3 biocompost were studied on solanum tuberosum in RBD plots. The result revealed that germination %, chlorophyll content, plant height, number of stem, leaf area, dry weight, average tubers weight were significantly increased in T_3 compost and follow trends $T_3 < T_2 < T_1$ over control. Manufacturing by compost not only produce beneficial effects on crop productivity and elluminate water pollution problem to save dolphin majestic river Ganga, but also improves soil fertility as well for sustainable agriculture. It will provide road map for agro-industrial development in rural India and will mitigate sub continental challenges of price inflation and jobs opportunity to youths.

Key words: Pressmud cake, Distillery spend wash, Biocompost, *Solanum tuberosum*, Trichoderma, Sustainable agriculture

SIV/P-55

Effects of Heavy Metal Stress on SOD Activity of *Nostoc muscorum*

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A general increase in the level of heavy metal posses a pervasive threat to the natural ecosystem, although many heavy metal when in trace amount are essential for various metabolic process in organism, they create physiological stress leading to generation of free radical, when in high concentration stress in turn induces the production of reactive oxygen species(ROS). Cyanobacteria posses an effective stress combat system to cope with pressure by the help of cascade of antioxidant where the SOD (superoxide dismutase) act initially followed by catalase and peroxidase. The objective of this study was to analyze the antioxidant property of heterocystous strain *Nostoc muscorum* under seven heavy metal chlorides (Zn, Mg, Co, Mn, Hg, Pb, Cd) stress by biochemical parameter SOD (superoxide dismutase). Cyanobacteria are well documented for its ability to maintain the anti oxidant level by releasing H_2O_2 into the environment. The differential response of heavy metal stress strain towards SOD activity at varying concentrations (0.5 µM to 1.0µM) was investigated. It was observed that SOD activity increased with increasing heavy metal concentration in the culture, pointed to the occurrence of scavenging mechanism. The activity of SOD in the culture was maximum in the presence of $Mg^{2+,}$ while culture containing Zn^{2+} and Cd^{2+} showed similar scavenging activity which was less than control as they have same SOD values. Mn^{2+} showed minimum cell density among all the metals having minimum SOD value. Order of SOD activities shown by metal adapted cultures and the culture containing no stress (control) was $MgCl_2 > Control > CoCl_2 > ZnCl_2, CdCl_2, > HgCl_2 > PbCl_2 > MnCl_2$. This may help in developing a strategy to improve cyanobacterial tolerance towards these metals in order to develop strains so to be used to reclaim the environmental stress.

Key words: Cyanobacteria, Heavy metals, SOD, Catalase, Peroxidase, Free radical

SIV/P-56

Induction of hydrogen peroxide generation in *Zea mays* L. exposed to Arsenite

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Abiotic and biotic stresses are reported to induce the formation of reactive oxygen species in the plants. A hydroponics experiment was carried out to study whether H_2O_2 was generated in the leaves of three cultivars of *Zea mays* L. (SRHM-445, Azad kamal, Azad uttam) exposed to different concentrations of arsenite (5, 10 µg ml^{-1}) for 7 days. The role of antioxidant enzymes (Superoxide dismutase, ascorbate peroxidase, guaiacol peroxidase and catalase) was also studied in the metalloid treated plants. For convenience, the treatments are abbreviated as SRC, SR5, SR10, and AKC, AK5, AK10 and AUC, AU5, AU10 for SRHM-485, Azad kamal, and Azad uttam, treated with 5 and 10 µg ml^{-1} of arsenite, respectively.

All the three varieties of *Z. mays* were observed to generate H_2O_2 in their leaves when exposed to arsenite in dose dependant manner. Maximum accumulation (µ mol g^{-1} fw) was recorded in AU10 (33.09±1.780) and the minimum in SRC (16.20±0.16). The activities of all the antioxidants were recorded. Primarily the H_2O_2 scavenging enzyme (catalase and ascorbate peroxidase) activities were higher. This experiment highlighted that the affect of arsenite within the same species was different as demonstrated by the different levels of H_2O_2 generation in the three cultivars of *Z. mays*. It may also be assumed from this experiment that the cultivar SRHM-485 was more tolerant than Azad uttam.

Key words: Antioxidants, Arsenite, Hydrogen peroxide,

Hydroponics, *Zea mays* L.

SIV/P-57

Impact of High Temperature Stress on Flowering and Reproductive Phenology of *Cajanus cajanifolius* (Haines) Maesen

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Two consecutive flowering events, i.e. first phase (from October to January) and second phase (from February to March) of flowering of *Cajanus cajanifolius* (Haines) Maesen, an endangered wild relative of *Cajanus cajan* (L.) Millsp., were monitored for high temperature stress. The species showed significant sensitivity towards the rising of ambient atmospheric temperature. Immense bud/flower drop was observed when the temperature exceeded above 30ºC. The process of bud/flower drop was more frequent in second phase where the temperature was most of the time above 30ºC. However, bud/flower abortion continued till the end of the flowering simultaneously along with the initiation of new flower-buds. Moreover, abrupt fall in minimum atmospheric temperature had adversely affected flowering of *C. cajanifolius* as it was completely ceased when minimum temperature dropped up to 5.4ºC. High temperature i.e., above 30ºC had also shortened the duration of reproductive phenology of second phase of flowering. The total duration of bud initiation to pod maturation was recorded only 32 days as compared to first phase of flowering where it was 94 days. The peak blooming period was also reduced by 6 days. Similarly pod maturation period was reduced 61 to 31 days. Since, heat stress is a major factor affecting the rate of reproduction, a short period of exposure to high (above 30ºC) temperature was fatal to buds and flowers of *C. cajanifolius* as they drastically abscised and caused heavy yield losses.

Key words: *Cajanus cajanifolius,* Bud/flower drop, Phenology, High temperature stress

SIV/P-58

Effects of Cinnamic Acid on Changes in Protein Profile and Antioxidative Enzyme in Maize (*Zea mays* L.) Plant Grown Under Salt Stress

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Plant growth and development are greatly affected due to changes in environmental conditions and become a serious challenge to scientific people. Change in environment is the basic causes of loss in crop yield as well as maintenance of agro-ecosystem Production of plants under stress conditions need new technology and sustainable work. Therefore, present study was conducted to determine the role of secondary metabolites on the growth and development of corn under abiotic stress specially salinity.

Cinnamic acid (CA) is one of the basic phenylpropanoids with antioxidant activity, produced by plants in response to stressful conditions. Response of maize seeds to the pre-soaking treatment with 0.5mM CA was studied under different concentrations of NaCl stress. Exogenous CA increased growth characteristics in saline and nonsaline conditions, while effects of CA were more significant under saline condition in comparison to nonsaline condition in maize plants. CA also reduced oxidative damage through the induction of ROS scavenging enzymes such as SOD, CAT and POD. The content of malondialdehyde (MDA), a peroxidation product of fatty acid was reduced significantly in maize leaf by exogenous CA. Changes in protein banding patterns in the maize leaves showed a wide variation in response to NaCl-stress, while in the presence of cinnamic acid salt-induced expression of polypeptides was reduced significantly. Present study, clearly reports the alleviative effects of CA in response to salinity stress on growth, metabolic activity and changes in protein profile of 21 days old maize plants. These findings may be translated in to efforts aimed to develop salt tolerant genotypes and maximize the use of CA under saline environment. The main objective of the present article was to develop new concept and insightment about the role of CA on growth regulation and metabolic homeostasis in plants.

Key words: Salinity, Metabolic homeostasis, Zea mays L., Lipid peroxidation, Phenylpropanoids

SIV/P-59

Indirect Shoot Regeneration in *Stevia rebaudiana* (Bertoni) Cultured *In vitro*

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Stevia rebaudiana Bertoni (Asteraceae family) is well known natural sweetener. Its leaves produce low calorie sweetener (steviol glycosides), of which stevioside and Rebaudioside A are major ones and these are about 300-400 times sweeter than sucrose. It can be used as an alternative substitute of artificial sweeteners (i.e. saccharine, aspartame, acesulfame K etc.) for diabetic patients. Having realized the potential of Stevia efforts have been started to get large quantity of Stevia biomass. Although, Stevia biomass is commonly produced through cuttings, seeds and employing tissue culture techniques, not only more quantity of Stevia

biomass in short period is obtained but also the natural sweet component (Steviol glycosides) can be further enhanced. The in-vitro plantlets can be regenerated by explants (shoot tip, node, internode etc.), callus, and somatic embryos and so on. A protocol for shoot regeneration was developed to produce large no. of plantlets (somatic embryos) in very short period through callus culture. For callus induction, surface sterilized leaf explants were cultured on MS medium supplemented with different combination of 2,4-D (0.2 to 0.5 mgl^{-1}) with BAP (1.0-3.0 mgl^{-1}), NAA (0.2 to 1.0 mgl^{-1}) with BAP (1.0-3.0 mgl^{-1}) and kinetin (3.0-4.0 mgl^{-1}). The development of shoots was observed from greenish white and fragile callus, cultured on

0.5mgl^{-1} NAA with 2.0 mgl^{-1} BAP and also from 4.0 mgl^{-1} kinetin. These two combinations of growth hormones produced higher number of somatic embryos as compared to other combinations. The young plantlets obtained from somatic embryos were further maintained on 1.0 mgl^{-1} kinetin for shoot development and multiplication. The present study deals with induction of callusing in Stevia rebaudiana to achieve the rapid plant multiplication for steviol glycoside production employing in-vitro techniques.

Key words: Stevia, Somatic embryos, NAA, 2,4-D, Kinetin

SIV/P-60

Differential Responses of Two Vegetable Crops to Ambient Ozone

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The present investigation was done to evaluate the response of two vegetable crops, radish (*Raphnus sativus* L. var. Pusa Reshmi) and brinjal (*Solanum melonogena* L. var. Pusa Hybrid-six) grown under similar ambient air pollutant concentration. Experiment was carried out using Open Top Chambers (OTC) with filtered (FCs) and nonfiltered (NFCs) treatments at a sub urban site of Varanasi, India experiencing topical monsoonal climate. Eight hourly mean concentrations of Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Ozone (O_3) were 11.8, 20.8, 48.7 ppm, respectively during the experimental period. Continuous monitoring data showed that O_3 was the most significant pollutant at the experimental site. Rate of photosynthesis declined in both the test plants grown in NFCs as compared to FCs. This decline was mainly attributed to the reduction in carbon fixation. Decrease in Fv/Fm ratio of the plants in NFCs was the regulatory mechanism to cope up with the inefficiency of Calvin cycle. Increments in lipid peroxidation were more in radish grown in NFCs as compare to brinjal under the same treatment. Contrary to this, the constitutive levels of the antioxidants as well as their increments upon O_3 exposure were of higher magnitude in brinjal than in radish. Morphological characteristics of both the test plants also showed negative response when grow in NFCs as compared to FCs. Yield reduced by 29.5 and 22%, respectively radish and brinjal plants grown in NFCs as compare to FCs. Biomass accumulation pattern showed that under nonfiltered conditions there was a greater reduction in root biomass of radish and in shoot biomass of brinjal. This investigation helped us to identify the sensitivity of vegetable crops in areas with high pollutant concentrations.

Key words: Ambient, Ozone, Open top chambers, Response, Radish, Brinjal

SIV/P-61

Antagonization of UV-B Radiation on Chlorophyll Content by Exogenous Ascorbic Acid in *Ocimum basilicum*

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The potential impact of an increase in solar ultraviolet-B (UV-B) radiation due to human activity on higher plants has been the subject of many studies. Little work has been carried out so far on *Ocimum* response to enhanced UV-B radiation. The objective of this study is to determine the effect of UV-B radiation on chlorophyll content in *Ocimum basilicum*. The observations showed the reduction in amount of chlorophyll in UV-B exposed plants.

Foliar spray of ascorbic acid was applied to antagonize the negative impact of UV-B radiation and found useful. Three concentrations of ascorbic acid were used i.e. 100, 200 and 500 ppm. Ascorbic acid not only totally countered the negative impact of UV-B but also proved to be stimulatory for chlorophyll content in *Ocimum basilicum*.

Key words: Ascorbic acid, *Ocimum basilicum*, UV-B radiation

SIV/P-62

Allelopathic Effect of Weeds on Growth and Productivity of Brown Mustard

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A pot culture experiment was conducted at the Department of Botany, K.N. Government Post Graduate College Gyanpur, Uttar Pradesh coinciding with the *kharif* season (July-October) of 2009 to assess the allelopathic effects of selected weeds on growth and productivity of T. 59 test variety of brown mustard (*Brassica campestris* var. *dichotoma*). The treatment consisted 2 and 4% aqueous leaf extracts of *Amaranthus viridis, Eclipta alba, Parthenium hysterophorus* and *Phyllanthus niruri.* Tap water was used as control. Observation on root length, shoot length, leaf area, root biomass and shoot biomass were recorded by harvesting method at an interval of 30, 60 and 90 DAT (days after treatment). These data were used to calculate net primary productivity (NPP), and relative growth rate (RGR). The results clearly indicated that the treatment of leaf extracts of all the four test weed species in general had a significant retarding effect on growth of brown mustard at both treatment levels at all sampling dates (30, 60 and 90 days). All the test parameters considered in the study, *viz.* root length, shoot length, total plant length, leaf area, root biomass, shoot biomass and total biomass were found to be significantly affected by weed leaf extracts and such effect was found to be concentration dependant.

Key words: Allelopathy, Growth, Mustard, Productivity, Weeds

SIV/P-63

Changes in the Growth, Chemical Composition and Mitotic Behaviour of Insecticides Treated *Vicia faba* Plants by Exogenously Applied Jasmonic Acid

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The present study was undertaken to test the influence of exogenously applied Jasmonic acid upon the growth, metabolism and mitotic behaviour of *Vicia faba* plants exposed to two different insecticides. Alphamethrin (a synthetic pyrethroid) and Endosulfan (an organochlorine insecticide) were the two tested insecticides for their toxicity potential. Both the insecticides pose adverse effects on growth, protein content, pigment content, mitotic index and induced different types of chromosomal aberrations in the root meristem cells of *Vicia faba*. However, Jasmonic acid was found to restore the toxicity caused by the insecticides. Pretreatment of *Vicia* roots with Jasmonic acid significantly increased the growth, chemical composition, mitotic index and reduced the chromosomal abnormalities induced by insecticides. Current work reveals that the effect of environmental pollutants can be partially reduced by Jasmonic acid application.

Key words: Jasmonic acid, Alphamethrin, Endosulfan, Chromosomal aberrations

SIV/P-64

Effects of Cadmium Toxicity on Antioxidative Defence System of *Nigella sativa* in Different Phases of Seed Germination

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Nigella sativa (black cumin, Kalonji) is an annual herbaceous plant growing in Western Asia and the Mediterranean region for its seed which is used as an important spice and condiment and also known for its various medicinal values. Seed germination is a complex process that involves the activation of specific enzymes and is affected by several environmental factors.

Oxidative stress is induced by a wide range of environmental factors including heavy metals stress. Therefore, antioxidant resistance mechanisms may provide a strategy to enhance metal tolerance and processes underlying antioxidant responses to metal stress must be clearly understood. Cd pollution is a growing environmental problem affecting human health and crop production. In the present study, the effects of Cd- generating antioxidative defense systems (i.e. superoxide dismutase, peroxidase and catalase) were studied in the germinating seeds of *Nigella sativa* grown in petriplates in aqueous cadmium chloride $CdCl_2$ solution of 10mM concentration under controlled environmental conditions. The results showed that exposure of seeds to Cd-stress reduced the rate of germination and fresh and dry matter production. The decrease in hypocotyl growth caused by toxicity of metals was more severe than the decrease in epicotyl growth. Of the antioxidant enzymes the activity of superoxide dismutase (SOD) was not altered significantly, peroxidase (POD) was decreased by metal toxicity. Since SOD dismutates ROS into Hydrogen peroxide the result obtained suggest that although cadmium may generate an oxidative stress, the SOD activity is sufficient to cope with an increased concentration of such radicals. However, the activity of catalase (CAT) was increased by metal stress. The antioxidative activity seems to be of fundamental importance for adaptive of *Nigella sativa* plants against environmental stress.

Key words: Cd toxicity, *Nigella sativa*, Antioxidant enzymes, Super Oxide Dismutase, Catalase, Peroxidase

SIV/P-65

Determination of Arsenic and Heavy Metals Concentration in Lichen *Graphis ceylanica* Occurring in Hooghly District, West Bengal

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Levels of arsenic (As) and other heavy metals (Al, Cd, Cr, Cu, Fe, Pb and Zn) were determined in *Graphis ceylanica* a crustose lichen collected from areas having elevated As levels in soil and water. A large number of studies dealing with As levels of soil and water are available from the area however, the atmospheric As levels are few. Hence in the present study an attempt has been made to estimate the levels of As and other metals accumulated in both lichens thallus and the substratum on which the lichen grows. The quantities of Fe (228.92µg g^{-1}dry weight), Al (167.40µg g^{-1}dry weight) and Zn (59.11µg g^{-1}dry weight) were maximum reported followed by As (16.10 µg g^{-1}dry weight), Pb (11.32µg g^{-1}dry weight), Cr (8.66µg g^{-1}dry weight) Cu (1.74µg g^{-1}dry weight) and Cd (0.97µg g^{-1}dry weight) in thallus. About 10-20 time lower concentration of Al, Fe and Zn were reported in substratum, whereas, Cd, Cr, Cu and Pb were not detected in substratum while As present in less concentration as 1.38µg g^{-1}dry weight. The selectivity sequence of metals in the area was as Fe>Al>Zn>Pb>As>Cr>Cu>Cd. Higher concentration of Fe, Al and Zn both in substratum and lichen thallus may be due to their anthropogenic origin. The present level of metallic pollutants will be a useful data for carrying out future studies related as ambient air quality in the area.

Key words: Arsenic, Heavy metal, Lichen biomonitoring, Hooghly district

SIV/P-66

Accumulation of Heavy Metals (MN and FE) in some Plants from Industrial Effluents in Gomti River at Jaunpur District

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The accumulation of heavy metals, magnesium (Mn) and Iron (Fe) from the effluent discharged in Gomti River,

was studied in plants of three species (*Beta vulgaris, Brassica nigra* and *Raphanus sativus*). The root and leaf of each plant was analyzed for the Mn and Fe. Results show that the accumulation of Mn and Fe was more in leafs than root. More of accumulation of Mn and Fe was found in Beet plant (*Beta vulgaris*) than other plants.

Key words: Heavy metals, Gomti River, Industrial effluents

SIV/P-67

Transcriptomic and Metabolomic Shifts in Rice Roots in Response to Cr (VI) Stress

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A significant effect on root growth being observed at 24h at 100 μM Cr (VI) this treatment is further used for transcriptomics and metabolomics analyses. Cr (VI) treatment was associated with lipid peroxidation and an increased in proline synthesis. Transcriptomics analysis revealed that the expression of 1138 genes was up-regulated, and that of 1610 genes was down-regulated in roots by Cr (VI). Most of the genes differentially expressed under both Cr (VI) stress were related to glutathione metabolism, transport, and signal-transduction pathways. However, somewhat unexpectedly, up-regulation of phytochelatin synthase was not detected by microarray analysis suggesting that PCs are not involved in Cr (VI) detoxification. This might be due to their nonresponsive behavior to Cr (VI) stress, which is in agreement with previous report. On the contrary, in our study it is clear that glutathione plays an important role for detoxification of Cr-stress. Simultaneous analysis of microarray and metabolite content suggested that sucrose degradation pathway was modulated in Cr stress response involving three main fermentation pathways operating as a rescue mechanism when respiration is arrested. We also analyzed presence of cis-acting elements in differentially regulated genes during Cr (VI) stress. To check whether the Cr-specific motifs were indeed significantly over represented in the promoter regions of Cr-responsive genes, occurrence of these motifs in whole genome sequence was carried out which suggests significant co-relation between differentially expressed genes and identified motifs.

Key words: Chromium, Rice, Glutathione metabolism, Signal-transduction, Phytochelatin, Detoxification

SIV/P-68

Effect of Arsenic on Growth, Oxidative Stress, and Antioxidant System in Rice Seedlings

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The physiological, biochemical, and proteomic changes in germinating rice seedlings were investigated under arsenic stress. A marked decrease in germination percentage, shoot, and root elongation as well as plant biomass was observed with arsenic treatments, as compared to control, whereas accumulation of arsenic and malondialdehyde (MDA) in seedlings were increased significantly with increasing arsenic concentration (both AsIII and AsV). The up-regulation of some antioxidant enzyme activities and the isozymes of superoxide dismutase (SOD, EC 1.15.1.1), ascorbate peroxidase (APX, EC 1.11.1.11), peroxidase (POD, EC 1.11.1.7), and glutathione reductase (GR, 1.6.4.2) substantiated that arsenic accumulation generated oxidative stress, which was more pronounced in As(III) treatment. We also studied the protective effect of reduced glutathione (GSH) and cysteine (Cys) to As(III)/As(V) stressed seedlings. Both GSH and Cys imparted enhanced tolerance to seedlings against arsenic stress. Seedlings growth improved while level of MDA declined significantly when GSH and Cys were supplemented to As(III)/As(V) treatments suggesting GSH and Cys-mediated protection against oxidative stress. The arsenic content was highest in roots of seedlings grown in As(III) in the presence of GSH/Cys. However, in case of As(V) plus GSH or Cys, the arsenic content in seedlings was highest in shoots. The results are suggestive of differential metabolism of As(III) and As(V) in rice.

Key words: Arsenic, Cysteine, Glutathione, Oxidative stress, Rice, Seed germination

SIV/P-69

Arsenic Tolerances in Rice (*Oryza sativa* L.) have a Predominant Role in Transcriptional Regulation of a Set of Genes Including Sulphur Assimilation Pathway and Antioxidant System

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Worldwide arsenic (As) contamination of paddy rice has raised much concern as it is the staple crop for millions. Four most commonly cultivated rice cultivars, Triguna, IR-36, PNR-519 and IET-4786, of the West Bengal region were taken for a hydroponic study to examine the effect of arsenate (AsV) and arsenite (AsIII) on growth response, expression of

genes and antioxidants visà-vis As accumulation. The rice genotypes responded differentially under AsV and AsIII stress in terms of gene expression and antioxidant defences. Most of the transporters were upregulated in all rice cultivars at lower doses of As species, except IET-4786. Phytochelatin synthase, GST and γECS were upregulated during As stress in all genotypes, however in IET-47886 they were down-regulated. Similarly, most of antioxidants such as superoxide dismutase (SOD), ascorbate peroxidase (APX), guaiacol peroxidase (GPX), catalase (CAT), glutathione reductase (GR), monodehydroascorbate reductase (MDHAR), dehydroascorbate reductase (DHAR) increased significantly in Triguna, IR-36 and PNR-519 and decreased in IET-4786. Our study suggest that Triguna, IR-36 and PNR-519 are tolerant rice cultivars accumulating higher arsenic; however IET-4786 is susceptible to As-stress and accumulating less arsenic than other cultivars.

Key words: Arsenic, Antioxidant enzymes, Heat shock protein, Rice, Sulphate transporter, Metallothionine

SIV/P-70

Effect of Date of Sowing and Irrigation Regime on Seed Yield and Biomass Yield of Chickpea (*Cicer arietinum* L.) and its Relation with Stress in New Alluvial Zone of West Bengal

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A field experiment was carried during the winter season of two consecutive years 2005-06 and 2006-07 to study the effect of date of sowing and irrigation regime in chickpea crop after harvesting of winter rice in New Alluvial Zone of West Bengal. There were two dates of sowing viz. 20th November and 6th December and 4 irrigation regimes viz. rainfed, one irrigation at branching, two irrigations at branching and preflowering and two irrigations at branching and pod formation stage. The maximum grain yield of 1742.71 kg ha^{-1} and 1416.98 kg ha^{-1} were obtained with two irrigations - at branching and pod formation during 2005-06 and one irrigation – at branching during 2006-07. But during 2006-07 two irrigations - at branching and pod formation and one irrigation – at branching recorded at par regarding grain yield. Whereas, in both the years two irrigations – at branching and pre-flowering stage recorded the highest biomass. Among the dates of sowing, 1st date of sowing recorded highest seed yield of 1474.24 kg ha^{-1} and 1442.58 kg ha^{-1}during 2005-06 and 2006-07, respectively. In both the experimental years crop faced maximum stress under rainfed condition, whereas least stress found with double irrigations. Results of this study showed that with the increase in stress degree day both grain and biomass yield decreases significantly. But the magnitude of the negative correlation is higher with biomass yield than grain yield.

Key word: Chickpea, Irrigation, Stress degree day, Grain yield and biomass yield

SIV/P-71

Study of Airborne Metal Deposition on some Plant Species Grown at Varying Distances from G.T. Road

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The present investigation was carried out at two urban parks to assess the deposition and solubility of airborne atmospheric heavy metals in six plant species grown (Common to Moradabad urban areas) at varying distances from two heavily trafficked road in Moradabad city. Emission of heavy metals from the automobile exhaust and brassware industries nearby the highway contaminates soil and surrounding plants. Samples of unwashed leaves were used to assess the concentration level of heavy metal (Cu, Cu, Cd, Fe, Ni, Zn, Pb) and for the purpose six common plant species i.e. *Holoptelea integrifolia, Ficus rumphii, Saraca indica, Bauhinia variegata, Alstonia schlaris and Anthocephalus kadamba* were collected from both sites and were analysed by ICP-OES. The result indicates that the plants species such as *Bauhinia variegata* is sensitive among all the species having highest concentration of heavy metals at both sites and *Ficus rumphii* with lowest concentration, is tolerant among all the species. It possibly may be due to differences in plant morphology and leaf surface and apparently particulate size decides the extent of solubility providing the bio-availability of metal to primary consumers.

Key words: Heavy metals, Plant species, Tolerant plants, Deposition

SIV/P-72

Modulations in Sulfur Supply Affects Arsenic Accumulation and Tolerance in *Hydrilla verticillata*

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Arsenic (As) contamination of the environment is a widespread problem today and there is a need to understand its effects on plant metabolism. An involvement of sulfur-containing metabolites and peptides in chelation and vacuolar sequestration of As is known. In addition, glutathione (GSH), the most important sulfur-containing tripeptide in the cells, functions as an antioxidant and also plays role in arsenate (AsV) reduction. The present study was aimed to analyze the effects of modulations in S supply on arsenic accumulation potential of *Hydrilla verticillata* (L.f.) Royle, a plant known to be a potential accumulator of As. Plants were exposed to either arsenate (AsV; 50 μM) or arsenite (AsIII; 5 μM) for 4 h and 1 day while S supply was varied as deficient (2 μM, –S), normal (1 mM, +S) and excess (2 mM, +HS). The level of As accumulation (μg g^{-1} dw) after 1 day was about 2-fold higher upon exposure to either AsV

(30) or AsIII (50) in +HS plants than that being in +S (12 and 24) and –S (14 and 26) plants. The +HS plants showed a significant stimulation of the thiol metabolism upon As exposure and did not demonstrate any negative impact to antioxidants except catalase. Hence, they did not experience significant toxicity, measured in terms of malondialdehyde accumulation; an indicator of oxidative stress. By contrast, –S plants suffered from oxidative stress probably due to negative impact to thiol metabolism and owing to an inadequate response of enzymatic and molecular antioxidants. Variable S supply also modulated the activity of enzymes of glycine and serine biosynthesis indicating an interconnection between S and N metabolism. In conclusion, an improved supply of S to plants was found to augment their ability for As accumulation and tolerance through stimulated thiol metabolism.

Key words: Antioxidants, Arsenic, Glutathione, *Hydrilla verticillata*, Sulfur supply

SIV/P-73

Heavy Metal Bioavailability and Chelate Mobilization Efficiency in an Assisted Phytoextraction Process by *Brassica juncea* (L.) Czern. (var. *Vaibhav*)

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To enhance the phytoextraction capacity of the plant by using chelant is an innovative technique for cleaning metal contaminated soil. Present study evaluates the degree of metal mobilization in soil and enhancement of phytoextraction of Cd, Pb and Zn by *Brassica juncea* (L.) Czern. (var. *Vaibhav*) from artificially contaminated soil by the application of EDDS. Six saplings of the plant were planted in each pot containing 3.5 kg (dry weight) of spiked soil. After the plants had grown for 10 days, four plants in each pot were retained and allowed to grow. After 45 days of the plant growth, the pots were divided in to the three sets (0.0-without EDDS, 2.5 and 5.0 mmol EDDS per kg soil), with three replicates. The tested plants were harvested by seventh day of EDDS application. *Experimental* results indicate that the concentrations of metals extracted by $CaCl_2$ and metals in the leachate decreased ,as the dose of EDDS increased. The root, shoot lengths, dry shoot biomass, and total chlorophyll contents in the EDDS applied plants were lower than that of control. However, the carotenoid contents were high. Experimental results showed that the EDDS application significantly reduced the Cd, Pb and Zn accumulation in root, and significantly increased in the shoot of the plant; similarly, bioconcentration factor (BCF) and translocation factor (TF). The application of 5 mmol EDDS kg^{-1} to metal-spiked soil may be an efficient alternative for the chemically enhanced phytoextraction by *Brassica juncea*.

Key words: Spiked soil, Leaching, Metal accumulation, Translocation, Photosynthetic pigment

SIV/P-74

Proteomic Analysis of Two Aspen Clones Exposed to Long Term Chronic Ozone Exposure under FACE System

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Troposphere ozone is a destructive gaseous pollutant with serious impact on human and animal respiration as well as causing extensive damage to both natural and cultivated plant populations. Ozone damage symptoms in plants depend on its concentration, length of exposure, age and genetic susceptibility of the plants, but they range from visible chlorosis and necrosis in the leaves, to inhibition of photosynthesis and growth, and reduced yield. The toxicity of this pollutant is derived from the high reactivity (strong oxidizing capacity) of ozone itself, which leads to the production of reactive oxygen species (ROS) which are responsible for initiating subsequent cellular damage.

We examined effects of moderately elevated ozone on growth and protein expression patterns in leaves of two soil-grown Finnish hybrid aspen (*Populus tremula* L. x *Populus tremuloides* Michx.) clones with different ozone sensitivities at Kuopio FACE facility, Finland. The plants were grown and exposed for three growing seasons and realized ozone enhancement was 1.3–1.4 times the ambient ozone concentration (approximately 35 ppb) mirroring increases expected in the near future. Contrary to our expectations, PCA analysis revealed that two clones did not appear to separate very clearly according to O_3 treatment. SYPRO ruby stained gels showed 447 reproducibly detected protein spots. Out of these, nine spots were significantly different; 6 were up-regulated and 3 were down-regulated. The up-regulated proteins included RuBisco large subunit fragment, transposon protein, WRKY transcription factor, a Myb protein. Down-regulated proteins included thioredoxin intermediate and glyceraldehyde phosphate dehydogenase.

Key words: Troposheric ozone, Hybrid aspen, Proteomics, FACE

SIV/P-75

Irrigation Effect of Fluoride Contaminated Water on Seed Germination and Growth Characteristics in *Pisum sativum*

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Fluoride is an endemic public health problem, these days prevailing in 23 nations globally, includes India as well, where it is endemic in 17 out of 32 states and Union territories. The prolonged fluoride consumption in excess (> 1ppm) causes dental caries, skeletal deformities, soft tissue damage viz., impairment of liver, kidney, muscle brain, heart,

thyroid, testis, ovary etc. Cosequently, fluoride contaminated soil, water and vegetation has become an area of great concern in the world. Because, even at a fairly low ambient concentrations fluoride may cause physiological and biochemical changes in plants without conferring visible signs of injuries. Hence, investigations for irrigation effect were made by using fluoride contaminated water. The differential phytotoxicity fluoride levels affected seed germination. 25ppm fluoride concentration impaired germination ca. 60%**.** Almost no germination could occur, in case seeds were irrigated with 100ppm fluoride. The root and shoot lengths both has shown a negative correlation with the enhanced levels of fluoride irrigations. The chlorophyll fluorescence variable yield has shown gradual loss in fv/fm values. However, an electrolyte leakage an indicator for ionic stress shown gradual enhancement with irrigation levels. The ultrastructural studies of root mitochondria shown aggregation followed by loss in their sizes as well. The biochemical & biomass related data will also be presented to correlate impact of fluoride contaminated water irrigation on plant performance and plant-productivity.

Key words: Chlorophyll, Electrolyte leakage, *Pisum sativum*

SIV/P-76

Evaluation of Genetic Potential of Some Promising Lines in Rice Under Limited Irrigation

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The present investigation was carried out with 78 rice genotypes during kharif 2006 under randomized block design having 3 replications at the experimentation center of Department of Genetics and Plant Breeding. The data was recorded on 10 characters to study the variability, heritability, genetic advance and genetic divergence. Significant differences were observed among the genotypes for all the characters studied except flag leaf width and test weight. High to moderate estimate of PCV and GCV was observed for grain yield per plant, harvest index, panicles per plant, tillers per plant. High heritability coupled with moderate genetic advance was recorded for plant height and grain yield per plant. All the genotypes were grouped into 9 clusters on the basis of Mahalanobsis D^2 statistics. Cluster V had maximum number (20) of genotypes. The maximum inter cluster distance was observed between cluster IV and VIII. On the basis of mean performance VANDANA was found to be best genotype under limited irrigation for Allahabad agro-climatic conditions. For crop improvement selection for plant height, days to 50% flowering may be effective. Besides, genotypes from cluster IV and VIII may be used as parents for hybridization programme as they revealed high genetic divergence.

Key words: Genetic potential, Limited irrigation, Hybridization

SIV/P-77

Variation and Association Among Yield and Yield Components in Upland Rice (*Oryza sativa* L.)

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A study of genetic variation and interrelationship of grain yield and its component traits in upland direct seeded rice was carried out using 49 advanced breeding line cultivars. High genotypic coefficient of variation was exhibited for grain yield / plant followed by sterility %, biological yield, unfilled grain/ panicle ,harvest index, plant height and filled grains / panicle. All the traits are influenced by environment because in all the characters exhibited higher PCV than the GCV. Grain yield / plant had significant positive correlation with biological yield, harvest index, panicles / plant, test weight, flag leaf length, plant height and panicle length. Path analysis revealed that the biological yield to be the major contributor of grain yield / plant followed by harvest index and spike lets / panicle. For maximizing the grain yield / plant, emphasis should be given for higher biological yield, harvest index and more number of spikelets/ panicle.

Key word: Character associations, path analysis, yield components, upland rice.

SIV/P-78

Impact of Climate Change on Agriculture

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Climate change and agriculture are interrelated processes, both of which take place on a global scale. Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, CO_2, glacial run-off, precipitation and the interaction of these elements. These conditions determine the carrying capacity of the biosphere to produce enough food for the human population and domesticated animals. The overall effect of climate change on agriculture will depend on the balance of these effects. Assessment of the effects of global climate changes on agriculture might help to properly anticipate and adapt farming to maximize agricultural production. At the same time, agriculture has been shown to produce significant effects on climate change, primarily through the production and release of greenhouse gases such as CO_2, methane, and nitrous oxide, but also by altering the Earth's land cover, which can change its ability to absorb or reflect heat and light, thus contributing to radiative forcing. Land use change such as deforestation and desertification, together with use of fossil fuels, are the major anthropogenic sources of CO_2, agriculture itself is the major contributor to increasing methane and nitrous oxide concentrations in earth's atmosphere.

Despite technological advances, such as improved varieties, genetically modified organisms, and irrigation systems, weather is still a key factor in agricultural productivity, as well as soil properties and natural communities. The effect of climate on agriculture is related to variabilities in local climates rather than in global climate patterns. The Earth's average surface temperature has increased by 1 $^{\circ}$F in just over the last century. Consequently, agronomists consider any assessment has to be individually considered at each local area.

On the other hand, agricultural trade has grown in recent years, and now provides significant amounts of food, on a national level to major importing countries, as well as comfortable income to exporting ones. The international aspect of trade and security in terms of food implies the need to also consider the effects of climate change on a global scale. Marine life and the fishing industry will also be severely affected in some places. Climate change induced by increasing greenhouse gases is likely to affect crops differently from region to region. More favorable effects on yield tend to depend to a large extent on realization of the potentially beneficial effects of CO_2 on crop growth and increase of efficiency in water use. Decrease in potential yields is likely to be caused by shortening of the growing period, decrease in water availability and poor verbalization.

Key words: Agriculture, Climate change, Global warming, Land, Soil

Session SV

Environmental Impact Assessment

SV/L-1

Aerosol Dynamics in Ambient Environment

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Aerosols in natural ambient environment manifest functional characteristics whereby they affect multiple atmospheric processes of importance: (i) cloud formation; (ii) attenuation of solar radiation and assists in maintaining thermal equilibrium; (iii) chaperons undesirable chemicals (organic, inorganic, elements) and purify air by their removal; and (iv) helps in distribution and deposition of nutrients on land and ocean to help in facilitating the sustenance of primary activity.

Flip side of aerosols character, particularly the proportion arising from anthropogenic activities, to a large extent has bestowed insidious functions: (i) agent to deposit refractory compounds; (ii) carrier of toxic and polluting compounds; (iii) agent to impair atmospheric visibility, and (iv) irritant to cause loss of artifacts etc.

Both, beneficial and deleterious, characters of aerosols are coupled with local and regional meterological variables: (i) Planetary boundary layer; (ii) atmospheric and surface temperature gradient; (iii) wind speed and its direction; and (iv) humidity and pressure. These factors brings in the dynamicity to aerosols, and understanding this dynamic nature is crucial in unfolding new questions about the aerosols attributes in ambient atmosphere

Key words: Aerosol dynamics, Temperature gradient, Ambient environment, Atmospheric processes

SV/L-2

Climatic and Pollution Impact on Algal Biodiversity of the Small Rivers in Eurasia

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Climatic impact on algal and cyanobacterial diversity in the altitude gradient was studied in the Caucasian region of Georgia. The comparative floristic and statistical analysis of algal communities from 14 Georgian Natural Reserves, altogether 1063 species, divides the communities of less and more than 200 species with diatoms or non-diatoms domination that correlate with climatic variables. The species diversity in the Natural Reserves increases from the Black Sea coast to the east, with increasing altitude. Three floristic groups are recognized: the high diversity group of the mountains areas; the moderate diversity group of lowlands; and the low diversity group of piedmonts. The Index of infraspecies variation of each reserve is a small range (1.01-1.15) and shown to be a result of constant amplitude seasonal climatic fluctuations. Correlation of algal diversity with environmental conditions shows that the altitude dependent regional climatic variables and the lowest winter air temperature in particular, are the major factors.

Regional environmental differences impact was studied in two polluted rivers of Eurasia from silicate (the Rudnaya River) and carbonate (the Qishon River) regions. We revealed that algal and cyanobacterial diversity have similar distribution of species over the higher taxa with diatom prevealing. Bio-indicational analysis in respect to salinity, acidification, oxygenation, and organic pollution show that the water is cleaner and the diversity is higher in the Rudnaya River than in the Qishon River. The indices of saprobity S ranged similar. As a result of CCA, for the Rudnaya River we revealed biosensors group of green and diatom species sensitive to borates and fluorides. For the Qishon River biosensor species included red and cyanobacteria species. We found that algal biodiversity is more sensitive to technogenic pollution in the silicate province being more tolerant to the same organic pollutants in the carbonate province.

The effects of climate change on algal communities was analyzed by comparing two unpolluted river ecosystems on the border of arid and semi-arid zones, the Oren River of the Mediterranean zone, Northern Israel and the Zin River of the Central Negev Desert, Southern Israel. A bio-indication show ecologically significant variations in composition of algal communities in both rivers. Our analysis highlighted the distinctions in taxonomic diversity and abundances of the salinity tolerant (halobic) and alkaliphilic groups. The percentages of indicator species decrease from the low halobity class to the high halobity class in the Oren River, but the opposite is observed in the Zin River. Although the geological substrates are carbonates in both cases, the indicators of alkalic water are more prominent in the Zin River than in the Oren River, in which the pH is buffered by organic substances from vegetation and soil. As a result of CCA analysis, we recognized two types of ecological communities, the alkaliphilic (high pH tolerant) and halophilic (high TDS tolerant) types. Predictably, the halophilic communities will be favored with further climate warming. The effects of climate change and anthropogenic pollution are synergistic in the case of the pollution-sensitive *Chara* community falling under high risk of extinction under the ongoing climate change.

Key words: Algal biodiversity, Ecology, Small rivers, Bio-indication, Climate change, Comparative floristic

SV/O-1

An Approach to Asses the Ecological Integrity of Running Waters

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The term ecological integrity reflects the necessity of considering water bodies as ecological system. In India, demand/ supply for running water has already increased

manifold over the decades and posed water conflict. The study deals with water quality assessment and availability of water in rivers at Allahabad city, in view of their religious importance and ecological sustainability. Based on bio-sequestering assessment, biological water quality criteria have been evolved, indicating various beneficial uses for water quality and their respective levels of characteristics. Physico-chemical factors represent the chief milieu of conditions governing the occurrence of various phytoplankton biodiversity and their associations. Qualitative analysis of cyanotoxin (microcystin), nutrient/ nutrient transport, and their interaction with phytoplankton were also described. The amounts of nutrient and water flow were dynamically influenced with time factor and water availability. The deficit water supply and improper sewage treatment infrastructures have increased the risk of exposure infectious as mass scale. Traces of chromium, iron, zinc, nickel and copper metal in water and sediments have been observed in clean water quality stretches. Besides describing the way of assessing the ecological integrity of running waters, some nation-wide programmes concerning water quality, habitat assessment, and river typology are briefly presented.

Key words: Water quality, Bio-sequestering assessment, Cyanotoxin, Phytoplankton

SV/O-2

Tandem Use of Solid-Phase Extraction and Dispersive Liquid-Liquid Microextraction for Determination of Mononitrotoluenes in Aquatic Environment

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Solid-phase extraction (SPE) in tandem with dispersive liquid-liquid microextraction (DLLME) has been developed for determination of mononitrotoluenes (MNTs) in several aquatic samples using gas chromatography-flame ionization (GC-FID) detection system. In the hyphenated solid-phase extraction-dispersive liquid-liquid microextraction technique (SPE-DLLME), initially MNTs were extracted from a large volume of aqueous samples (100 mL) into a 500 mg octadecyl silane (C_{18}) sorbent. After the elution of analytes from the sorbent with acetonitrile, the obtained solution was put under the DLLME procedure, so that the extra preconcentration factors could be achieved. The parameters influencing the extraction efficiency, such as breakthrough volume, type and volume of the elution solvent (disperser solvent) and extracting solvent, as well as the salt addition, were studied and optimized. The calibration curves were linear in the range of 0.5-500 μg L^{-1} and the limit of detection (LOD) for all analytes was found to be 0.2 μg L^{-1}. The relative standard deviations (RSDs, for 0.75 μg L^{-1} of MNTs) without internal standard varied from 2.0 to 6.4% (n = 5). The relative recoveries of the well, river and sea water samples, spiked at the concentration level of 0.75 μg L^{-1} of the analytes, were in the range of 85-118 %.

Key words*:* Dispersive liquid-liquid microextraction, Solid-phase extraction, Gas chromatography-flame ionization detection, Mononitrotoluenes, Aquatic environment

SV/O-3

Genotoxicity Assessment of Soils in *In vivo* and *In vitro* Assays: A Review

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Soil is one of the key elements for existence of all life on this earth. It functions as the habitat for microorganisms, plants and animals. In recent years, soil is increasingly becoming sink for a wide range of hazardous chemicals generated by various industrial, agricultural and domestic activities. Hazard and risk assessment of polluted soil is usually carried out by means of physical and chemical analysis. But such studies are limited in their ability to characterize the chemical composition of genotoxicity in soil. On the other hand, biological test systems (Bioassays) which consist of exposing living organisms to polluted mixtures provide a means for assessing the genotoxicity/mutagenicity of soil, without the need of precise chemical characterization. Genotoxicity is one of the most dangerous effects of contaminated soils. The genotoxic compounds in soil can affect human health in various ways i.e. inhalation of dust which contains these compounds, ingestion of plants that uptake compounds from soil and leaching of these compounds from soil to groundwater and surface water used as drinking water. During last two to three decades, a number of studies have been carried out to assess the genotoxicity of soil using various test system like the bacterial *salmonella*/ Ames test; plant bioassays like *Tradescantia* micronucleus test, *Tradescantia* staminal hair mutation test, *Allium cepa* test, *Vicia faba* test etc; Comet assay; Chromosomal aberrations and micronucleus test in mice/rats etc. In this paper we attempt to review different *in vivo* and *in vitro* bioassays used for genotoxicity assessment of soils.

Key words: Soil, Bioassays, Risk assessment, *Allium cepa* test, *Salmonella* Ames assay

SV/O-4

Use of *Dracaena* Species for Improvement of Indoor Air Quality: An Overview

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The quality of indoor environment is of critical importance to our health and wellbeing. Concentration of many pollutants can be several times higher in the indoor

than in the outdoor air. The major contaminants of indoor air are the volatile organic compounds (VOCs). They are emitted directly by materials inside the buildings (e.g. paints, adhesives, cosmetics; e.g. n-hexane) and also infiltrate from the outside, mainly from fuel emissions (e.g. benzene). Chronic exposure to high concentrations of VOCs can cause health problems. The VOCs are recognized as causative agents of "sick building syndrome" or "building-related illness". Since it has been discovered that the potted-plant microcosm has the capacity to contribute to the improvement of the indoor air quality, the use of potted plants to reduce the VOCs from indoor air has become a cost-effective method. This study is an overview focusing on the use of potted-plants of *Dracaena* species (e.g. *D. deremensis*, *D. fragrans*) as a sustainable biofiltration system that helps improve the indoor air quality.

Key words: *Dracaena,* Air pollution, Air quality, Indoor pot plants, Volatile organic compounds

SV/O-5

Modeling of Building Construction in Urban Areas for Sustainable Human Settlement through use of Remote Sensing and GIS Techniques

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In the recent years, explosive increase in the exponential form of 'Population Growth' has caused havoc for the human life in the city environment, so there is a need to increase concept of sustainable human settlement. Sustainable human settlement in its simplest form advocates that the present generation develops(manage) the settlements of an area with available resources, to achieve growth and social and economic well-being in such a manner, that will not compromise the chances of generation yet unborn in meeting their own needs. But how we can improve the building construction in urban areas for sustainable human settlementfi We can improve and promote the sustainable human settlement through the use of different techniques of remote sensing and Geographical Information System (GIS). Population growth, in-migration of poor people, industrialization, urbanization, inefficient and inadequate traffic corridors, poor environmental infrastructure, etc. are the important factors that have deteriorated the overall quality of environment of human settlements in an area. In Delhi these factors has affected the housing and quality of life. Day by day there is an increase in number of migrant people and also the rate of expansion is very fast, unplanned, uncontrolled and most of them are illegal. Illegal building construction, unregistered slums and others are of major concern for the sustainable human settlement in urban areas. The remote sensing and GIS technique helps in satellite images data collection, interpretation of data, data structure and scaling, map composition etc. One of the important software Idrisi32 play an important role in layers and collection, navigation map query, map composition, Palettes, symbols, and creating text layers, data structure and scaling, vector collection and SQL . Idrisi32 is also used for the cartographic modeling, geometric anisotropy modeling and designing of an isotropic model. This research therefore discuss the modeling of building constructed in urban areas and models that can improve the quality of human settlements and help to improve the sustainable human settlements through the use of remote sensing and GIS techniques.

Key words: Population growth, Sustainable human settlement, Building construction, Remote Sensing, GIS techniques

SV/O-6

Radial Growth and Development of a Tree as a Model of Sustainable Development of Local Society

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One of the most important and interesting questions which nowadays we should answer concerns the ability of our societies to adapt to the consequences of climate change, declining water and energy resources, threats to food security and health risks, shrinking biodiversity and economic crisis. What type of development will help us to survive in our rapidly changing worldfi Sustainable development is supposed to be the best alternative. This idea has many opponents pointing out that it is an unrealistic ideology rather than a pragmatic political and economical system. On the other hand, uncontrolled exponential growth of production and consumption in modern civilization, overexpansion of human population and intensive exploitation of natural resources cause real threats to human beings all around the world. In searching for a good model of a complex natural system which possesses common features of the 'ideal' sustainable local society, we have chosen a tree.

A tree living in one place for a long period of time is the essence of sustainable development. Successful trees have to adapt constantly to diurnal and annual cycles for as long as several hundred years or even more. This capacity is a proof of the ability of complex living system to recycle non-renewable resources from the local environment which are essential to maintain most of its processes. Moreover the structure of the tree and the flow of energy in the tree are mostly based on the renewable resources. Throughout its entire life the tree must be ready to maintain its structure despite winds, floods, pollutants, frost, seasonal deficits of water and other essential substances, invasions of pests, etc. On a wider scale it must cope with changing biotic and abiotic environments. Although a tree changes its environment during its life, this change creates new niches, supports thousands of organisms, stabilizes microclimate, etc. The long evolution of trees, selected mechanisms and different strategies which allow a tree not only survive in certain place but also to constantly improve its structure to in order to meet the constraints of its surroundings. This presentation discusses the possibility of applying the model of radial growth of a tree as a homeomorphic model of sustainable development of local society.

These successful self-renewing adaptive mechanisms in trees offer an analogy for humankind's need to adapt to the current stresses arising from its constantly changing interaction with the global environment.

Key words: Sustainable development, Growth, Tree, Stress, Local society, Model

SV/O-7

Geochemical and Geophysical Investigation to Assess Impact of Landfill on Groundwater Quality

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The integrated investigation of groundwater, by both geochemical and geophysical approach, aims to assess groundwater quality and to examine the impact of landfill on aquifer. The waste generated in a planned city of Punjab, Mohali, is dumped in a non-engineered landfill which is located near seasonal rivulet.Characteristics of the leachate generated from the dumping site confirm that the site is in acidogenic phase due to its pH (5- 6.3). The groundwater samples were collected from hand pumps and deep wells located near and around the dumping site within an area of 2 kms. The groundwater samples were analyzed for various physicochemical parameters (pH, temperature, EC , total alkalinity , total hardness, TDS, BOD , COD, Ca^{2+}, $Mg^{2+,}$ Na^{+}, K^{+}, Al^{3+} ,Cl^{-} ,PO_4^{3-} ,SO_4^{2-} ,$NO^{3-,}$,$F^{-}$and NH_3-N) and heavy metals (Pb, Ni, Cu, Fe, Zn). Pb, Fe and Ni content in more than 85% of the samples have been reported above the prescribed limit while rest are within the permissible limits as per BIS drinking water standards. In order to study the ground water pollution at shallow depth geophysical prospecting was carried out with the D.C. resistivity meter. Twenty five vertical electrical soundings were conducted at sites around landfill, the apparent resistivity values at different current and potential electrode separation were recorded in the field, were plotted on log-log graph, and manual interpretation with the help of master curves was done which clearly indicates contamination of groundwater due to leachate. Further, presence of ammonical nitrogen and nitrate also indicates organic contamination due to leachate. The study shows that the aquifer is affected by the seepage of leachate in the subsoil and hence deteriorating the quality of groundwater which may pose serious health impacts.

Key words: Landfill, Aquifer, Leachate, Geophysical, Geochemical, Groundwater

SV/O-8

Stability Comparison of Forest Species Planted in Mosian Plain Aquifer in Ilam Province, Iran

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In **s**election and plantation of tree seedlings without study in borders roads, forest regeneration, development of parks and green spaces etc., a kind of interference and violation of privacy is considered normal, if the species is not compatible with the climate zone. This forest is also likely to fail and incidence of severe damage from climate change and natural seedlings to native species will be gradual. Therefore, the stability and persistence of species in the forest protection is important for planners of natural resources.

Field station of spreading Dehloran aquifer is one of the major forestation in Ilam province, aimed of protecting the soil and underground water table feeding in hot dry plains of Mosian. It has been planted with native and non-native species. In this article 100 trees of each species planted during the years 1998 and 1999 in the station, such as *Ziziphus spina-christi, Prosopis juliflora, Eucalyptus camaldulensis* and *Acacia sp.* were randomly selected and information about these species were measured and recorded annually.

Finally by comparison test, the growth, persistence of seedlings and species durability was studied.Results indicate that non-native species of *Eucalyptus* despite high average in height (85.4 cm/year) and relatively large diameter (2.43 cm/year), in terms of viability and freshness was not found in good condition (36.2 percent). Against, the native species of *Ziziphus* with relatively low average height and diameter (22.64 and 2.28 cm/year respectively), in terms of viability (65.4 percent) and freshness was found in good condition. Drawing height and diameter shows a higher durability and significant different between *Ziziphus* and *Prosopis* with the *Eucalyptus*.

Key words: Sustainable development, Conservative forestation, Durability

SV/O-9

Environmental Benefits Assessment of Urban Green Land in Shenzhen Special Economic Zone

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Located in southeastern Guangdong Province of South China, Shenzhen Special Economical Zone (Shenzhen SEZ or SEZ) covers an area of 395.81 km^2, of which 185.8 km^2 is green land. In order to estimate the ecological benefits of green land in Shenzhen SEZ, the high-resolution color aerial photographs and SPOT5 multi- spectral images were used as the main source of data, 542 samples with a total area of 504856 m^2 (2.72‰ of the total green land) were investigated. The urban green land was classified and the benefits of the main plant species in urban green land were quantitatively analysed.

The total leaf area of the green land was 528.9 km^2, with approximately 233,079 metric tons of carbon (C) stored, 622,100 metric tons of oxygen (O_2) released and 48,900 metric tons of dust cleared per year. In addition, 269.9 billion MJ of heat is needed for the whole green land to evaporate 111.0 million metric tons of water per year, which

equivalently decreases 3.2 degrees centigrade of temperature in the SEZ. The emission of isoprene of the green land was 332 metric tons, while terpene 591 metric tons per year. It is worthy to be mentioned that the road green land performed excellently in total leaf area per hectare, carbon storage, oxygen releasing, heat absorption for transpiration and dust removal, which indicates that the road green land in the SEZ has been managing quite effectively.

As the respiration system in cities, urban green land is of increasingly important while the globe is urbanized rapidly. Further studies on the ecological benefits of urban green land are desirable for its healthy and sustainable maintenance.

Key words: Shenzhen special economical zone, SPOT5, Aerial photographs, Green land

SV/O-10

Ultrastructural Changes in Glandular Trichomes on Leaves in Vigna radiata (l.) Wilczek in Response to Arsenic Toxicity in soil

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The effect of enhanced levels of arsenic (As) in soil on growth and development of *Vigna radiata* (mung bean) was studied. Pot experiment was carried out in the Botanical Garden, Department of Botany, University of Delhi with soil that was mixed with As to achieve defined levels of As concentrations (5, 10, 15, 20, 25, 30 and 35 mg As kg^{-1} dry soil). A control set without any As addition was also included. Inhibitory effects of As treatment were concentration dependent and found to be significant on almost all growth parameters studied. Two types of trichomes were observed on leaf surface - glandular (secretory) and non-glandular (non-secretory), with the latter being more abundant. Trichome density of both types decreased on both adaxial and abaxial leaf surfaces with higher concentration of As in soil. Scanning electron microscopy revealed that leaves of control plants had well-developed trichomes covered with a rich striated layer of epicuticular wax. Comparison of ultrastructure of glandular trichomes from control and As-treated leaves revealed contrasting dissimilarities. At primordial stage on control leaves, active cytoplasm with numerous vacuoles and granular material in extraplasmic space were distinct. Trichome from control leaf had well-defined globular shape with a basal cell, two stalk cells arranged in two tiers, and four head cells arranged in two tiers of two cells each. The cells were characterized by dense cytoplasm depicting active state of function. The lower stalk cell showed presence of numerous polyribosome clusters, multi-vesicular bodies, microtubules, dictyosomes and abundant rings of endoplasmic reticulum representing its high activity. Multiple plasmodesmata connect the adjacent cells. Several groups of unusual inclusions were often encountered in glandular trichomes of both control and As-treated plants.

In treated leaves, trichomes were smaller in size and displayed structural disruption. At 35 mg As kg^{-1} soil, wax deposition was disrupted and cracks were seen. In 20 mg As kg^{-1} soil treated plants, the primordium had unusual electron dense inclusions in vacuoles, and tubular-vesicular membrane network of rough endoplasmic reticulum in cytoplasm was noted. In As-treated plants, divisions of head cells were incomplete. Each trichome cell showed shrinkage of protoplast and withdrawl of plasmalemma from the cell wall. Disintegration of cytoplasm and cell organelles was observed. All these changes are bound to have profound effect on the secretory function of trichome, and compromise the plant defence.

Key words: Arsenic, Glandular trichome, Mung bean, Ultrastructure

SV/O-11

A GIS Model for the Master Plan of Madurai Metropolitan Region

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The process of urbanization often leads to the human settlements in the cities rather than the rural areas in metropolitan cities resulting in haphazard growth, deterioration in living conditions and worsening of environmental scenario. This unabated trend increases the settlements and also increases the pressure on the limited land available in the city. Tamil Nadu is the second highest urbanized state in India. Madurai city is the second largest town in Tamil Nadu, has the haphazardness of growth. Lack of scientific planning and integrated development have made, urbanism and urban growth, economic liabilities rather than economic assets in which it leads to the over population settlements, the land meet the residential, commercial and industrial needs resulting in more environmental hazards.

The present study involves in planning the city and its peripheral areas in to an integrated manner for the human settlements, as a result good agricultural land may be saved in the periphery of the city. In order to make the Madurai city as a metropolitan urbanized region for the human settlements, an integrated approach through GIS, along with Remote Sensing was made. The objectives include: preparing land use/ land cover maps by employing digital image processing techniques from the satellite data for different period wise 1997 and 2005; to collect data on cropping pattern and socio economic attributes; capture the location information of various cultural, heritages, amenities, institutions, etc. using GPS; generate spatial data base of the spatial changes on various land use classes from 1997 to 2005; suggest sustainable development strategies based assessment of the resources; Interact with line departments to use the project outputs in implementing development schemes at various

level based on the predefined user need assessment exercise. In this study an integrated approach through GIS is made to evolve a model which can serve as an input to the planning authorities.

Key words: GIS, Remote Sensing, Human settlement, Metropolitan region, Urbanization

SV/O-12

Environmental and Human Health Risk Pathway Study of Arsenic Poisoning in Soil, Water, Rice and Vegetable System in Arsenic Affected Blocks of Nadia District, West Bengal, India

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Natural toxic metalloid, arsenic, generally found in trace quantities in rock, soil, water and air. Though natural abundant arsenic concentrations is higher in certain areas due to either geochemical conditions or human activities, agricultural activities especially high irrigation has mined out natural arsenic in to the land and gradually to the human system through food chain. Consumption of arsenic contaminated drinking water is the primary route of exposure, and diets provide additional exposure as their production is based on soil and water quality. The concentrations of arsenic in irrigation water, field soil and in different parts of grown crops have been assessed to show the bioaccumulation level of arsenic in the system. The irrigation water contains arsenic in the range of 0.23 to 0.73 mg L^{-1} and soil arsenic concentration ranges from 3.58 to 8.50 mg Kg^{-1} of dry weight. In rice plant, arsenic ranges from 2.52 to 5.98 mg Kg^{-1} of dry weight in straw; 0.72 to 1.79 mg Kg^{-1} of dry weight in husk; 0.10 to 0.81 mg Kg^{-1} of dry weight in the rice grain; and 9.79 to 17.61 mg Kg^{-1} of dry weight in the rice root. Arsenic content is beyond the WHO permissible limit of 1.0 mg Kg^{-1} in straw, husk and in roots being highest overall. Higher range of arsenic is assessed in the rabi season vegetables like in spinach 0.96 to 1.69 mg Kg^{-1} of dry weight, 0.96 to 1.69 mg Kg^{-1} of dry weight in tomato fruit, and 0.45 to 2.24 mg Kg^{-1} of dry weight in chick pea, which all are with higher range of inorganic arsenic, being accumulated through the food chain. Thus, bioaccumulation of the arsenic in food chain occurs. Besides, arsenic accumulation potential among all the useable parts of rice and vegetables, the rice root part shows highest followed by straw but among the edible vegetables spinach shows highest value. Therefore, this bioaccumulation potential can be used to calculate the total risk from total dietary intake of arsenic contaminated edible food by using Monte Carlo Simulation technique.

Key words: Arsenic, Bioaccumulation, Contamination, Ground water, Rice, Vegetables

SV/O-13

Survey of Vegetation in Relation to Water Pollution at Ahmedabad Region, Gujarat, India

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The water is vital to life since it is essential for physiological activities of plants and animals as well. Besides temperature, water is the other such key factor that influences the global ecology. Water influences weather and climate on any region and thus its flora and fauna. The city Ahmedabad is a leading industrial center of Gujarat, India, comprising two GIDC estates. Physico-chemical parameters like Temperature, Odour, Colour, Turbidity, TDS, EC, DO, BOD, COD, Phosphate, Ca- Hardness, Sodium, Potassium, Magnesium, Oil and Grease and heavy metals like Iron and Chromium were analysed by standard method to derive the water pollution status of ground and surface water of residential and industrial area of the region. The vegetation of the sampling sites was surveyed periodically during all seasons. The results revealed that the residential area showed prominent growth of mesophytic vegetation, where as industrial area where the quality of water is deteriorating under the effect of industrial pollution, supports xerophytic vegetation. This may be due to physiological stress of water. Further Chandola pond showed cultural eutrophication showing encroachment of *Eichhornia* species. The work on phytoremediation through terrestrial plant species is going on.

Key words: Water, Ecology, Water quality parameters, Industrial pollution

SV/O-14

Regional Geochemical Mapping of Soils in Medak District, Andhra Pradesh, India

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This paper reports the first results on the geochemical mapping of soils in Medak district of Andhra Pradesh, India. Eight hundred and twenty-three soil samples (502-topsoil, 321-subsoil) were collected in the district from undisturbed locations using a stratifying site selection strategy to capture the diversity of parent materials and soils. The topsoil comprised of 0-25 cm depth interval and is a composite sample collected from three locations making a triangle with a distance of ~10 m between each sample. The subsoil samples were collected from a 25 cm thick section from a depth range of 70 to 95 cm, wherever subsoil samples were collected invariably topsoils was also sampled. However at 181 locations, the thickness of the soil was less than 30 cm hence at such locations topsoil were only sampled. The 2mm fraction of samples is routinely analyzed for 29 elements by simultaneous XRF. The results show good correlation between soil chemistry and underlying geological formations. Baseline values of elements in soils are determined over different lithological units for the identification of the anomalous values relative to these. The database can be used in the chemical characterization of

different geological units and well as in applications in the fields of environment and agriculture.

Key words: Geochemical mapping, Topsoil, Subsoil, Medak district

SV/O-15

Biomonitoring of Air Pollution Near Paricha Thermal Power Plant, Jhansi, Uttar Pradesh

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Lichens are excellent bio-indicators. As bio-indicators, the presence/absence of sensitive species is pointer to use for distribution patterns of Air pollutant deposition. The accumulation of various air pollutants including heavy metals by lichens is well documented. Pollutants like SOx and NOx affect the growth of lichens and its colony. Sometimes the lichens which are sensitive can die or shift their colony. This shows the presence of air pollutants in the air. The resistant lichens accumulate the heavy metals and air pollutants in their thallus. In Indian context, a survey of the lichen of 25 Kolkata streets demonstrated that the species and population of lichens could be an indicator for determining the air quality. The sampling of lichen and Air Pollution monitoring were carried out during the month of April to July 2007 in and around the Paricha Thermal Power Plant, Paricha Jhansi. We have assumed the Paricha Thermal power Plant as central part and collected samples from all the four directions. Samples were also taken from a control location at distance of about 24 km from the Paricha Thermal Power Plant.

The results of the study revealed that the concentration of SO_2 at different monitored sites ranged between 19µg/m^3 and 28µg/m^3, while the concentration of NO_2 at different locations varied between 25µg/m^3 and 36µg/m^3. The SO_2 levels at the control site varied between (6µg/m^3 and 9µg/m^3) and the NO_2 at the control location ranged between (8µg/m^3 and 13µg/m^3). The levels of both SO_2 and NO_2 at all the monitored locations were found to be well within the National Ambient Air Quality Standards set by the Central Pollution Control Board, India. Heavy metal concentrations across various locations ranged between 3.1µg/g & 7.2µg/g, 1.2µg/g & 2.8µg/g, 13.7µg/g & 23.0µg/g, 15.3µg/g & 19.4µg/g, 10.37µg/g & 38.0µg/g and 0.15µg/g & 0.9µg/g for Mn, Zn, Cd, Pb, Fe, and Cu respectively. The concentrations of the various pollutants at the control location were found to be less than that at other locations.

Key words: Accumulate, Concentration, Heavy metal, Lichens, Air Pollutants

SV/O-16

Soil Amelioration through Afforestation on Degraded Sodic Soils

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Tree plantations on degraded lands is one of the propositions for rehabilitation and remediation of wastelands in which various leguminous and non-leguminous fuelwood tree species were planted on sodic land of Biomass Research Centre of NBRI, Lucknow. The land was highly degraded before the plantation (pH 9.5-11.45, EC 570-1350 µS/cm, OC 0.092-0.19%, total N 16-85, Avl. N, P & K 7-23.7, 4-12 and 183-283 mg/kg respectively, bulk density 1.7-1.85 g/cm^3 and porosity 33-40 %) from surface to 60 cm depth under the study. This study was conducted to evaluate the contribution of various leguminous and non-leguminous fuelwood tree species with respect of their growing stock on degraded sodic wasteland. Analytical data reveals that the pH (8.28), EC (345 µS/cm) and bulk density (1.55-1.73g/cm^3) of the soil reduced under 25 years old plantation and the organic carbon, total N along with available NPK and porosity enhanced to the extent of 0.07 -0.7%, 319.67 -664.0, 19.52-59.5, 16.54-18.32, 225-371.43 and 35.33-44.43 % respectively. There were significant differences from the younger plantations of 15-20 year-old as also from the unplanted control sites. Leguminous species contributed more significantly in land renewal and fertility development as compared to non-leguminous tree species. However, the phosphorus availability increased in the soil planted with non-leguminous tree species. The improvement in soil properties was better on surface than that of lower depth (60 cm) as the incorporation of humus in sub-soil is a slow process to make the effective changes even after 25 years. It is observed that litter accumulation was greatest under *Acacia auriculiformis* stand; even then impact of *Prosopis juliflora* was superior in soil amelioration due to a relatively fast decomposition and mineralization of litter, which led to high biomass and basal area over the years in *P. juliflora* plantation. Thus leguminous tree species vis. *P. juliflora*, *A. nilotica*, *Albizia procera* and *P. dulce* are more suitable for rehabilitation and remediation of sodic lands of north India.

Key words: Leguminous, Non leguminous, Fuelwood trees, Litter, Biomass, Soil amelioration, Sodic soil

SV/O-17

Effect of Sulphur Dioxide Exposures on the Plant Growth of Mustard and on Alternaria Leaf Spot Disease

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Effects of intermittent exposures of SO_2 at 2, 25, 50 and 75 ppb were investigated on the Alternaria blight on Indian mustard cultivars under artificial treatment condition in open top exposure chambers. Ten cultivars of Indian mustard, *Brassica juncea* L. viz., Alankar, BS-2, Kalamoti, Karishma, Kranti, Mahyco Bold, Pusa Bold, Rohini, Swarna

and T- 59 were exposed to 2 (ambient), 25, 50 and 75 ppb SO_2 concentration for 5 h day^{-1} on alternate days for 3 months in open top exposure chambers to evaluate resistance/tolerance against the gas. The exposures at 25 and 50 ppb SO_2 concentrations did not incite any measurable injury to mustard cultivars. However, 50 ppb SO_2 caused visible injuries to all cultivars screened and led to a significant reduction in plant growth, yield, oil contents and leaf pigments. Chlorophylls and carotenoids were found more sensitive to SO_2 than the plant growth parameters. Inoculation with *A. brassicicola* caused dark brown to almost black necrotic circular lesions on the leaves of mustard cultivars. The severity of the disease increased on plants exposed to 50 ppb SO_2, but decreased at 75 ppb SO_2. The interaction between the gas and the fungus was found to be dependent of SO_2 concentration. The gas at 25 and 50 ppb SO_2 promoted pathogenesis of *A. brassicicola* with result the cv. Kalamoti, expressing tolerance to the fungus, becoming susceptible and exhibiting greater blight and plant growth reductions at 50 ppb SO_2; the gas injury was also relatively greater in this treatment. The gas promoted sporulation of the fungus. Interaction of 75 ppb SO_2 concentration and *A. brassicicola* was found to be antagonistic. The cv. Kalamoti showed resistance to *A. brassicicola* and did not exhibit significant suppression in the yield. The exposures especially 50 ppb apparently broke the tolerance reaction of the cv. Kalamoti and greater lesions (32%) developed on the leaves of inoculated plants, fungus inoculation, however, did not influence the sensitivity of the cultivars to SO_2. Synergistic interaction between 50 ppb SO_2 and the fungus was recorded on six cultivars out of ten cultivars tested, whereas the interaction at 75 ppb SO_2 was antagonistic on two cultivars (Alankar and Mahyco Bold) and on rest near to additive. At 75 ppb SO_2, the sporulation was suppressed but increased at 50 ppb SO_2.

Key words: Air pollution, *Alternaria brassicicola*, Mustard cultivars

SV/P-1

Ecology of Microcystin Production in Laxmi Kund and Sankuldhara Ponds in Varanasi City

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Rising concern about potable water supply led us to study about the two local open aquatic bodies i.e. Laxmi Kund and Sankuldhara Pond in Varanasi city. These water bodies were sampled fortnightly for studying physical and chemical parameters and also examined microscopically. Microscopic analysis showed various types of algae hailing from cyanophyceae and chlorophyceae. However, the dominance was observed with *Microcystis* sp. (a cyanobacteria) contributing more than 80% of the total algal species. Both the ponds were found alkaline (pH 8.2-9.1), with very low oxygen (1.2-2.0 ppm) dissolved, high Chl-*a* level(106-139 µg/l) and other nutrients like TN, TP, TDP, TDN, PO_4^{-3}, NO_3^{-2} were also invariably high in their levels over the recommended levels of WHO. *Microcystis* sp. is already established as one of the causative agent in microcystin production therefore, we are also quantifying its various forms (microcystin-LR, -RR and -YR) present in the aquatic bodies. The data correlating microcystin production, selected inorganic nutrient load as well as recurrence of algal bloom in the Laxmi Kund and Sankuldhara pond has been discussed.

Key words: *Microcystis* sp., Microcystin, Inorganic nutrients, Bloom

SV/P-2

Assessment of Pollution of Mithi River, Mumbai, India

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The world is facing a growing water crisis, affecting the well-being of millions of poor people. Rapidly growing population, urbanization, agricultural intensification and climate change (such as global warming) all contribute to scarcity of water resources. Although we as humans recognize this fact, we disregard it by polluting our rivers, lakes and oceans, reducing many water bodies to mere shadows of their original glory. This has lead to water scarcity and organisms are dying at an alarming rate. Today, steps need to be taken to understand the problem of water pollution and revive our water bodies.

River Mithi is a river in the island of the city of Mumbai. It originates from the overflow of Vihar Lake and flows through the city before meeting the Arabian Sea. However, as the river passes through congested residential colonies, hutments and small factories, it is subjected to indiscriminate disposal of raw sewage and industrial waste. In the past this river served as an important storm water drain for Mumbai. Decades of abuse had led to the Mithi river wreaking havoc on July 26, 2005 when the city of Mumbai was submerged following very heavy rainfall. One of the factors responsible for the severity of floods was the choking of Mithi river by plastic waste material and sewage, making it difficult to discharge the flood waters into the sea. Later the Municipal Corporation of Greater Mumbai undertook a cleanliness drive and spent crores of rupees so that such floods were not repeated, but citizens still continue to dispose sewage and garbage along the stretch of the river.

Inorder to revive this dying river there is an urgent need of evaluating and creating awareness of the pollution levels of the Mithi river. This research project was undertaken to evaluate the physicochemical and microbiological quality of the water of Mithi river (as of the year 2010). For testing, water samples were collected at the origin of the river, near Vihar Lake and at a sampling point, further downstream, near Bandra Kurla Complex. The site near the origin showed much lower levels of pollution, the water was clear, had a normal pH and no dissolved solids

.The biological oxygen demand was satisfactory (2 ppm). However, using atomic absorption spectroscopy, traces of mercury were detected.

The water sample collected further downstream showed a much greater evidence of sewage contamination and discharge of industrial effluents from small factories. The water was brownish, had alkaline pH and ammonical odour. The total dissolved solids content and total suspended solids content were 19.9 g/l and 22.7g/l respectively. This was much beyond the acceptable limits and such waters could cause distress in animals and can damage plants.The water showed poor dissolved oxygen content (BOD level of 12ppm) as a result of discharge of effluents into the water. Many harmful chemicals like nitrites, nitrates, zinc, cadmium, chromium (possibly from leather factories) and mercury were detected which are harmful to humans, animals, plants and aquatic life. Microbiological tests revealed high levels of coliforms, faecal streptocooci and clostridia in the river at both sampling points showing that the water was polluted with human and animal excreta Further, cadmium resistant bacteria,were isolated from the river water by the elective culture technique and their potential in bioremediation process (by removal of cadmium from solution) was studied.

Key words: Mithi river, Pollution, Heavy metals, Bioremediation, Coliforms

SV/P-3

A Comparative Assessment of Microbial Biomass – C, N and P along Sodic, Semi-Reclaimed and Normal Agricultural Soils

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A variation in microbial biomass (MB) - C, N and P along sodic, semi-reclaimed and normal agricultural soils in dry tropical soils of Sultanpur district of eastern Uttar Pradesh (U.P.), India, was studied from November 2009 to September 2010. The study site is representative of large areas of abandoned natural sodic soils of the Indo-Gangetic alluvial plain. The water holding capacity, organic-C, total-N, P and soil moisture content was comparatively higher in normal agricultural soils than that of the sodic and semi-reclaimed sites. Across different study sites the annual mean MB-C, N and P at 0-15 cm soil depth varied. At all the selected sites, the maximum MB-C, N and P were during the wet period (rainy season) and minimum in dry period (summer season). In the present study, soil MB-C, N and P was higher at the normal agricultural soils compared to sodic and semi-reclaimed soils. ANOVA indicated significant differences in MB-C, N and P due to sites and seasons ($P <$ 0.001). The MB-C, N and P were positively correlated with organic-C. The relationship between soil moisture and MB-C, N and P was positive. The decreasing order of MB-C, N and P along study experimental sites was normal agricultural soils semi-reclaimed sodic. The results suggests that strength of soil sodicity causes the alterations in soil physico-chemical properties as a consequence this lead to reduction in soil nutrients and MB-C, N and P in the soil of disturbed sites (semi-reclaimed and sodic soils) compared to normal agricultural soil.

Key words: Sodic Soil, Semi-reclaimed soil, Normal agricultural soil, Microbial biomass

SV/P-4

Environmental Impact on Pulicat Lake, SPSR Nellore Dist, Andhra Pradesh

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The lagoon's boundary limits range between 13.33° to 13.66° N and 80.23° to 80.25°E, with a dried part of the lagoon extending up to 14.0°N.; with about 84% of the lagoon in Andhra Pradesh and 16% in Tamil Nadu. This is a valuable and rich flora a good botanical heritage need be conserved and protected to preserve ecological balance and to keep a watch on the micro climatic changes and result out environmental impact on the flora.

Thousands of water birds are seen in the winter waters of Pulicat lake. Migratory birds swarm around the environment to enhance the beauty and elegance of the surroundings of Pulicat Lake, which is enchanting enthralling and interesting. Abundant vegetation of Casuarina, Eucalyptus, Cashew, Palms and Coco nut groves and Cane brakes provide a pleasant landscape. Natural calamities by cyclones, forest fire, grazing and browsing are alarming in causing damage to the flora of the Pulicat Lake. About 3000 and above wild cattle roam in the forest, pasture lands and also resident areas, trampling heavily the under growth grazing and browsing vegetation.

Fishing activities; Illegal prawn farming; Industrial development on the shores of the lagoon; and Siltation are threaten issues. Mangrove pockets need to be developed. Eradication of exotic plants. Plants like *Baringtonia acutangula* serving as a nesting tree and meeting the nutritional and breeding requirements of the birds, have to be grown in large number. The plant species are chosen with the twin goal of raising the bio sheilds and deriving liveihood benefits to the local communities. Creating awareness among local resident about the numerous benefits imparted by the coastal ecosystems on mankind. Critical study on ethnobotany of Yanadis hamlets needs to be done. Along the beach line Casuarina is found to be quite ideal for plantation. In addition *Ancardium occidentale* is a suitable species in preventing soil erosion.

Key words: Pulicat lake, Natural calamities, Mangroves-importance, Protection

SV/P-5

A Novel Approach to Assess Underground Drinking

Water Quality at Moradabad

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Underground drinking water samples at six different sites of hand pump at Moradabad were collected and analysed for pre-monsoon period and after onset of monsoon for fifteen different water quality parameter following standard method and procedures. With the help of this statistical data, water quality index has been calculated using W.H.O. drinking water standards. Comparison of W.Q.I. values with standard assumptions revealed that the drinking water of study area at site-I, II and III for pre-monsoon period and at site-I after onset of monsoon was severely polluted. At other sites for pre-monsoon period and site-II after onset of monsoon the water is found to be moderately polluted. The underground water is found to be good in quality at site- III to site-VI after onset of monsoon. The data clearly reveals that the water quality is improved after the rains. The present study suggests that people dependent on this water are prone to health hazard of contaminated drinking water.

Key words: Groundwater quality, Water quality index, Unit weight, Quality rating

SV/P-6

Water Quality of River Betwa and Pahuj in and Around Jhansi, Bundelkhand Region of Uttar Pradesh, India

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In present investigation an attempt has been made to assess the quality of two major rivers in central India of Bundelkhand region of Uttar Pradesh namely Betwa and Pahuj river. The sampling locations were chosen carefully in east and west part of the Jhansi city to get maximum representation of the diverse eco-hydrological environments within the river system. Study showed that the water of Betwa and Pahuj river are alkaline in nature with higher concentration of cations. Nitrate was dominant at site-III followed by site-II and site-I respectively, in both river and it can be attributed due to high rate of decomposition and anthropogenic pressure. In both the river dissolved oxygen was dominant at site-I and II compare to site-III due to abundance of animated life and the microbial activity. Maximum hardness 160 mg/l was recorded during May in Betwa river. High concentration of chlorides is regarded as an indicator of sewer pollution and it was observed highest in Pahuj river but high concentration of nitrate was recorded in Betwa river. In general our study found that the water quality of Pahuj river is more polluted in compare to Betwa river.

Key words: Betwa, Pahuj, Nitrate, Fluoride, Chloride, Dissolved oxygen

SV/P-7

Impacts of Rapid Urban Development: Heavy Metals in Yamuna River Basin, Delhi Segment

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Heavy metals are present in the atmosphere, soil, water and air. They can enter human body mainly through inhalation and ingestion. Heavy metal intake by human population through food chain has been reported in literature. This study estimated levels of heavy metal (nickel, lead, cadmium, cobalt, arsenic, mercury, chromium) concentrations in the irrigation water, drinking water and soil of Yamuna river flood plain flowing through Delhi. The levels of heavy metals in select crops grown in this segment were measured and compared with concentrations in vegetables from rural areas.

Traces of metals (Hg, Ni, Cr) were observed in urban agriculture soils above the reference standards. Heavy metal levels found in vegetable samples from Yamuna basin were compared with samples from agricultural land in Haryana. Bioaccumulation of Ni, Pb, and As in urban area samples was seen; these were in highest concentrations in spinach and lowest in radish. The crops cultivated in urban areas showed accumulation several folds higher than samples from rural fields. Some heavy metal (Ni, Cd, and Hg) were not traced in vegetables from rural areas.

Key words: Heavy metals, Vegetables, Bioaccumulation, Waste water

SV/P-8

Urban Pond Water Bodies: Status and Threats

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The significance of urban and peri-urban waterbodies (ponds) as water resources is being appreciated now as never before. Increasing population in urban and peri-urban centres has put more stress on water management of city administrations. This has necessitated proper management of the ponds economically for better water quality. Unfortunately the value of services rendered by such waterbodies often gets unnoticed. Ponds are vulnerable to loss and damage by a wide range of factors. Urban ponds are also subject to a different set of stressors at the local scale than their rural counterparts. This is due to the developed nature of the surrounding landscape, which has many impermeable surfaces from which contaminants can be washed off following rainfall events as well as drainage misconnections and stormwater drains, which often

discharge directly into urban ponds. Key stressors include heavy metals, petrochemicals, salt compounds and wastewater. Urban catchments pose major threats to water quality of ponds and other water bodies.

Key words: Catchments, Drainage, Heavy metals, Stormwater, Waste water

SV/P-9

Water Quality Assessment of an Untreated Effluent Impacted on Antiyatal, Jhansi City (U.P.)

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Semi-arid areas like the Bundelkhand region in the state of Uttar Pradesh often experience acute shortage of water, both for drinking and irrigation purpose. The region has a varied geology and topography. In this study, physico-chemical parameter such as temperature, pH, BOD, Alkalinity was in permissible limit except DO and heavy metals. Heavy metals such as Cr, As, Pb, Fe, Hg and Cd in reservoir bed sediment were analyzed using comparative sediment quality guideline from various derived criteria. The selection of sampling points was based upon inflow and outflow regions of the reservoir. The extent of sediment quality deterioration was more pronounced in Cr, Fe and Pb and failed the sediment quality guideline, while As, Hg, Cd remained within the safety levels of sediment quality guidelines prescribed for the study. These ranges pose threat on aquatic life and human health.

Key words: Water quality, Physico-chemical characteristics, Heavy metals, Reservoir, Sediment quality guidelines, Health effect

SV/P-10

Impact of Pollution on the Quality of Water in Two Major Nalas of Berhampur City, Ganjam, Orissa

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The corporation city of India is realigning under the pressure of severe water scarcity. Berhampur is among the water affected as it has suffered long spells of water shortages combined with rapid and haphazard urbanization of its ever-expanding suburbs. In light of the above, it is important to assess the quality of the water bodies that supply precious water to the human population. The present study was undertaken to asses the quality of water in two important Nalas of Behampur City which re-charges the surface water as well as estuarine environment of plant and animal life. Dumping and burning of waste, and unchecked inflow of domestic, industrial, and medical effluents have deteriorated the water quality. The parameter studies were:- color, order, temperature ,pH , dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, calcium hardness, magnesium hardness, total dissolved solid, total suspended solid, nitrate and phosphate. The result of chemical characteristic such as DO, BOD, and COD during the period of January-2009 to December-2009 showed that the values varied from one station to another station. The result obtained was low as compared to the permissible limit as prescribed by United State Environmental Protection Agency and World Health Organization.

Key words: Impact of pollution, Water quality, Two major nalas, Berhampur city, Ganjam

SV/P-11

Hydrogeochemistry and Water Quality Assessment of Groundwater Resource of Jhansi District (U.P.)

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Groundwater is generally a renewable resource. However, the natural supply of groundwater in hard rocks is limited to time and space. Further, the quality of available fresh water resource is under severe threat. One of the most important issues in ground water management is extending minimum negative effects to the environment while exploiting it for maximum economic benefits. Ground water is highly valued because of certain properties not possessed by surface water. Bundelkhand has geological disadvantage, its underground granite layer doesn't allow plenty groundwater recharge. That is the reason why the area is dense with surface water harvesting structures or shallow dug wells. But off late the predominantly agrarian region is depending on groundwater for irrigation. Hydro geochemical investigations are carried out in the different blocks of Jhansi district in Bundelkhand region (U.P), India, in order to assess its suitability for drinking as well as irrigation water purpose. Altogether 70 representative groundwater samples are collected from tube wells and dug wells. Groundwater samples were collected from 70 locations during month of January and May 2010. Each of the groundwater samples was analyzed for these parameters such as pH, electrical conductivity, turbidity, silica, alkalinity, TDS, total hardness, bicarbonate, chloride, sulphate, nitrate, fluoride, calcium, magnesium, sodium and potassium, heavy metals using standard procedures recommended by APHA.

Key words: Physico-chemical characteristics, Water quality assessment, Hydrogeochemistry**,** Major ions, Heavy metals, SAR, RSC, Health effect

SV/P-12

Analysing the Hydrochemistry of River Sai at Rae Bareli

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Water samples and preservation samples of Sai river were collected at monthly interval in the first week of each

month from January 2009 to December 2009. Physico-chemical characteristics of river water (viz, Temperature, pH, alkalinity, acidity, D.O., B.O.D., C.O.D., Cr, NO_3 , PO_4^{-3} - P, Na, Fe, Cu, Zn, Pb, Cd and Mn) were analysed by standard methods for the examination of water and waste water as prescribed by American Public Health Association (APHA, 1985). The low level of D.O and high level of other characteristics are possibly due to adsorption of cations. The adsorption of cations may be explained on the bases of surface hydroxylation of oxide present in the adsorbent at the solid solution interface. The present study also entails the experimental revelation that certain plants and wastes may be effectively used for water treatment at the lowest cost and most convenient technology.

Key words: Hydrochemistry, River Sai, Rae Bareli

SV/P-13

Pollution Status of River Pandu at Kanpur Frontage

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River Pandu flowing on the southern outskirts of Kanpur is severely subjected to anthropogenic stress all along its stretch passing through Kanpur. Municipal and industrial wastes of the southern Kanpur, especially of the Kanpur Industrial Area, are discharged into it without any treatment. The present investigation deals with the pollution stress on the river and its impact on the water quality and algal profile of the river at its Kanpur frontage. Data obtained indicate the unhealthy, stressed condition of the river which needs an urgent attention both at governmental and non-governmental level to save it from further deterioration in order to save the holy river Ganga in which it merges at Fatehpur, downstream of Kanpur.

Key words: River Pandu, Anthropogenic pollution, Anthropogenic stress, Pollution status, Kanpur frontage

SV/P-14

Heavy Metal Concentration in Water and Sediment of River Ganga at Selected Sites in the Middle Ganga Plain

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The concentration of Copper, Chromium, Nickel, Zinc and Cadmium in water and sediment of River Ganga have been studied in a stretch of 10 km from Champanala to Barari at Bhagalpur in Bihar (Middle Ganga Plain). Grab samples of water and sediments (January 2006 –December 2007) were collected from 3 different sites following the Standard Methods. Water and sediment samples of the river were processed and analyzed for heavy metals viz., Cu, Cr, Ni, Zn and Cd using AAS. The heavy metals found in the river water were in the range of: Cu (ND to 0.12 mg/l); Cr (BDL to 1.09 mg/l); Ni (BDL to 0.12 mg/l); and Zn (BDL to 0.87 mg/l), and in the sediments in the range of: Cu (BDL to 0.09 mg/g); Cr (BDL to 0.14 mg/g); Ni (BDL to 0.09mg/g); and Zn (BDL to 0.87 mg/g). Cd was found absent both in river water and sediment samples. Some physico-chemical parameters viz., pH, dissolved oxygen, total hardness, phosphate-phosphorous and nitrate-nitrogen were also estimated as they have direct or indirect influence on incidence, transport and speciation of the heavy metals. Based on the findings, the Ganga river sediments from Champanala to Barari can be considered as unpolluted with respect to Cd, Cu, and Ni, whereas concentration of Cr and Zn show their pollutional status which may be detrimental to the rich biodiversity of the river segment.

Key words: Ganga river, Heavy metal pollution, Water, Sediment

SV/P-15

Study of Industrial Effluents at Ankleshwar Sites

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Ankleshwar is famous for chemical industrialization. Various Chemical, Dyes, Paints, Pesticides, Fertilizers, Paper Pulp, etc are produced by many small and medium scale units. Due to industrialization and also negligence heavy metals like Cadmium, Chromium, Lead and Arsenate were present in industrial effluents, which are hazards not only for human but also to whole eco system. At many places the ground water was also contaminated with such pollutants. The effort has been made to study physico-chemical parameters of waste water sample from pollutant site. Seasonal variation was also observed in water quality and concentration of heavy metals in the waste water.

Key words: Effluents, Heavy metals, Industrilization, Pollutants, Water quality

SV/P-16

Plant Species Recommended for Green Belt Development at Selected Areas in Delhi

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Air pollution control is more complex than most other environmental challenges. A suitable alternative may be used to develop a biological method by growing green plants in and around industrial and urban areas. To check the spread of air pollutants emitted from anthropogenic sources, many scientists recommended growing green vegetation in and around the industrial and urban areas. It is well documented that plants remove air pollution such as hydrogen fluoride, SO_2, and some compounds of photochemical reactions and collect heavy metals such as Hg, Pb from air. Plants remove air pollutants by three means: absorption by leaves, deposition of particulates and aerosols over leaf surface and fallout of particulates on the leeward side of the vegetation. Some of the plant species differ markely in their response to

pollutants, some being highly sensitive and other hardy and tolerant. Recommendation of new plant species (either tolerant or sensitive) can be done for the development of the new green belt areas on the basis of certain physiological and biochemical parameters. Thus, plants can be used as both passive biomonitors and bio mitigators in the urban environment to indicate the environmental quality and to atteunate the pollution level in a locality. Our present study emphasizes on the selection of some of the plant species which are recommended for green belt development in some selected sites in Delhi with the help of Air Pollution Tolerance Index (APTI) taken as a parameter. The main objective of the study is to calculate APTI of some of the common plants grown in Delhi and also common in all the experimental sites (especially in Riverine Zone and Hilly Zone), besides this, to determine their sensitivity or tolerance limit and further recommend for green belt development at the selected sites in Delhi. The sites which were chosen: Riverine Zone {Site I (Yamuna Biodiversity Park, YBP, Jagatpur Gaon), Site II (Traffic intersection outside YBP, Gandhivihar)}and Hilly Zone {Site III (Aravalli Biodiversity Park, ABP, near Vasant Vihar) and Site IV (Traffic intersection outside ABP, Vasant Vihar)}. The common plant species which were chosen at Site I & II (*Ipomoea plamate*, *Ziziphus mauritiana*, *Datura stramonium*, *Prosopis juliflora*, *Calotropis procer* and *Ricinus communis*) and Site III & IV (*Azadirachta indica*, *Derris indica*, *Prosopis juliflora*, *Morus alba* and *Haplophragma adenophyllum*). Hence our study concludes that in area around Riverine Zone *R. communis* and *P. juliflora* were found to be the most tolerant plant species which may be recommended for plantation, can act as air purifiers and in Hilly Zone *A. indica* and *P. juliflora* were found to be the most tolerant plant species which may be recommended for green belt development in Delhi.

Key words: Green belt, APTI, Air pollution, Riverine Zone, Hilly Zone, Delhi

SV/P-17

Assessment of Traffic Noise Pollution in Varanasi City

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On the basis of the continuous traffic noise data observed at 50 sites distributed in 25 roads, the characteristics of traffic noise and effect factors were analyzed through traffic noise indices, such as Leq, L_{10}, L_{50}, L_{90}, TNI, and Lnp. Our findings allow us to reach a number of conclusions as follows: First, traffic noise pollution was serious; Second traffic noise adverse**ly** affects the human health. Noise level emitted by different types of vehicles driven under realistic way in the field experiment was measured. The results showed that the vehicles in low gear and low speed cause higher noise level. Among all the vehicles taken under consideration Autos are found 30 dB (A) nosier than Car, 10 dB (A) nosier than Vikram, 5 dB (A) nosier than HDV and 4 dB (A) nosier than LMV. Noise level can be limited by banning of vehicles which emits higher noise level.

Key words: Noise, Traffic, Control, Gear, Pollution, Health

SV/P-18

Atmospheric Dispersion Measurements from Ground Level Source under Tropical Conditions

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Atmospheric processes in the tropical countries differ from those in mid-latitudes because atmospheric diffusion in the tropics is generally associated with low wind speed magnitude less than $3ms^{-1}$. Low wind speed would cause significant free convection in the daytime and strong stable conditions in the night time. Hence, atmospheric surface layer turbulence associated with low wind speed could be different from that of moderate to high wind speed. So an observational programme using SF6, a trace gas, was conducted in 1991-1992 and 1995 - 97 to have a better understanding of the lower part of atmospheric boundary layer in tropics and to know the onsite dispersion scenario resulting from point source during low, calm and variable winds which are of common occurrence in tropics and leads to high pollution potential. Low and variable winds exhibited some unusual but interesting tracer concentration distribution and even hourly average plume just like an instantaneous plume is unlikely to be cone shaped due to lack of well defined plume centerline. As a result the observed concentration field normally has a relatively large lateral spread typical of a non Gaussian distribution. The unusual concentration patterns were puff, biguassian and multipeak in nature.

Key words Atmospheric boundary layer, Turbulence, Air pollution, Atmospheric dispersion, Tracer

SV/P-19

Chemical Characterization of Aerosols from Srinanagar (J&K)

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Chemical identification of organic compounds and quantitative estimation for the aerosol samples collected from Srinagar region (J&K) was done. These samples were collected continuously over a period spanning from August 2008 until December 2009. This is the first systematic long term study done in Kashmir region which addresses the chemical characteristics of aerosols. The major class of organic compounds which were particularly focused include: Alkanes, PAHs, and VOCs. The seasonal variability of identified organic compounds was analyzed with reference to local and regional meteorology. The analysis of aerosol samples was done by developing novel method for GC-MS.

Key words: Aerosols, Alkanes, PAHs, VOCs, Meteorology

SV/P-20

Identification and Quantitative Estimation of N-Alkanes Associated with Ambient Aerosols by using Td-Gc/Ms

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Significant fraction of ambient aerosols consists of multifarious complex organic species, viz., alkanes, alkanoic acids, alkanals, and polynuclear aromatic hydrocarbons etc. Aliphatic hydrocarbons, particularly n-alkanes are ubiquitously present in all rural and urban environments. Their non-polar and stable nature assists in source identification. With the help of parameters like CPI and Cmax, the origin of n-alkanes can easily be traced to be biogenic, petroleum or marine. In this regard, it is essential to devise reliable methodology to identify and quantify these. In present study, we have used Thermal Desorption GC-MS (TD-GC/MS) method to identify and quantify the n-alkanes associated with aerosols. Standard curves for homologous series of n-alkanes from C_{10} to C_{35} manifested statistical linearity for C_{10}-C_{26}. Results from the study suggest that TD-GC/MS technique can indisputably be used to identify and quantify the particle bound n-alkanes, without chemical preprocessing of aerosol samples.

Key words: Air pollution, Aerosols, Organic species, n-Alkanes, TD-GC/MS

SV/P-21

Relationship among Various Pollutants in Indoor Environment of Hairdressing Salons In Ahmedabad

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The purpose of this study was to assess the level of chemical compounds in the indoor air of hairdressing salons. Twelve hairdressing salons were monitored for two days for SO_2, NO_x, RPM, and VOCs. The number of customers, type of beauty treatment, ventilation and dimensions of salon were recorded. The levels of p – xylene were well below the recommended standards. On first and second day it was observed that SO_2 has positive and significant correlation with NOx (r = 0.625, n=12, p0.05) and (r = 0.709, n=12, p0.01). All the samples analysed for VOCs showed the presence of only p-xylene and few samples also showed the trace levels of toluene.

Key words: Hair salons, p-Xylene, PM_{10}, SO_2, NOx

SV/P-22

Aeromycological Approach and Analysis of the Public Parks of Bhilai Township, Chhattisgarh

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A systematic aeromycological analysis of four public parks in Bhilai Township was carried out during July 2009 to June 2010. A total of 22 genera of fungi having 37 species were recorded during the study period. Maximum fungal species were observed in the month of November (152) followed by October (148). Overall highest prevalence of fungal types was represented by *Aspergillus* (06 spp.) followed by *Alternaria* and *Curvularia* (04 spp. each) respectively. *Aspergillus niger* was found as most frequent (91.66%) fungal species followed by Alternaria *alternata* (83.33 %). However, the highest percentage contribution (9.34%) was observed for *Alternaria alternata.*

Key words: Aeromycology, analysis, *Alternaria, Aspergillus, Curvularia*

SV/P-23

Photo Bioreactor: can be an Artificial Tree in the Metro Cities to Minimize Environmental CO_2

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The space in the metro cities is the main problem for the plantation of various trees which can maintain the level of CO_2 in the environment of cities and hence the global temperature. By keeping this important view in mind, we have studied the photobioreactor which can serve as an artificial tree inside the home and offices in these metro cities. In this paper our ultimate aim is to develop a correlation to find out the time required for an average populated city to minimize the percentage level of CO_2 in the atmosphere of city on the basis of reported data on the photobioreactor.

Key words: Bio-reactor, Photosynthesis, Carbon, Capture, Sequestration, Greenhouse, Solar, Renewable, Photobioreactor

SV/P-24

Study of Environmental Pollution by Textile Industries in Tamil Nadu using Special Fam Model

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In this paper we do not discuss about types of garment production, labour situation and wages, labour relations, employers, labour inspection, labour laws and acts, payment of a living wage, exploitation of child labour, discrimination in employment, excessive working hours, health and safety, legally biding employment relationship or trade unions role. We only study the environmental pollution by these industries, ground water pollution, river pollution and atmospheric pollution and its evil effects on locals and labourers. We study only the effects of pollution and how to control it. Is the only solution lie in closing down of these plantsfi

The problems of pollution leading to health hazards and hazarderous diseases, the future population has chances

of suffering genetic disorders, malformed children, etc all types of new health problems which may be very new to the world. The vegetation in that area has been very badly affected and we see even the bringing up of the domestic animals has become a problem. Since we cannot exactly say the exact percentage of chemicals found in the waste water or we are not in any way able to say precisely the percentage of hazarderous gas let out into the atmosphere; these short comings has forced us to study this problem only with opinion of the experts. Only when we have a past data we can use neural networks or fuzzy control theory.

Here we use special FAM models using NGO's, socio scientist, environmentalists, labourers working in textile industries, locals and trade union leaders as experts. Conclusions are based on the resultant fit vector of the FAM model.

Key words: Fuzzy Associative Memories (FAM) model, Fuzzy vector matrix, Fit vector, Reverse Osmosis (RO)

SV/P-25

Assessment of Environmental Impacts by Open Cast Mining Activities in and Around Jhansi, Uttar Pradesh, India

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In Bundelkhand region mining especially open cast mining and its allied activities have taken big strikes during the last couple of decades, contributing significant infrastructure development and raising the living standards of mankind. However, they have also brought in their wake, degeneration and degradation of natural resources, pollution, health risk and socio-ecological instabilities. Bundelkhand region, occupying almost 71818km^2 in the central planes of India, is known for its rich deposits of pyrophyllite, moram, salt peter, granite, diasporas, sand, etc. There are around 325 active mining sites in Jhansi district alone. Deforestation, dust generation, water, air and noise pollution and resource depletion are common hazards associated with opencast mining widely prevalent in this region. The present paper attempts to reveal the base line environmental quality and socio-economic setting in and around such mining sites with special reference to the effects on the air, water, changes of land use pattern and occupational health effects of mine workers as well as people living along adjacent areas. It also attempts to provide a framework for management strategies to improve the environmental conditions in the mining sites and its adjoining environments.

Key words: Air quality, Bundelkhand region, Health hazards, Opencast mining, Water pollution

SV/P-26

Methane and Nitrous Oxide Emissions from Sandy Loam Soil under Sugarcane Cultivation

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Agricultural soils have been identified as important emitters of two potent greenhouse gases namely methane (CH_4) and nitrous oxide (N_2O). At the same time, soils act as a sink for these gases depending on the physicochemical characteristics. Field studies are continuing throughout the world to estimate the contribution of different agricultural systems towards the emissions or removals of CH_4 and N_2O. The objective of the present study was to measure CH_4 and N_2O fluxes from sandy loam soil under sugarcane (*Saccharum officinarum* L. cv. CoS 96255) crop in subtropical climate of Varanasi, India. Fluxes were measured through closed chambers and analyzed through gas chromatograph equipped with FID for CH_4 and ECD for N_2O. Fluxes of CH_4 and N_2O were most of the time either not detectable or negative with cumulative emission of -13.2712 and -2.1621mg/m^2/h respectively over the monitoring period from July 2009 to June 2010. This indicated that the soil acted as a net sink for both the gases although there were occasions when positive fluxes were also observed. Maximum positive fluxes (6.240 mg/m^2/h for CH_4 and 8.371 mg/m^2/h for N_2O) were observed during July, 2009 when the soil was water logged. The negative flux of N_2O may be because no nitrogenous fertilizers were applied during the entire experiment. Under reduced available nitrogen, litter decomposition remains the only source of nitrogen and it is possible that flow of N_2O took place from atmosphere to soils. The aerobic soil didn't allow formation of CH_4 during decomposition, and methanotrops whose activity is enhanced under the aerobic environment, consumed atmospheric CH_4 leading to negative fluxes. The study clearly showed that sugarcane cropping system is a potential sink of CH_4 and N_2O if nitrogenous fertilizers are not used.

Key words: Methane, Nitrous oxide, Greenhouse gas flux, Greenhouse gas sink, Global warming

SV/P-27

Indoor Air Quality of Rural Residences of Agra, North Central India

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Indoor Air Quality has received a lot of attention in recent years, mainly due to the large amount of the time we spend indoors. Indoor Air pollution poses high risks of health ailments and can cause respiratory diseases. There is an urgent need to know Indoor Air Quality issues, to share the latest information, to make people aware of the risks of Indoor Air pollution and let them know how to avoid it. In this study we performed an observation of indoor and outdoor air quality of domestic homes located in rural environment from May 2004 to May 2005 in Agra, north central India. The purpose of this study was to characterize the indoor/outdoor (I/O) relationship of airborne pollutants, to recognize their

probable source in all three seasons, that is, winter, summer, and rainy season. We surveyed people (by means of questionnaire) to find out different diseases/symptoms that they were facing due to indoor pollution. Concentrations of SO_2, NO_2, CO_2, CO, RSPM, and PAH were monitored simultaneously and I/O ratios were calculated at all the fifteen different houses/huts at rural environment. In order to investigate the effect of seasonality on indoor and ambient air quality, winter to summer and winter to monsoon average ratios were calculated. We find that the levels of pollutants increase from summer to winter to monsoon, and from indoor to outdoors. Regressions analysis had been done to further investigate the influence of indoor air-pollutant concentrations on outdoor concentrations. The most probable categories of sources for these pollutants have been identified by using principal-component analysis. Indoor air pollution is a complex function of energy housing and behavioral factors. It was also found that most rural people suffered from respiratory diseases. On the basis of this study and observations, some interventions and some precautions were suggested.

Key words: Indoor air quality, Respiratory diseases, Indoor/outdoor relationship, India

SV/P-28

Five Year Studies on Suspended Particulate Matter Trends in Moradabad City

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Moradabad is an important city in western U.P and also knows as "Pital Nagari", as about one thousand large and small scale brassware industries are located in and around the city. Suspended Particulate Matter (SPM) was collected two times in a week using respirable dust samplers. The SPM emissions that are investigated based on the measured database for the six selected sites of Pital Nagari. The result indicates annual and seasonal variations of SPM from 2004-2009. The highest value (863.5g/m^3) was observed at Mughalpura in June 2005-06, while lowest value (70.91g/m^3) was found at PTC in July 2004-05.

Key words: SPM, Pollution trends, Moving average, Industrial

SV/P-29

Role of Physico-Chemical Properties of Soil and Water of Jaunpur City in Better Growth of *Raphanus sativus*

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Raphanus sativus is native to western India. It is annual sometimes biennial herb with a rosette of lyrate with short stem. A particular variety of *Raphanus sativus* named Jaunpuri or Newar grown in certain belt of Jaunpur city showed better growth in terms of length, girth and biomass at certain period of its growth cycle. However, this was not conspicuous in another variety of radish i.e. *Raphanus sativus cv.* Pusa chetki growing at the same site. It was found that the chemical properties of irrigated water such as hardness, chloride content and electrical conductance along with some chemical properties of soil such as electrical conductance, nitrogen and sulfur content enhanced 112.5% length, 133.3% girth and 2077.5% biomass of cv. Newar in comparision to cv. Pusa chetki. Among the three selected sites (Siddiquepur, Bhaarajpur and Mandi Naseeb Khan), the site Mandi Naseeb Khan provided suitable environment to Newar variety of raddish.

Key words: Radish, Pusa chetki, Jaunpuri, Hardness, EC, Bulk density

SV/P-30

Effect of Fly Ash on Soil-Water Characteristic Curve of a Locally Available Soil

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The reliability of unsaturated soil modeling depends on its precise characterization, which includes the development of a graphical relationship between water content (or saturation) and soil suction, popularly known as soil-water characteristic curve (SWCC). SWCCs are quite useful in predicting the different unsaturated soil behavior such as unsaturated hydraulic conductivity, seepage, thermal flow, volume change behavior etc. It is believed that each soil has got a unique SWCC that may get influenced by different factors. The present study aims to investigate the influence of addition of fly ash on SWCC of a locally available soil. It can be noted that the fly ash has been reported to improve the growth of some plants by providing some essential nutrients. SWCCs have been obtained for sand, fly ash and sand-fly ash admixture using a tensiometer and volumetric water content sensor. The details of the methodology adopted are discussed in the paper. Based on the test results, the effect of fly ash on the SWCC is analyzed. The details of the test set up used in this study are also presented.

Key words: Unsaturated soil, Fly ash, Matric suction, Volumetric water content, Soil-water characteristic curve

SV/P-31

Effect of Fertilizers on Germination of Seeds

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The present paper deals with the effect of fertilizers (i.e., biological and chemical) on industrially polluted soils collected from Hyderabad and West Godavari district. The soil samples are collected from Industrial areas of Bollarum, Patancheru and Jeedimetla in winter season. Soil samples were also collected from rural areas of West Godavari in winter season only.

The heavy metal content in all soil samples are determined by DTPA extraction method. It is found that Zn, Cu, Mg and Cd contents of Industrial area samples is very

high. The N and P content of rural areas are found to be sufficient whereas in industrial areas it is low. In the present study, germination of seeds is carried out in industrially contaminated soils, by applying chemical fertilizers like diphenyl amine and urea and also by applying a biological fertilizer like vermicompost under lab conditions.

It was observed that germination started after 60 hours in untreated sample and when the soil sample is treated with biofertilizer like vermicompost, the germination started after 60 hours but in relatively lesser number of seeds. In the soil samples treated with diphenylamine, germination began after 50 hours and the number of seeds germinating is also found to be relatively more. Growth rate is observed in the following order: Vermicompost>diphenylamine>untreated samples>urea (zero growth rate).

Key words: Heavy metals, Fertilizers, Seed germination, Diphenylamine, Vermicompost, Urea

SV/P-32

Characteristics of Particulate Matter Pollution Inside and Outside a Natural Ventilated School Building

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Indoor air quality (IAQ) has become a growing environmental issue and public health concern. People spend most of their time indoors buildings, such as school and offices as well as their homes. This study investigates variation in indoor/outdoor (I/O) concentrations of particulate matter pollution in the natural ventilated school building. Long term I/O PM monitoring began March and is ongoing, were observed in different patterns of concentration between PM outdoor & indoors. PM outdoor average concentrations were 12 μgm^{-3} (PM_{10}), 4 μgm^{-3} ($PM_{2.5}$) & 1 μgm^{-3} (PM_1) for the whole week. PM indoor average concentrations were generally much higher than outdoor levels, with an average of 1000μgm^{-3} (PM_{10}), 50μgm^{-3} ($PM_{2.5}$) and 5 μgm^{-3} (PM_1) during weekdays. Minimal PM concentrations were observed during weekend. I/O PM ratio's were found to differ significantly (p-value <0.05) between weekdays and weekend for fractionated PM_{10} and $PM_{2.5}$. During weekdays only 6.8, 2.3 & 2.8% variation in the indoor concentration of PM_{10}, $PM_{2.5}$ and PM_1 could be attributed to the outdoor concentration respectively. The very low values of R^2 revealed the independent sources of particulate matter in the indoor environment at the classroom. In the case of I/O PM during weekends there was a significant impact of outdoor PM on indoor PM; results indicating that 68, 65 & 63% variation in indoor levels of PM_{10}, $PM_{2.5}$ and PM_1 can be due from outdoor sources. Average indoor PM was recorded 500μgm^{-3} (PM_{10}), 100μgm^{-3} ($PM_{2.5}$) & 5μgm^{-3} (PM_1) while the school was open and these values decreased rapidly when the school closed to 30μgm^{-3} (PM_{10}), 10μgm^{-3} ($PM_{2.5}$) and 1 μgm^{-3} (PM_1). In conclusion, this study showed the levels of indoor PM were higher than outdoor and these concentrations were considerably higher than any established standard guidelines (EU, USEPA and WHO). The use of the classroom was a principle contributor for high concentration indoor PM as was the nature of the class activity.

Key words: Indoor Air Quality (IAQ), Particulate Matter (PM), PM size fractions, Building characterization, Source

SV/P-33

Study on Morphology, Mineralogy and Elemental Composition of Fly Ash at Panki Power Plant at Kanpur

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Fly ash being generated in large quantity in thermal power plant is generally recognized as waste and an environmentally hazard. The present study was conducted to study morphology, mineralogy and elemental composition of fly ash at Panki Power Plant of Kanpur, to explore the possibilities of its utilization in agro ecosystem to improve soil property. During present investigation detailed studies on particle size distribution, morphological feature of the individual ash particle, pH and electrical conductivity, variation in concentration of four macro-elements(N, P, K ,Ca) and four micro-elements (B,Cu,Mn,Zn) in fly ash were conducted. The trace elements were given due importance because in addition to their potential to toxicity, these elements show a marked tendency for plant uptake hence particular attention was paid to the enrichment of these elements in sized fractioned fly ash particles.

The results indicate that there is very little variation in pH, conductivity and elemental concentration of fly ashes collected as periodic intervals from the power plant. The concentrations of trace elements such as B, Cu, Mn and Zn in fly ash collected from power plant are much higher than the concentration of the respective elements of soils collected from local cultivated field. Fly ash may be a better choice for making amendment to arable soils as a good conditioner.

Key words: Fly ash, Micro-elements, Macro-elements, Ash particles morphology

SV/P-34

Effect of Nitrogen on Weed Competitiveness of Rice Field in the Indo-Gangetic Plains of India

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Weeds are the major constrains in crop production, it accounts for heavy yield losses in various agricultural crops especially in developing countries. In case of India it accounts for 37 % of the total annual loss of agricultural products. Soil nitrogen (N) is considered as an important

driver of crop weed interactions, yet the mechanism involved have been only partially explored. Therefore, a field experiment was carried out to investigate the influence of increasing level of soil N on growth, biomass accumulation and physiological parameters of rice and its dominant weeds. Nitrogen was applied in the form of urea at the rate of 0, 30 and 120 kg N ha^{-1}. Result showed significant effect of varying level of N on biomass accumulation, leaf area index (LAI), leaf area ratio (LAR), specific leaf area (SLA) and photosynthetic traits of crop and weeds. Among grassy weeds *Echinocloa cruss-gali* and among broad leaf *Caesulia axillaris* were the most competitive weeds of rice at high N condition, while *Fimbrystylis meleiaceae* and *Cyperus iria* were responding moderately to increasing level of N. Photosynthetic rate, SLA and LAI are found to be the key determinant of plant growth at high N condition. This study would be helpful to suggest the fertilizer management strategies for high crop yield in condition when weed infestations consist of species known to be highly responsive to higher soil N levels.

Key words: *Caesulia axillaries*, *Echinocloa cruss-gali*, LAI, LAR, Photosynthetic traits, SLA

SV/P-35

Mosses in Relation to Air Pollution Around National Thermal Power Corporation (NTPC), Unchahar, Raebareli, India

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The impact of air pollution, around National Thermal Power Corporation (NTPC), Unchahar, RaeBareli, India, was studied on three moss species viz.**:** *Barbula consanguinea* (Thw. et Mitt.) Jaeg., *Ceratodon stenocarpus* B.S.G. and *Physcomitrium japonicum* (Hedw.) Mitt., in terms of their morphology, leaf area index, density, biomass, chlorophyll and heavy metals.

Our conclusion reveals that among three studied mosses, *B. consanguinea* has been found least affected by air pollutants and hence considered as tolerant / resistant species whereas *C. stenocarpus* and *P. jaiponicum* have been found as more or less equally sensitive species towards air pollution.

Key words: Air pollution, Resistant, Sensitive, Mosses

SV/P-36

Estimation of Genotoxicity of Soil Samples Collected from Different Dumping Sites of Amritsar

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In many under developed and developing countries including India, major portion of wastes find its way to open dumping sites due to lack of knowledge, resources and inadequate technologies, ultimately posing health risks among populations residing near such sites. Further, the wastes of dumping sites can become toxic by additive, synergistic or antagonistic interactions of chemicals present in them. Some studies have also reported their effects on human gene pool. Considering this, the present study was planned to estimate the genotoxic potential of soil samples collected from three dumping sites of Amritsar *viz.* Haripura (Hp), Ibban Kalan (Ik) and Kathunangal (Kn) employing *Allium cepa* root chromosomal aberration assay. *In situ* conditions were simulated by allowing the bulbs to root directly on the soil contained in small pots. The bulbs were allowed to root for 36-42 h. After the roots were grown to 0.5 cm (approx.), they were washed, cut and fixed in Farmer's fluid (3 : 1 , ethanol : acetic acid glacial). The root tips were squashed in aceto-orcein to prepare slides and the slides were screened under microscope to score various types of aberrations. It was observed that all the three samples were highly genotoxic and induced various types of physiological aberrations *viz.*, laggards, vagrants, c-mitosis, delayed anaphase, stickiness and clastogenic aberrations *viz.*, chromosomal breaks and chromatin bridges in *Allium cepa* root tip cells. The maximum chromosomal aberrations (25.4%) were induced by Ibban Kalan (Ik) sample which was followed by 24.25% and 24.1% for Kathunanagal (Kn) and Haripura (Hp) respectively.

Key words: Soil Pollution, Genotoxicity, *In situ* treatment, landfills, *Allium cepa*

SV/P-37

Evaluation of BOD and COD in Influent and Effluent Water with Reference to Badwai STP, Bhopal, M.P. (India)

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There is an increasing trend to require more efficient use of water resources, both in urban and rural areas. The increase in water demand in addition to water shortage has led to growing interest in wastewater reuse. In the present study influent and effluent wastewater samples from Badwai sewage treatment plant, situated at Bhopal, Madhya Pradesh, were analyzed for BOD and COD by using standard methods. The sewage treatment system using different materials showed excellent potential for BOD and COD removal from domestic wastewater. The result of analysis of treated water for BOD and COD indicates that the treated water can be use for industrial cooling and agricultural purposes.

Key words: Wastewater, Sewage treatment plant, BOD, COD, Effluent water

SV/P-38

Nitrate Toxicity and Possible Contaminant Sources in Groundwater of Western Uttar Pradesh, India

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Efforts were made to evaluate nitrate (NO^-_3) content in the groundwater of rural habitations of western Uttar Pradesh, India. Sixty one water samples from 31 villages of district Meerut were evaluate for nitrate contamination. Nitrate level observed in the range 7.92-298.20 mg/l for individual samples and average nitrate for total samples was 71.31 ± 58.12 mg/l. 60.6% water samples contained nitrate more than permissible limit of 45 mg/l as per U.S. EPA (Environment Protection Agency) standard. Heavy use of nitrogenous fertilizer was identified as major responsible factor for nitrate elevation in groundwater along with open dumping of animal excreta and open laterine system of rural habitants. Groundwater is the only source of drinking water and for irrigation of 81.8% total irrigated land in the study area. Results indicated the non-suitability of groundwater for domestic purposes. Water purification techniques are not in use in the study area and continuous consumption of such water may pose serious health hazardous in villagers.

Key words: Nitrate, Groundwater, Western Uttar Pradesh, Meerut

Session SVI

Bioindication & Bioremediation

SVI/L-1

Characterization of Genes Induced in Response to Heavy Metals in a Hyperaccumulator Plant

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Heavy metals are important environmental pollutants and many of them are toxic even at very low concentrations. Global industrialization has resulted in the release of potentially toxic compounds into the biosphere. Among non-nutrient heavy metals Hg and Pb are the most widespread. A number of heavy metal pollutants have reached beyond threshold levels in the environment since the beginning of the industrial revolution and adversely affected the health of millions of people worldwide. Mercury, lead and other metal contamination are one of the world's most serious environmental problems. Metal pollutants are notoriously hard to remediate from soil, water and air because, unlike organic pollutants that can be degraded to harmless small molecules, toxic elements such as Hg, Pb, are immutable by biochemical reactions. In general, heavy metals cannot be destroyed biologically but are only transformed from one oxidation state or organic complex to another. From soil and water, certain plant species have the ability to hyperaccumulate or remove heavy metals. However, excessive accumulation of these heavy metals can be toxic to the most plants. The ability to accumulate higher concentrations of heavy metals without toxicity has evolved both independently and together in a number of plant species. Our research focuses on identification of heavy metal hyperaccumulator plants. In particular, *Sesbania drummondii* is characterized by its rapid growth, high biomass and an appreciable capacity to take up various toxic metals including Hg and Pb; therefore, it is recognized as a potential hyperaccumulator. To improve phytoremediation of heavy metal polluted sites, a detailed molecular investigation on metal induced/regulated genes and their role in hyperaccumulation and/or tolerance in *Sesbania drummondii* have been studied. The identification of genes regulated by heavy metals in naturally selected hyperaccumulator plants will be useful for the improvement of phytoremediation. Here we employed suppression subtractive hybridization (SSH) technique to identify genes that are induced by certain metals in *Sesbania drummondii*. Differentially expressed genes were further validated by Northern blot analysis. In addition, these genes were cloned and characterized to understand the tolerance and accumulation mechanisms in this species.

Key words: Metal hyperaccumulator, Phytoremediation, Metal-induced genes, Suppression subtractive hybridization (SSH)

SVI/O-1

Study of Bioremediation of Different Oil Sludge Concentration in Soil

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The oil industry generates large quantities of oily and viscous residues, which are formed during production, transportation and refining. Most of the storage tanks and other vessels in a refinery contain bottom sediments which accumulate over time. These residues, called oily sludge, are composed of oil, water, solids, and their characteristics, such as high content of resin and asphaltene, make them highly recalcitrant and very difficult to reutilize. Oil sludge in the bottom of tank can accelerate corrosion, reduce storage capacity and disrupt operations. During cleaning operations, the oil sludge is removed and dumped in nearby lands. In this study the effect of soil microorganisms in bioremediation of oil sludge in soil was investigated. The soil was mixed with different concentration of oil sludge (0-10% w/w). The contaminated soils were mixed and aerated each every other day and also the moisture of the soils was kept constant by tap water. After three months of treatment, our results showed that the total soil bacteria and oil-degrading bacteria were increased by increasing the concentration of oil sludge in the soils. The colony count showed that the population of bacteria was higher in 7 and 10% of oil sludge in soil and it was lower in the control and 1% samples. The TPH (Total Petroleum Hydrocarbon) reduction was measured after three months in the contaminated soils. The results showed that the highest TPH reduction was observed in 1% and the lowest was seen in 10% of oil sludge contaminated soil. About 65% of oil sludge was degraded in 1% sample, while in 7 and 10% of contaminated soil the reduction of TPH was 30 and 15% respectively. In conclusion, our study showed that there were many innate oil-degrading bacteria in the soil which had the good potential to biodegrade the oil sludge, so there was no need to use bio-augmentation to help oil sludge reduction in these soils.

Key words: Oil sludge, Soil, Pollution, Bioremediation, Bacteria

SVI/O-2

Pine Leaves as Indicator for Heavy Metal Pollution in the Atmosphere of Tehran City, Iran

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The increasing industrialization and human activities intensifies the emission of various pollutants in the environment and introduces different types of harmful substance into atmosphere. In this study the leaves of Pine (*Pinus eldarica* Medw) were evaluated as biomonitors of heavy metal contamination in the city of Tehran, Iran. In order to about 300g (fresh weight) of leaf samples were collected from young pines. Samples of unwashed leaves for testing were collected from different locations with different degrees of metal pollution (urban, industrial, highway and control sites). The concentrations of lead (Pb), zinc (Zn), copper (Cu), nickel (Ni) and chromium (Cr) were determined

by flame atomic absorption spectrophotometer. The result of this study showed that the highest metal concentrations were found in the heavy traffic sites, while the lowest metal concentrations were found in the controls site. Nickel, copper and lead contents were found at high concentrations in sample collected from highway sites, while samples collected from industrial areas were found to have high contents of Zinc and chromium. Significant correlations between the heavy metal concentrations in unwashed leave samples were obtained. The variation in Pb, Zn, Cu, Ni and Cr contents between the studied sites is due to heavy traffic volume and industrial activities. However, industrial and traffic emission was found to be main source of metal pollution in the atmosphere of Tehran. The examined elements were classified into three main groups according to their sources: natural, traffic and industrial. The statistical analysis, metal analysis and correlation analysis were effective tools in identifying the source of metal in pine tree samples. The principle component analysis (PCA) along with correlation analysis provide significant information about the origin of heavy metals in pine tree samples. The trend of increasing industrial, traffic and anthropogenic activities in the city indicates the need for pollution control in the city environment. The presented results showed that *Pinus eldarica* Medw leaves can be used a simple way to monitor polluted sites.

Key words: Air pollution, Heavy metals, Biomonitor, Pine, *Pinus eldarica* Medw, Tehran

SVI/O-3

In-situ Immobilization of the Copper-Contaminated Effluent - Irrigated Soils

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The use of sewage sludge and effluents from wastewater treatment plants for irrigation of agricultural lands is on the rise particularly in peri-urban areas of developing countries. Pollution of the biosphere with toxic metals has been accelerated dramatically since the beginning of Industrial revolution. Increases in heavy metal concentration in soil are liable to contaminate the food chain through their absorption by plants and cause several important human-health-related issues. *In-situ* immobilization of metals by using different ameliorants is logical and rational remediation option as compared to soil excavation (expensive) and phytoremediation (slow and time-consuming) for metal-contaminated soils. Present investigation was undertaken to study the effect of ameliorants on the bioavailability and predict the Cu uptake by crops grown on ameliorated soil. For this purpose, a Cu contaminated (total and DTPA-Cu: 1235 and 226 mg kg^{-1}) bulk surface (0- 15 cm) was collected from the field adjoining Atlas cycle factory, Sonepat (Haryana), India which had been receiving industrial effluents for last 15 years. Soils were amended with lime (2.5 and 5%), farmyard manure (FYM: 2.2 and 4.4 g kg^{-1}), biogas slurry (2.2 and 4.4 g kg^{-1}) and hydrous manganese oxide (HMO: 0.5 and 1%). Greenhouse pot experiment experiments were conducted using this amended soil with radish, lettuce and onion as test crops grown in a sequence. Copper uptake by plants was predicted using the combined pH-dependent Freundlich and free ion activity model (FIAM). Results indicated that the application of lime (5% and 1%) was most effective in reducing the Cu content in radish, lettuce and onion followed by FYM (4.4 g kg^{-1}) and BGS (4.4 g kg^{-1}). Among the different fractions, Cu content underwent transformation from water soluble and exchangeable to the less labile fractions due to application of lime and HMO (both the levels). Integrated solubility-free ion activity model based on DTPA-extractable Cu, Walkley Black organic carbon and pH more consistently predicted the Cu content in radish (r2=0.90), lettuce (r2=0.90) and onion (r2=0.87) as compared to that based on loss on ignition, and either of EDTA, NH_4OAc or $CaCl_2$-extractable Cu. A major inherent problem associated with immobilization techniques is that although the heavy metals become less bioavailable, their total concentration in soils remains unchanged. This is a matter of concern because heavy metal might recycle back into plant available forms with time. So such ameliorated soils need to be monitored regularly.

Key words: Soil pollution, Effluents, Ameliorants, Copper, Lime and HMO

SVI/O-4

Application of Nanomaterials for Environmental Remediation

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The presence of heavy metals in aquatic systems due to discharge of industrial effluents is of great concern because of their toxic and non-biodegradable nature. Activated carbon has been the most popular adsorbent being used for the removal of metallic and other pollutants from water and wastewater. A number of minerals, clays and waste materials have been regularly used for the removal of metallic pollutants from water and industrial effluents. Recently there has been emphasis on the application of nanomaterials as efficient and viable alternatives to activated carbon. Nanomaterials exhibit good adsorption efficiency especially due to the higher surface area and greater active sites for interaction with pollutant species. In the present study, nanosized alumina powder was used for the removal of metallic pollutants from their simulated samples. BET surface area of nanosized alumina powder was found to be 78.79m^2/g and porosity was measured to be 0.51. Because of their importance from an environmental viewpoint, special emphasis has been given to the removal of Cr (VI) and Ni (II). Effects of various important parameters were studied to investigate the removal efficiency of the nanomaterial. It was found that removal of both metals from their aqueous solutions was influenced by pH of solution. Temperature is

another major parameter which affects the removal of metals from their aqueous solutions. Results of present study revealed that nanosized alumina powder can be used in treatment of water containing Cr (VI) and Ni (II) in particular and that of pollutant species in general at large scale.

Key words: Adsorption, Environmental pollution, Metallic pollutants, Nanomaterials

SVI/O-5

Bio-Monitoring of Dissolved Oxygen Through Testate Amoebae: A Lesser known Microbe

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Testate amoebae (thecamoebians), the primary destructors of cellulose and lignin are free-living Rhizopods (protozoans) that take an active part in cleaning the polluted water ecosystems. This work explores the utility of thecamoebians for monitoring dissolved oxygen in stagnant and flowing sewage disposal drains in an urban area of Lucknow, Uttar Pradesh. About 25 major drains dump the city sewage into the Gomti river which bisects the Lucknow city into cis and trans-Gomti area. Eight dredge samples were collected at the sediment-water interface, in the month of October –November. Out of this 3 samples were collected from stagnant sewage water and another 5 samples were collected from the Kukrail nala that drains the major sewage disposal of trans-Gomti area throughout the year. Abiotic factors like temperature, pH, conductivity, dissolved oxygen and total dissolved solids were recorded and correlated with the thecamoebian percentage. A total of 9 genera and 25 species were found in Kukrail nala (flowing sewage drainage) exhibiting DO which ranged between 4 to 6.4 mg/l (beta-mesosaprobic). Thecamoebians like *Arcella vulgaris, A. megastoma, A. eurystoma, Amphitrema, Centropyxis aculeata, C. arcelloides, C.aerophila, Cyclopyxis kahlii, Difflugia protaeiformis, D. gramen*, *Cucurbitella tricuspis, Trigonopyxis acula, Trinema/Corythion,* dominate in moderate DO. However, in very low DO (2-3 mg/l) dominance of *D. protaeiformis, A. vulgaris, Cucurbitella tricuspis, Centropyxis arcelloides, C. constricta*, *C. aerophila* and *Cyclopyxis eurystoma* were recorded along with several unidentified, deformed, partially identifiable forms in the alpha-mesosaprobic stagnant sewage sediment. The additional research in monitoring urban aquatic ecosystem (particularly, DO) with the thecamoebians as low-cost effective bioindicators is required. Thecamoebians can also serve as useful mitigators of aquatic pollution if a moderate DO level is maintained which can be achieved either by artificial aeration or flow of pooled polluted water. The study also reveals potentials of thecamoebians for monitoring palaeoecology and palaeoclimate.

Key words: Testate amoeba, Aquatic ecosystem, Dissolved oxygen

SVI/O-6

Phytoremediation of Heavy Crude Oil Contaminated Soil by *Panicum miliaceum*

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Contamination of soil by crude oil can damage ecosystem and environment. The effect of oil on the plants which are the first element in food cycle can cause severe damage on other organisms. On the other hand there are some plants that can be used to remediate crude oil-contaminated soil. Some plants such as grasses family have been demonstrated to have better capacity in biodegradation of oil in the soil. In this study the effect of different concentrations of light crude oil (1- 10%) on the growth and germination of *Panicum miliceum* was studied in 90 days. Our results showed that the germination number and dry biomass of the plant decreased by increasing heavy crude oil concentration in the soil. The percentage of germination and total biomass (root + shoot) was higher in the control (75% and 0.79 g respectively) while it was lower in 10% sample (30% and 0.14 g). The leaf area was reduced in higher crude oil concentration in comparison with the control. Total colony and oil-degrading colony count in soil showed that the microbial population in 7% and 10% samples was higher than the control and low concentrations of crude oil. The effect of the plant on crude oil reduction was also studied and compared in samples. The TPH reduction was higher in 1% sample (54%) while the reduction was lower in 7 and 10% samples (23 and 15%). In conclusion, *Panicum miliceum* as a grass could tolerate high concentration of heavy crude oil in soil and is a suitable plant for phytoremediation of oil-contaminated soil, however high concentration of oil could affect its growth and germination, reducing the root distribution in the soil and causing untimely chlorosis in plant.

Key words: Plant, Phytoremediation, Crude oil, Soil pollution, *Panicum miliceum,* Germination, Distribution, Soil, Chlorosis, Concentration

SVI/O-7

Bioremediation of Coalmine Overburden Dumps with Tree Species - Special Emphasis on Micronutrients and Heavy Metals Accumulation

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Major environmental impacts of opencast mining are degradation of landscape and aesthetics of the area by creating huge overburden dumps and deep voids at the mining sites. These overburden dumps are characterised by high rock fragment contents, low moisture retention capacity, higher bulk density, low nutrients, lower pH and elevated metal concentrations. Overburden dumps are

reclaimed by tree species for stabilising as well as pollution control and overall improvement of the visual aesthetics.

A field study was carried out in the old reclaimed coal mine overburden dumps at KD Heslong project, Central Coalfields, India to study the physico-chemical changes in the reclaimed overburden dumps and determines the magnitude of trace elements accumulation in the planted tree species. Total, bioavailable and acid extractable trace metals concentration in minesoils of overburden dump and topsoil in the mining areas was compared with undisturbed soil. The study showed that tree plantation improves the moisture contents, bulk density, pH and overall nutrient contents of minesoils. The study revealed that lower pH in the minesoils increases the bioavailabity of metals but concentration were found within toxic limits. However, ratio between total and bioavailable metals was found lower in overburden dumps than topsoil due to low pH and lack of organic matter. Out of six tree species studied, *Bambusa* shows highest accumulation of Fe and Cr. Bioaccumulation coefficient for Cr and Zn was found 74 times in *Bambusa* and 83 times in *Dalbergia sissoo*. The results of the study underscore the need for close monitoring of trace elements in reclaimed overburden dumps.

Improvement of field moisture, bulk density, pH, organic carbon, macronutrients (NPK) and CEC in the minesoils has a direct effect on bioreclamation. The elevated concentration of metals in the minesoils of overburden dumps and topsoil of mining areas may be due to deposition of air borne particulates matters and geochemistry of overburden strata. Tree species like *Dalbergia sissoo, Eucalyptus, Cassia seamea, Acaccia mangium* and *Peltaphorum* were found to be the best species for bioreclamation of overburden dumps.

Key words: Coalmine overburden dumps, Tree, Bioreclamation, Metals, Bioaccumulation

SVI/O-8

Eco Friendly Weed Control in Rice Fields through Soil Solarization for Reducing the Soil Pollution

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Weed causes significant damage (up to 90 per cent) to the crop yield. Weed control through chemical means in the form of herbicide is commonly used to kill the weed plants or inhibit their growth though out the world. However, the use of herbicides has added the toxic residues dangerously to non-target organisms, environment, and ground water, and created a serious upheaval in the ecosystem. Studies were conducted through a series of experiments for five consecutive wet seasons with a variety of alternative biological solutions to control weeds which are benign, harmless, pollution free, non - hazardous and eco - friendly to control the pre emergence weeds in the rainfed, upland rice ecosystem of high rainfall coastal region of eastern India through soil solarization. This is a method of heating the soil surface by using the transparent low-density polyethylene (LDPE film) sheets placed on soil surface to trap the solar radiation. This raises the soil temperature to a level lethal for many soil borne pathogens and weed seeds, thus killing weeds before crop emergence.

The rise in soil temperature due to solarization by using LDPE film is significantly correlated to soil temperature under normal condition (uncovered) and cumulative solar radiation (watt/m^2) of that day but the effect of air temperature was found insignificant. A quardatic relationship was developed between temperature difference (T) and soil temperature (ST) and cumulative solar radiation (SR) of the day. The use of transparent and black LDPE sheets reduces the weed growth and increases the rice yield. Higher yields were found in the treatments of transparent LDPE films of 200 gauges and 400 gauges for 30 days followed by black LDPE film. However, lower yields were recorded from the field which were covered with LDPE films (both 200 and 400 gauge) beyond 30 days.

Key words: Solarization; LDPE film; Rice; Weed control, Herbicide, Microbes

SVI/O-9

Reduction and Partial Dedgadation of Azo Dye Methyl Red by Novel Bacterial Consortium - PES

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Reduction and partial degradation mechanism of Methyl Red using a newly isolated consortium PES [*Pseudomonas aeruginosa* (Gene Bank Accession No. GQ884172), *Escherichia hermanii* (Gene Bank Accession No. GQ884173), *Stenotrophomonas maltophila* (Gene Bank Accession No. GQ884174)] was investigated. The consortium had the ability to decolorize fifteen different azo dyes. The effect of physicochemical parameters (temperature, pH, static and agitated condition, co-substrate, and salt concentration) on the Methyl Red (C.I Acid red 2) decolourization were studied. Under optimal conditions the bacterial consortium completely decolorized 100 mg/l of Methyl Red in 20-24 h and 500mg/L in 48 h. The transformed and degraded products examined by TLC, UV-Visible spectrophotometer and HPTLC showed the presence of four intermediates. The results strongly support a mechanism of azo dye reduction by the process via the reductive cleavage of the azo bond to from the corresponding amines. Further the rate of decolourization could be correlated well with the

presence of the azoreductase activity in the consortium. Azoreductase activity and specific activity of the cultures were found to be *7.81* units/ml and 10.96 units/ mg of protein; 18.52 units/ml and 16.96 units/mg of protein and 11.12 units/ml and 9.36units/ mg of protein for *Escherichia hirmannii, Stenotrophomonas maltophila* and *Psuedomonas aeruginosa*, *respectively.* Certain kinetic parameters like temperature, pH, substrate specificity, substrate concentration of azoreductase were studied for Stenotro*phomonas maltophila.*

Key words: Decolourization, Degradation, Methyl red, Consortium, Azoreductase

SVI/O-10

Antioxidant Phytochemicals: Do they Defend Against Free Radicals and Diseases?

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Presence of unpaired electron in the outer orbit of free radicals (FR) makes them highly reactive to damage nucleic acids, proteins, lipids and carbohydrates that consequently affect the immune functions causing degenerative diseases. They are formed by four electron reduction of oxygen in respiratory chain followed by a partial reduction to generate super oxide anion that can be protonated at low pH to FR. Generation of FR is also possible through xanthine oxidase (EC 1.1.3.22), a molybdenum containing enzyme by activation of oxygen molecule. In addition to this, superoxides are also produced during mitochondrial respiration, by NADPH oxidase, cytochrome P-450, cyclo-oxygenase and lipoxygenase. When production of free radicals exceeds the body's antioxidant defense system, it results in oxidative stress (OS). It is imposed on cells due to increase in oxidant generation, decrease in antioxidant protection and failure in repair of oxidative damage. Exposures to pathogens, inappropriate lifestyle, and excessive exercise and by products of normal metabolism are also contributing factors to OS. It deregulates the cellular functions leading to neurodegenerative diseases, gastro-duodenal pathogenesis, cancer, antioxidants such as glutathione peroxidase, glutathione reductase, super oxide dismutase (SOD), catalase, selenoprotein, transferrin, ferritin, lactoferrin and non-enzymatic proteins etc., suppress the formation of free radicals. They act by quenching of ROS, decomposition of H_2O_2 and sequestrations of metal-ions. Antioxidants are known to defuse free radicals leading to limited risk of OS and associated disorders. At cellular and molecular levels they inactivate FR and under specific low concentration inhibit or delay oxidative processes by interrupting the radical chain reaction of lipid peroxidation.
Phytochemicals with antioxidant capacity naturally present in food are of great interest due to their beneficial effects on human health as they offer protection against oxidative deterioration. Epidemiological and animal studies suggest that the regular consumption of fruits, vegetables and whole grains, reduces the risk of pathogenesis of various chronic diseases, like cancer, diabetes, inflammation, neurodegenerative disorders and ageing associated with OS. Carotenoids, tocopherols, ascorbates, lipoic acids and polyphenols generally present in various foods are strong natural antioxidants with free radical scavenging activity. Endogenous antioxidant enzymes like SOD, catalase, glutathione peroxidase, glutathione reductase, minerals like Se, Mn, Cu, Zn, vitamins A, C and E, carotenoids, limonoids and polyphenols exert synergistic actions in scavenging free radicals. Synthetic antioxidants such as butylated hydroxy anisole (BHA) and butylated hydroxy toulene (BHT) play a useful role in food and pharmaceutical industries. Main sources of biologically active polyphenols are berries, red wine, onions, apples, grapes, chamomile, citrus, dandelion, green tea, licorice, rosemary, thyme, fruits, vegetables and beverages. Isoflavones like daidzein and genestein found abundantly in legumes such as lentils, chickpeas and soybeans, offer protection against tumor growth, breast and uterus cancer.

Key words: Free radicals, Antioxidants, Enzymes, Phytochemicals and phenols

SIV/O-11

Effect of Light Crude Oil - Contaminated Soil on Growth of *Lens culinaris*

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Crude oil and its products are widely used by human for various activities. The spillage of crude oil in to the soil causes damages to the environment and changes the physicochemical properties of the soil. Some petroleum components are toxic for living organisms, however some plants and microorganisms are able to biodegrade the crude oil hydrocarbons into products less toxic than the parent compounds. In this study lentil *(Lens culinaris)* was planted in the soil with different concentration (0-10%) of light crude oil, and the effect of contaminated-soil on germination and growth of the plant was investigated. Our results showed that the germination of plant was not affected below the 10% of contamination. The length of shoots was reduced by increasing the oil concentration. The minimum length of shoots was observed in 10 % samples (17cm) with comparison to control (30 cm). Increasing the oil concentration decreased the total and root biomass, the lowest biomass was seen in 10 and 7% sample respectively. The total and oil degrading bacterial count showed that increasing the light crude oil concentration increased the bacterial populations in samples. The oil reduction was observed in all contaminated samples, however the highest oil reduction was observed in 1 and 3% samples (about 23 and 27% rduction) and the lowest was seen in 10 and 7% samples respectively (about 6 and 13% reduction).

Key word: Light crude oil, Bacteria, Growth, Phytoremediation, *Lens culinaris*

SIV/O-12

Pollution Effect and Ecological Reconstruction of Polluted Soils from Zlatna Area, Romania

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Pollution of the Zlatna area and surroundings is due to emissions by SC Ampellum Zlatna SA, specialized on copper metallurgy, emitting dust, powders, aerosols containing SO_2, SO_3, CO, oxides, lead, zinc, copper, cadmium, arsenic sulphides. Total Pb concentration was in the range of 50-457 mg kg^{-1}, total in the range Cu 3-85 mg kg^{-1} ppm and total Zn in the range 8-89 mg kg^{-1}. Soil contamination led to soil acidification, humus depletion, physico-chemical and biological degradation, soil loss through erosion. Industrial emissions also contaminated orchards and forest soils and exposed plants and humans to high concentrations of various trace elements. The Pb content in plants was in the range of 5-130 mg kg^{-1} in hay and pasture plants, and was in the range 130-1200 mg kg^{-1} range in plum and apple leaves, and the Zn concentrations was in the range 47-735 mg kg^{-1} in hay and pasture plants and 79-1000 mg kg^{-1} in plum and apple leaves, respectively, with values related to the distance from pollution source.

The experimental plots were established the in Patrangeni village, the right side of the factory, 2 km distance from the factory, on a heavily sloped ground (25-28% inclination), used as meadow. The soil is a luvosol (SRTS 2003), with clayey-sandy texture (19.6-23.8% clay), index of texture differentiation of 1.21, mid acid (pH 5.65), average content of humus in Ao of 3.56%, with a good N content and low in P and K contents. The experimental site shared randomized blocks design with 3 replicates and 8 variants: First year – 2005: V_1 – $CaCO_3$ amendment 5 t/ha; V_2 – $CaCO_3$ amendment 5 t/ha + $N_{100}P_{100}K_{100}$; V_3 – $CaCO_3$ amendment 5 t/ha + $N_{100}P_{100}K_{100}$ + manure 30 t/ha; V_4 – $CaCO_3$ amendment 5 t/ha + $N_{100}P_{100}K_{100}$ + over seeding; V_5 – $CaCO_3$ amendment 10 t/ha; V_6 – $CaCO_3$ amendment 10 t/ha + $N_{100}P_{100}K_{100}$; V_7 – $CaCO_3$ amendment 10 t/ha + manure; V_8 – $CaCO_3$ amendment 10 t/ha + $N_{100}P_{100}K_{100}$ + over seeding; complex fertilizer of 16:16:16 type. Second year – 2006: V_1 – $N_{150}P_{75}K_{75}$; V_2 – $N_{100}P_{50}K_{50}$; V_3 – $N_{80}P_{40}K_{40}$; V_4 – $N_{100}P_{50}K_{50}$; V_5 – $N_{150}P_{75}K_{75}$; V_6 – $N_{100}P_{50}K_{50}$; V_7 – $N_{80}P_{40}K_{40}$; V_8 – $N_{100}P_{50}K_{50}$; complex fertilizer of 27:13,5:13,5 type. Third year – 2007: V_1 – without fertilizer; V_2 – $N_{50}P_{50}K_{50}$; V_3 – $N_{40}P_{40}K_{40}$; V_4 – $N_{20}P_{20}K_{20}$; V_5 – no fertilizer; V_6 – $N_{50}P_{50}K_{50}$; V_7 – $N_{40}P_{40}K_{40}$; V_8 – $N_{20}P_{20}K_{20}$; complex fertilizer of 20:20:20 type.

The amendments, organic and mineral fertilizers, were applied as follows: April 9, 2005; April 11, 2006; April 15, 2007. Soil tests have been sampled from 0-20 cm depth in 3 repetitions / variant, every year, after the second mowing. Yield results were obtained through green mass mowing, for every repetition and variant. The treatments increased the soil pH values between 6.18 and 6.42 in 2005, when the experiment started, and increased to near neutral values over time, particularly in some treatments. The humus content of soil ranged between 3.96-5.23% in 2005 and reached 4.52-5.7% in 2007. All applied treatments allowed the soil revegetation in all variants, thickening of fallow ground layer and increase of organic matter in 0-20 cm layer. The most significant increase was registered in V_3 and V_7 variants, where 30 t manure/ha were applied. The organic C, in these cases, increases with 0.72-1.2%. Significant increases of N, P, K contents of soil were found during the three years, particularly for Phosphorus and Potassium. Hay yield in 2005 were in obtained in the soils treated with 5 t $CaCO_3$ ha^{-1} and correlated with mineral fertilizer doses. In 2006, hay production was larger in treatments with 10 and 5 t $CaCO_3$ ha^{-1}, with the strongest influence on production related to organic and mineral fertilizations doses. The ecological restoration of polluted soils from Zlatna area can be realized only by complex interventions, starting with toxicity reduction, leading to general soil amelioration and reduction of nutritional elements deficit. This was apparently achieved using calcareous amendments in doses up to 10 t ha^{-1}. Increases of crop yield were enhanced by mineral fertilization.

Key words: Pollution, Soil reconstruction, Soil revegetation, Ecological, Polluted soils

SIV/O-13

Heavy Metal Accumulation in *Eichhornia crassipes* Induced Biochemical Response and Genotoxic Effects

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Industrial wastes and discharges have been recognized as one of the major sources of heavy metal pollution in aquatic environment resulting into serious consequences. Water hyacinth (*E. crassipes*) a prolific aquatic weed of cosmopolitan distribution, has shown promise in the biological management of aquatic pollutants because of its high potential to absorb and concentrate heavy metals. Heavy metals are known to induce the production of reactive oxygen species, which are potentially toxic and induce nonspecific oxidation of proteins and membrane lipids and DNA injury.Exponentially growing plants of *E. crassipes* were exposed to various concentrations (0.01 – 10 ppm) of Cr and Pb at 96 h. Plants accumulated appreciable amount of both metals from solution culture which were maximum in roots in both the cases, however, accumulation of Cr (1124.90 g g^{-1} dw) was more as compared to Pb (1119.30 g g-1 dw) at 10 ppm. Although there was a slight stimulation in various biochemical activities including chlorophyll, protein and nitrate reductase activity at lower doses, inhibition was found at higher doses. Carotenoid content in the plant increased at all doses of the metals in comparison to unstressed plant which could be described due to its antioxidant property to detoxify metal stress and could be used as biomarker of metal toxicity. The plant showed

adequate bioremediation potential of Cr and Pb from industrial effluent under field condition. Plants significantly accumulated the level of Cr (1352 g g^{-1} dw) and Pb (1378 g g^{-1} dw) from their respective industrial site i.e. Jajmau containing Cr (1.307 ppm) and Scooter India Limited (SIL) containing Pb (1.713 ppm). Higher concentrations of the metals lead to lipid peroxidation and induction of several chromosomal aberrations and micronuclei. Results will be discussed in relation to possible use of plants in industrial waste treatment vis-à-vis use of some their scientific parameter in biomonitoring of metal toxicity.

Key words: Toxic metals, *Eichhornia crassipes*, Biochemical response, Genotoxicity

SVI/P-1

Species Composition and Indigenous Knowledge on Indicator Species in a Limestone Quarry at Mawsmai, Meghalaya (India)

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Limestone is the second most important mineral of Meghalaya. The state has a rich deposit of good quality limestone with an estimated reserve of 12000 Mt. So far, limestone mining in Meghalaya has been synonymous with the complete absence of any rehabilitation measures and tackling of environmental hazards by the societal segment engaged in the activity.

The mining activity has inflicted severe damage to the landscape, as is evidenced from the vegetation and edaphic impairment. The present work aims at studying the vegetal profile of both the undisturbed (control) and disturbed sites (mined area). Besides identification of plant specimens notwithstanding the indicator species, a study of the vegetation growing in the control as well as experimental sites were undertaken. An interview coupled with a transect walk was carried out with the local villagers to collect information about the indicator species. The village has a protected forest just adjacent to the mining site which was considered as the control site for the present study. This forest houses important plant species with medicinal values in addition to endemic plants like *Phlogocanthus* sp. and *Rapidophora dicursiva* (Endemic to Sikkim and NE India).

Key words: Limestone mining, Indicator species, Indigenous knowledge, Endemic species, Land reclamation

SVI/P-2

Plant Based Remediation of Organic Pollutants Contaminated Soils in a Changing Climate

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There is a growing perception that global warming and subsequent climatic changes are a global threat and a challenge for the twenty first century. Despite the great speculations and uncertainty on the exact evolution of current climate conditions, there is little doubt that even relatively modest climatic alterations will have significant environmental changes. Like climate change, environmental contamination caused by persistent organic pollutants (POPs) is another concerning global issue and these changing climatic conditions will have a powerful effect on the environmental fate and behavior of POPs. Due to climate change, there may be an alteration in type of pollutant residues, residue levels, and residue occurrence in soil and biota, microbial diversity, plant-rhizospheric-chemical interactions etc. Although various technologies are available for the remediation of contaminated soils, the interest in plant and associated rhizospheric microbial based cleaning of contaminated soil sites has escalated during the last few decades because apart from the direct benefit of remediation, the growing plants can also provide additional benefits like carbon sequestration, soil quality improvement and biomass production. Therefore, the successful harnessing and interlinking of this green technology is utmost important in an era of increased pollution, energy crisis and global warming. The present article summarizes the concerns regarding the plant and associated microbial based cleaning of volatile organic compounds and the possible strategies for enhancing the effectiveness of this green technology under a changing climatic condition.

Key words: Global warming, Climate change, Persistent organic pollutants, Phytoremediation, Microbial diversity, Root exudates, Organic compounds

SVI/P-3

Monitoring of Herbicide (2,4-D) Toxicity by Using Pollen as Indicators Pollen of *Phaselous mungo* Roxb.: A Critical Review

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Foliar applications of 5, 10, 25, 50, 100, 200-200-1000, 1000-1000-5000 mg/ml 2,4- Dichlorophenoxy acetic acid were given to 3 weeks old crop (at pre flowering stage) of *Phaseolus mungo* Roxb. (var. T-9, urid) by an air compressor. After 2 weeks of treatment successive flowers (viz. F, F-24, F-48, F-72 series i.e. open flowers and the flower buds which require 24, 48, 72 hours to open respectively) were plucked at the same time after dehiscence of anthers (in open flowers). Pollen viability was tested by using 2,3,5-Triphenyl tetrazolium chloride (Hauser and Morrison, 1964). An optimum concentrations (10% sucrose for F-24 and F-48 series and a 20% sucrose for F, F-72 series) of sucrose was used for the germination of pollen of successive flowers. Pollen grains were incubated soon after the dehiscence of anthers. The culture were then transferred to a moist filtered chamber, stored at room temperature (25-

31°C) having RH of 53% and in diffuse laboratory lights. In the experience were run in triplicate and average results were recorded. Observation were made by 24 hours after incubation. For each experiment a random count of 100 grains was made (from different fields of the slide). To determine the pollen viability and germination. For measurement of length of pollen tubes, 50 tubes were selected randomly and measured at a magnification of 100x. The data obtained was statistically analysed applying t-test.

Potentiality of the germinability of pollen *Phaseolus mungo* was noted in all the 4 series i.e F, F-24, F-48, F-72 series investigated. The foliar application of all the concentration of 2,4 D above 100 mg/ml suppressed the flowering. It should be noted that none of the concentration of herbicide could suppress the cent percent pollen fertility which is necessary for the successful plant breeding programme. This proves that the existing method of plant breeding i.e chemical induction of pollen sterility fails here. Hence it is necessary to found out an alternate method of plant breeding. It should be noted that all the concentration of 2,4 D above 25 mg/ml prevented the germination of pollen of all the 4 series. When there is no germination of Pollen the question of the transfer of the male gametes to the female gametophyte does not arises and when there is no transfer of male gametes to the female gametophyte the question of the fertilization and ssed settings does not arises. Hence instead of suppressing the pollen fertility which is not possible even with such a high concentrations of 2,4_D. Hence we should suppress the germinability of pollen with such a low concentrations of the gametocide which is very economical and less danger of pollution too. Thus this gives the birth to the new method of plant breeding- "Salgare 's Method of plant breeding". Thus it is confirmed that the pollen development and activity are more sensitive indicators of adverse factors in the botanical environment and the use of an entire vascular plant as an indicator of pollution is a very crude method and rather a wrong choice. There is no evidence of any entire vascular plant exhibiting this much degree of sensitivity. This is confirmed in the oresent critical review.

Key words: Palynology, Toxicology, Environmental Sciences, Herbicides, Genetics and Plant Breeding

SVI/P-4

Biomonitoring of Chromium – Induced Oxidative Stress and Metabolic Adaptations in *Pteris cretica* L.: A Common Fern of Kangra Valley H. P., India

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The present study demonstrates the tolerance of chromium (Cr) ions in the growth environment of *Pteris cretica* L. a commonly growing fern in Kangra valley of Western Himalaya and their further metabolic adaptations. The plant was grown hydroponically in 5 % Hoagland medium in controlled condition and were treated with 25, 50 and 100 mg/L chromium as potassium dichromate ($K_2Cr_2O_7$) for 8 days. There was no adverse effect of Cr on the fern at 100 mg/L. The treatment level was enhanced to 300, 600 and 1000 mg/L chromium for 1, 4 and, 8 d. The fern fronds and rhizome including roots were analysed for differences in oxidative stress and antioxidant capacities after chromium exposure. Upon exposure to 300 mg/L chromium, concentration of chlorophyll started to diminish but protein and carotenoids content increased in *P. cretica* frond whereas it remained similar to control at 600 mg/L and further decreased at 1000mg/L. The analysis of data revealed that the level of MDA, Cystein and NPSH was higher in the roots of the plant than leaf frond, which was found positively correlated with the metal accumulation, doses and time of Cr exposure. The level of oxidative stress (MDA, Cystein and NPSH) was found significantly lower in the roots and fronds of *P. cretica* under control condition. An increase of 250, 75 and 225% in MDA, Cystein and NPSH content, respectively was observed after 8 d in the roots of *P. cretica* grown in 1000 mg/L Cr concentration. The result of the present study revealed that higher levels of MDA, Cystein and NPSH provide greater scavenging ability to defend themselves against Cr-induced stress. The result together indicates the protection from oxidative damage by high level of antioxidants production as well as metabolic adaptations in Cr-hyperaccumulator *P. cretica* L.

Key words: Chromium, MDA, Cystein, NPSH and *P. cretica* L.

SVI/P-5

Bio-Control of *Colletotrichum musae* Causing Post-Harvest Disease of Banana

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Control of post-harvest diseases of banana is generally aimed at reducing the number of diseased fruits during packaging, transporting and storage. The present investigation was undertaken to assess the percent of inhibitory effects on mycelial growth and germination of spores of post-harvest disease (*Colletotrichum musae*) of banana through plant extracts. Plant extracts of five different plants – *Azadirachta indica*, *Cassia sophera*, *Datura metel*, *Ricinus communis* and *Vinca rosea* were tested for their antifungal properties on *Colletotrichum musae*. All the plant extracts were found significant control. Out of these, *Azadirachta indica* was found the most effective against the mycelial growth of *C.musae* (51.35%) and spore germination (60.5%) at 5% concentration followed by *Vinca rosea* (43.12% & 57.4%), *Datura metel* (33.72% & 40.12%), *Ricinus communis* (30.27% & 37.3%) and *Cassia sophera* (24.75% & 31.4%). It has been observed that the application of plant extracts could be used as bio-fungicide to control *C.musae*, substitute for chemical fungicide mancozeb in management of post-harvest disease of banana caused by *Colletotrichum musae*.

Key words: Bio-control, *Colletotrichum musae*, Plant-extracts,

Mycelial growth, Antifungal, banana

SVI/P-6

Arsenic Accumulation in Native Plants of West Bengal, India: Prospects for Phytoremediation but Concerns with the use of Medicinal Plants

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Arsenic (As) is a widespread environmental and food chain contaminant and class I, non-threshold carcinogen. Plants accumulate As due to ionic mimicry that is of importance as a measure of phytoremediation but of concern due to the use of plants in alternative medicine. The present study investigated As accumulation in native plants including some medicinal plants, from three districts [Porbosthali (Bardhman), Chinsurah (Hoogly) and Birnagar (Nadia)] of West Bengal, India, having a history of As pollution. A site specific response was observed for Specific Arsenic Uptake (SAU; mg kg^{-1} dw) in total number of 13 (8 aquatic and 5 terrestrial) collected plants. SAU was higher in aquatic plants (5-60 mg kg^{-1} dw) than in terrestrial species (4-19 mg kg^{-1} dw). The level of As was lower in medicinal plants (MPs) than in non-medicinal plants, however it was still beyond the WHO permissible limit (1 mg kg^{-1} dw). The concentration of other elements (Cu, Zn, Se and Pb) was found to be within prescribed limits in medicinal plants (MP). Among the aquatic plants, *Marsilea* showed the highest SAU (avg. 45 mg kg^{-1} dw), however, transfer factor (TF) of As was the maximum in *Centella asiatica* (avg. 1). Among the terrestrial plants, the maximum SAU and TF were demonstrated by *Alternanthera ficoidea* (avg. 15) and *Phyllanthus amarus* (avg. 1.27), respectively. In conclusion, the direct use of MP or their by products for humans should not be practiced without proper regulation. In other way, one fern species (*Marsilea*) and some aquatic plants (*Eichhornia crassipes and Cyperus difformis*) *might be suitable candidates for As phytoremediation of paddy fields.*

Key words: Arsenic, Medicinal plants, Selenium, Specific arsenic uptake

SVI/P-7

Sustainable Green Approach for Heavy Metal Phytoremediation through Wetland Plants: A Case Study of Tropical Industrial Region

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Pollution of the biosphere with toxic metals has accelerated dramatically since the beginning of the Industrial Revolution. Further, due to discovery of mining and metal working techniques in ancient times, the close link between metals, metal pollution and human history was formed. Toxic metal contamination of aqueous water streams and ground water poses a major environmental and health problem which is still in need of an effective and affordable technological solution. The removal of heavy metals using living organisms attracted a lot of public attention and R&D spending. Present paper describes work on phytoremediation in last six years and hand in hand addresses the various ecological issues, benefits and constraints pertaining to heavy metal pollution of aquatic ecosystems and its phytoremediation. Wetland plants/macrophytes were found to be ideal bio-system for heavy metals removal in terms of both ecology and economy, when compared with chemical treatments. However, there are several constraints or limitations in the use of aquatic plants for phytoremediation in microcosm as well as mesocosm conditions. An eco-sustainable model has been proposed in order to resolve the certain constraints imposed. In relation to future prospect genetic engineering in macrophytes for enhanced heavy metal accumulation is still in embryonic stage and needs more attention in this area. Moreover, harvesting and recycling tools needs more extensive research. A multidisciplinary research effort that integrates the work of biotechnologists, plant biologists, soil chemists, microbiologists, and environmental engineers is essential for greater success of phytoremediation as a viable water cleanup technique.

Key words: Phytoremediation, Heavy metals, Wetland plants, Eco-sustainable technology

SVI/P-8

Mitigation of Selenium Toxicity by Two Immobilized Cyanobacteria *Hapalosiphon sp. and Gloeocapsa* sp.

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Industrial based life style of our current world has led to sudden anthropogenic impact on the biosphere in the form of pollution such as heavy metal pollution. A clean environment is the most important for the sustenance of the present and future generation. The problems affecting the environment are diverse, and approaches to find solutions are often intimately connected with modern or classical methods of biotechnology. In this connection unique ability of microorganism especially cyanobacteria have been found useful with a variety of effluents because they tolerate, accumulate and interact with pollutants and metabolize or use them as nutrient from the environment and this made them as active research subject in the past few years. With this aim the present study has been attempted to study the mitigation of selenium toxicity by two immobilized cyanobacteria *Hapalosiphon* sp. and *Gloeocapsa* sp. when selenium reached to the environment through different pollution sources.

The observations of the present study clearly demonstrate that both cyanobacteria efficiently ameliorating

selenium toxicity from the environment. But *Hapalosiphon sp.* is more efficient compare to *Gloeocapsa* sp. which could be due to the fact that *Hapalosiphon* is a filamentous cyanobacteria with many cells so selenium uptake is over a large surface area whereas Gloeocapsa is an unicellular, so the surface area is reduced. This paper also concludes that the presence of selenium in any ecological niche with immobilized cyanobacteria will not affect the organisms of that ecosystem.

Key words: *Hapalosiphon* sp., *Gloeocapsa* sp., Immobilization, Selenium

SVI/P-9

Environmental Protection through Bioremediation

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Environmental pollution is not only affects the human life but also causes drastic changes in flora and fauna of a particular area by changing the physical and chemical parameters of water, soil and air. The pollution caused by industries has lead to rapid depletion of natural sources, aquatic environment is contaminated mainly by increasing chemical contaminants, in most cases liquid and semi-solid effluents are being discharged in water bodies without proper treatment.

Removal of various effects of environmental contamination on human beings is necessary, if we want to live on earth hale and hearty. It is high time to give top priority to control all types of pollution. It will involve the proper assessment at contaminated sites and development of remediation technologies for the removal of environmental pollutants or contaminants for the protection of environments. This can be done by various chemical, biological and by monitoring methods. In India several projects like minimizing and reutilization of industrial waste, development of eco cities, development of better sewage and common effluent treatment plants like algae, bacteria and fungi are going on for environmental remediation. Bioremediation includes Phytoremediation, Microremediation and Zooremediation. Phytoremediation is an economical suitable technique to remove pollutants from the environment, present in air, water or soil is by using plants. It is also referred as 'GREEN CLEAN' means cleaning up of environment with the help of plants. Phytoextraction, is the most important form of Phytoremediation involves the use of plants to extract contaminants from the environment. Examples including mainly the plants of Brassicaceae family, *Ficus* species, *Ipomoea fisstulosa*, *Eichhornia*, *Salvinia*, *Phragmites*, *Pistia, Khuskhus, Lemon grass, Cetronella* etc. Microbial remediation means removal of pollutants from the environment using microorganisms. Some of these techniques are microbial bioremediation of heavy metals, sulphur industrial effluents, nitrates and volatile compounds etc from waste. Two principal type of biological sewage treatment is more popular i.e. biological filtration and activated sludge treatment. That is performed by bioagent are Fungi (*Ganoderma lacidum,, Coriolus (Trametes) versicolor, P. chrysosporium, Coprinus macrorhizus, Hericium erinaceus* etc.), Bacteria (*Arthobacter viscosus, Pseudomonas syryngae, P. aereeginosa, P. putida, Bacillus Subtilis, E. coli, Streptomyces nouresei, S. pimprina* etc.), Algae (*Chlorella valgaris, Ascophyllum nodosum, Cladophora crispata* etc.). Zooremediation means decontamination of polluted environment by using animals. Waste like solid organic wastes is purified through this way. Most common example is Vermicomposting in which earthworm (*Pheretima posthuma*) are used for scavenging the waste. Other bioagents are being used Arthopodes like *Daphnia* species and fishes like *Aristichthys*, *Hypothamichthys*, *Mugil* species.

Key words: Environment, Bioremediation, Species, Heavy metals, Bioagent

SVI/P-10

Prospects of Linseed (*Linum usitatissimum* L.) for Accumulation of Metals

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Some plants (Hyperaccumulators) have tendency to accumulate metals from soil. So, for the last few years cleaning up technology of different metals from the soil by the plants has been a burning issue. The technique is being applied wherever the soil surface is suffering from ongoing chronic pollution from different metals. Few earlier reports have shown that linseed (*Linum usitatissimum* L.) also has tendency to accumulate metals like other hyperaccumulator crops. Keeping this in mind, a pot culture experiment was carried out using a linseed variety 'Neelam' to see the effects of different doses of different metals As, Cr, Zn, Cu and Fe on morphological traits especially seed yield and to reconfirmed the tendency of metal accumulation in linseed. 100% plants lethality was noticed just after the treatment of As and Cr. Seed yield showed positive effects with metals for each treatment and positive correlation with plant height, capsules/plant and seeds/capsules in the plants treated with Cu, Fe and Zn. The effective dose to obtain enhance seed yield was 50 mg/kg for Cu and 600 mg/kg for Fe and Zn. The variety was noticed hyper accumulator of Fe followed by Zn and Cu. The elevated concentration of metals in plant parts of linseed have no effects on human health or the environment as 80% of its oil is majorly utilized in paints, varnishes, paper industries etc. and 20% only for edible purposes.

Key words: Accumulation, Metals, Linseed, Seed yield, Correlation

SVI/P-11

Heavy Metal Bioremediation by Cyanobacteria (Blue-Green Algae)

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Heavy metals (metallic elements with density greater than 5 g/cm^3) constitute toxic, non-biodegradable and persistent environmental pollutants which adversely affect all life forms. Discharged from various mining and industrial sites, they find way into the food chain and drinking water. The detrimental effects of heavy metals results from their action on a number of cellular and biochemical processes, biomolecules and structures in living organisms, including human beings. The ever-increasing contamination of aquatic bodies and soil by heavy metals is an issue of serious concern and challenge worldwide. The bioremediation of heavy metals from contaminated water using various microorganisms, including cyanobacteria have been recognized as a cheaper, more effective and an eco-friendly alternative to the conventional physico-chemical remediation methods. Owing to their tremendous adaptability and metabolic versatility, cyanobacteria colonize diverse terrestrial and aquatic habitats, including extreme and polluted ones. Many species of unicellular and filamentous cyanobacteria possess efficient heavy metal removal capabilities from aqueous solutions. They produce metal - binding proteins (metallothioneins) and metal - sequestering agents (organic acids, amino acids and extracellular polysaccharides). The bioremoval of heavy metals by cyanobacteria is mediated by biosorption and bioaccumulation. Cyanobacteria, because of their rapid growth rate, simple growth requirements, heavy metal tolerance and amenability to controlled laboratory culture, are the promising candidates for the removal of heavy metal contaminants from water. The present study, which was conducted for the assessment of heavy metal bioremoval potential of several laboratory-grown freshwater cyanobacteria using cadmium (Cd) and chromium (Cr) as test metals, revealed rapid kinetics of removal of these metals by *Aphanothece* sp., *Nostoc muscorum*, *Rivularia* sp. and *Spirulina platensis*. The degree of metal bioremoval varied with the species, duration of exposure and pH of the solution.

Key words: Heavy metal, Bioremediation, Biosorption, Metallothioneins, Cyanobacteria

SVI/P-12

Azadirachta indica Leaf Powder as a Powerful Biosorbent for Removing Cu (II) from Aqueous Solutions

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Mature leaves of Azadirachta indica (Neem) tree were converted to a biosorbent by washing with water, drying in sunlight till they were crisp and then mechanically grinding them into a powder. The powder was further washed with water to get rid of soluble materials and pigments, dried again and sieved a 200 mesh (74 μm) sieve to obtain the cellulosic biosorbent, *Azadirachta indica* leaf powder (AILP). The AILP was used to separate Cu (II) from water under varying conditions of pH, interaction time, Cu (II) concentration and AILP amount. While very low pH was found unsuitable for Cu (II) sorption, up to 90% of Cu (II) can be separated by sorption on 4 g of AILP from an aqueous solution of concentration 50 mg/L at pH 5.6. The equilibrium experimental data were in agreement with Langmuir and Freundlich isotherms and followed second order kinetics. Langmuir monolayer capacity of *Azadirachta indica* leaf powder for Cu (II) was observed between 6.7 – 33.3 mg/g, which could be considered as reasonable. The cellulosic fragments present in the biosorbent provide a matrix of OH^-, COO^-, CN^-, and other anions that bind Cu (II) ions to the surface. The process was exothermic with fiH values of - 96.1 to - 105.4 kJ mol^{-1} revealing strong Cu (II) – AILP linkages. This is supported by appropriate increase in entropy and decrease in Gibbs energy.

Key words: *Azadirachta indica*, Cu (II), biosorbent

SVI/P-13

Biosorption of Cu (II) and Ni (II) on *Magnifera indica* Leaf Powder

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A novel biosorbent was developed from naturally abundant leaves of Mango (*Magnifera indica*) tree. The biosorbent was characterized with respect to surface functional groups by FTIR spectra, porosity and surface area measurements, and surface topography by SEM. Sorption of copper(II) and nickel(II) from aqueous solutions on mango leaf powder (MLP) was studied with both equilibrium batch process and non-equilibrium column process. The batch sorption was studied with respect to the influence of pH, agitation time, ion concentrations, MLP amount and sorption temperature. The experimental data were fitted to Langmuir and Freundlich isotherm equations and the kinetics were worked out on the basis of Lagergren pseudo first order, pseudo-second order and Weber–Morris intra-particle diffusion models. The maximum monolayer sorption capacity was found to be 14.26 mg/g for Cu (II) and 17.07 mg/g for Ni (II), respectively. The magnitude of these values indicates moderately strong Cu (II)-MLP and Ni (II)-MLP interactions. The sorption enthalpy, ΔH changes from −41.83 to −27.19 kJ/mol with a mean value of –31.59 kJ/mol for Cu (II)-MLP and from −37.13 to −33.71 kJ/mol with a mean value of – 36.54 kJ/mol for Ni (II)-MLP interactions, suggesting moderately strong exothermic processes. Breakthrough curves, obtained from column flow experiments, demonstrate a strong potential for using mango leaf powder to remove Cu (II) and Ni(II) ions from aqueous medium.

Key words: Cu (II) and Ni (II) biosorption, Mango leaf powder, Batch sorption, Column sorption, Kinetics, Langmuir capacity

SVI/P-14

Equilibrium and Kinetics of Pb (II) Biosorption on Untreated Jackfruit Leaf Powder

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Untreated leaves of Jackfruit tree (*Artocarpus heterophyllus*) were dried crisp in sunlight and ground into a fine powder (Jackfruit leaf powder, JLP) for screening as a potential biosorbent for Pb (II) in aqueous solutions. Equilibrium sorption experiments in a batch process were carried out to evaluate the effects of pH, contact time, temperature, Pb (II) concentration and biosorbent amount on sorption efficiency. Optimum Pb (II) sorption was obtained at a strongly acidic pH of 3.0, but considerable sorption was possible upto pH 7.0 beyond which precipitation occurred. At pH 3.0, sorption of Pb (II) (80 mg/L) was ~ 99% (JLP 2 g/L). Application of kinetic models to the time variation of sorption showed that the rate processes followed a pseudo-second order model. The equilibrium data fitted both Freundlich and Langmuir isotherm equations with appropriate values of the sorption coefficients. The Langmuir monolayer capacity, q_m, is considerably large with values varying from 41.15 to 92.59 mg/g (mean 73.99 mg/g) for JLP amounts of 1 to 5 g/L. The sorption process was accompanied by an enthalpy change, ΔH of 51.77 to 90.86 kJ/mol (mean 63.69 kJ/mol) indicating the Pb (II)–JLP interactions to be endothermic in nature. Column study showed that at 90% breakthrough, the sorption capacity decreased from a maximum value of 95.00 mg g^{-1} for feed flow rate of 3.0 mL min^{-1} to 70.00 mg g^{-1} for 11.5 mL min^{-1} with Pb (II) concentration of 100 mg L^{-1}, JLP 0.5 g, bed depth 1.4 cm. The break-through volume at 90 % removal increased from 575 to 975 mL as the bed depth was changed from 2.2 to 3.7 cm (JLP 1.0 to 1.5 g). Bohart–Adams model was used to interpret the results.

Key words: Pb (II) biosorption, Jackfruit leaf powder, Batch process, Column sorption, Sorption equilibria, Isotherm, Kinetics

SVI/P-15

Alkalinity and Phosphorus Deficiency: Major Limiting Factors in Phytoremediation of Red Mud Ponds

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Red mud emerges as the major waste product of the alkaline extraction of Aluminium from bauxite through Bayer's process. It comprises of oxides of iron, titanium, aluminium and silica along with some other minor constituents. Disposal of red mud remains a burning issue with serious environmental implications in Alumina industry due to its large volume, alkaline pH, high caustic soda and iron oxide content. Red mud is usually disposed off from the Alumina plant either in form of slurries, which gets collected to nearby pools made for this purpose or after drying in the form of heaps or impoundment reservoirs in nearby areas. These red mud dumping sites have environmental risks. Establishment of vegetation on these red mud dumping sites is imperative for reducing the ensuing environmental risks. With an objective to bioreclaim the red mud dumps, an experiment was planned to study the effect of red mud as planting medium for selected tree species viz. *Dalbergia sissoo, Prosopis juliflora, Acacia auriculiformis, Pithecelobium dulce, Casia siamia*. Red mud amended with gypsum, single super phosphate and normal soil in different proportions were studied as medium for the germination of these selected species. Germination of *Prosopis juliflora* was found best in comparison to other species. Best germination was reported in treatment medium with red mud amended with gypsum, single super phosphate and soil. However, after one week of the germination, the saplings died, may be due to deficiency in organic carbon and nitrogen. The findings of the experiment may be used for further management and remediation of red mud dumps.

Key words: Red mud, Bioreclamation, Alakalinity

SVI/P-16

Pollution Indicator Algae of River Ganga at Kanpur

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In view of increasing pollution and subsequent algal growth in Ganga waters, a detailed study of algal flora of river Ganga at Kanpur has been conducted during present investigation. Physicochemical characteristics of water samples from river Ganga at Kanpur have revealed varying levels of pollution. Quantitative and qualitative estimates have been made on monthly basis and as many as 36 significant algal species have been identified which can tolerate high degree of pollution. Their role as possible indicators of pollution has been discussed. Principal groups of algae constitute Cyanobacteria, Chlorophyceae and Chrysophyceae. The most significant finding being that apart from 4 species of *Euglena* and 3 species of *Scenedesmus* which perhaps are the best adapted species of polluted waters, the members of Cyanobacteria like *Oscillatoria*, *Merismopedia*, *Chroococcus* and *Spirulina* etc. are the major pollution indicating species. The other dominant group is the diatoms with the genera like *Nitschia*, *Navicula*, *Synendra* and *Fragilaria* etc. Species of *Microcystis, Nostoc, Anabaena, Cladophora, Spirogyra, Closterium, Gomphonema, Pediastrum, Hidrodictyon* are abundantly found during present investigation.

Key words: Water pollution, Indicator plants, Algae, Ganga river

SVI/P-17

Blue Green Algae as Indicator of Disturbed Conditions in North Indian Gangetic Plains

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Algae, because of their nutritional needs and their position at the very base of aquatic food webs, provide relatively unique information concerning ecosystem condition compared with other aquatic flora and fauna. Algal response is rapid and predictable to a wide range of pollutants and pressures providing potentially useful early warning signals of deteriorating conditions and their possible causes. Comparative assessment of algal assemblage provides one of the important benchmarks for characterizing the minimally impacted biological conditions of disturbed ecosystems.

Fresh water bodies in populated plains of tropical countries face various disturbances in the form of pollutant and nutrient inflow, heavy metal and elemental precipitation (wet or dry) and constant silt inflow (natural or anthropogenic). These adverse constrain effectively influence the algal assemblage and can be a good indicator of overall health of the water body. Present study examines the comparative algal assemblage in fresh water bodies of two sites (Lakhna town and Kanpur) of Uttar Pradesh situated in the Gangetic plains of north India, in order to identify potential factors influencing the algal growth and indicator algal species for these habitats.

Lakhna (26°39'00.33" N, 79°9'00.12" E), in Etawah district of Uttar Pradesh, is situated at an average elevation of 143 mt. and is primarily a rural town (population- 10,452), with moderate to low level of anthropogenic pressure; whereas Kanpur (26°27'38.66" N, 80°20'00.26" E) situated at an average elevation of 126 mt. is the second largest city of the state (population- 2,551,337) and has been one of the oldest industrial townships of North India .Water bodies in Kanpur city receive loads of nutrient inflow through precipitation (dry /wet) and through industrial effluents. Therefore the human related pressures are higher in localities in Kanpur than in Lakhna town (effluent and precipitation inflow etc).

Water samples from different water bodies in the two localities (i.e. Lakhna town and Kanpur) were collected throughout the year and physical (water level, total hardness, total hardness, water temperature and transparency) and chemical (dissolve oxygen, BOD, nitrate, ammonia, pH, carbonates, bicarbonates, alkalinity and chloride) characters of these water bodies were also recorded. These samples were analysed for blue green algae (BGA). A total of seventeen genera of fresh water blue-algae were recorded from Lakhna whereas water samples from Kanpur recorded eighteen genera of blue-green algae. Though there was considerate presence of BGA throughout the year in both localities, the growth was maximum during winter and spring seasons. Further nearly all the chemical and physical parameters of water bodies showed elevated trend in localities from Kanpur relative to Lakhna town indicative of more disturbed conditions in localities in Kanpur.

Key words: Algae, Algal assemblage, Blue green algae, BOD

SVI/P-18

Enrichment of Beneficial Microflora in the Rhizosphere Degrade the Residual Toxicity of Pesticides

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The injudicious and indiscriminate use of synthetic pesticides for the management of insect and pest have created serious animal and human health problems as well as environmental problems leading to the development of the resistance in pest, destruction of the beneficial microbial biota of the rhizosphere and it also pollutes the food chains. Among the various pesticides which have applied as soil application, Chlorpyriphos is a well known termitecides and extensively applied to control termites by every farmer. Such pesticides have 3-5 year residual toxicity in the soil. In order to reduce this problem, the experiments were designed to screen out beneficial soil-borne microflora which has ability to degrade the toxicity of chlorpyriphos. Among the screened microflora only few microflora viz., *Pseudomonas fluoroscens*, *P. syringae, P. aeruginosa*, *Pseudomonas* sp. and *Bacillus subtillis* were found to be able to degrade residual toxicity of chlorpyriphos.

Key words: Chlorpyriphos, Residual toxicity, *Pseudomonas* spp. *Bacillus subtillis*

SVI/P-19

Lichen Biomonitoring Studies in Forest Localities of Narayan Swami Ashram, Pithoragarh District, Uttarakhand

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The Narayan Swami Ashram situated in Pithoragarh district of Uttarakhand between the altitude of 2500-3000 m exhibit luxuriant growth of *Quercous semecarpefolia* together with coniferous trees. The temperate forest in the Himalayas provide suitable habitat for different lichen genera to grow luxuriantly on all the available trees on their trunks, twigs and branches. Apart from trees lichens also grow on soil, exposed rocks and small bushes.

The Narayan Swami Ashram (NSA) being a holly pilgrimage experienced a heavy anthropogenic pressure of tourist from April to November every year. Due to the fast pace of urbanization, development of roads, and construction of hydroelectric dams the forest of the areas are destroyed exhaustively which ultimately affect the growth of epiphytic lichens on trees and other substrates. The lichens are well known bioindicators of forest structure and condition. The lichen biodiversity in a particular area can be used for planning strategies for forest management and assessment of forest fragmentation.

A large number of methods for monitoring ecosystem

function with the help of lichens are available. The "forest health" or "ecosystem health" can be monitored with the type of lichen species or communities in that particular forest. The type of lichen species or communities indicate the changes in forest age structure, changes due to fire, clear cutting verses single tree harvesting and road building. Some selected species of lichens can be used to monitor forest ecosystem function. All the 59 species of lichens known from NSA can be grouped in to seven bioindicator communities (Dimorphic, Parmeleoid, Physcioid, Lecanoroid, Usneoid and Umbilicate) groups of lichens based on morphological guild.

The Parmeliod communities (*Cetrelia*, *Parmotrema, Parmelaria, Parmelinella, Nephromopsis, Everniastrum, Flavoparmelia* spp.) mostly growing on trees in open canopy forest have been shown to be particularly useful as indicator of open tree forest. Many of these species are dependent on light and exposed stable rough bark. The Dimorphic communities (*Cladonia* and *Cladia* spp.) growing on soil indicate a moisture rich stable soil crust. The cyanolichens group (*Lobaria, Leptogium* and *Sticta* spp.) indicates moist and shady habitat of the forest. Lichens in the "Usneoid" morphological guild (tufted and pendulous fruticose lichens including the genera *Ramalina, Usnea* and others) have been found to be useful as indicators of old forest with ecological continuity and also indicates a pollution free atmosphere. The Umblicate communities (*Dermatpcarpon* and *Umblicaria*) grow on the rocks and boulders indicates a stable rock surface. Occurrence of toxitolerent communities of Physcioid lichens (*Heterodermia*) indicates that some area of the NSA has high anthropogenic activity and poor air quality.

The present record of different lichen bioindicator communities enumerated from the NSA clearly indicates the present condition of the forest and will be used as a base line record for conducting biomonitoring studies in the area in future.

Key words: Forest localities, Lichen biomonitoring, Umblicate communities, forest health, ecosystem health

SVI/P-20

Assessment of Seaweeds in Biomonitoring and Biosorption of Heavy Metals

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The brown seaweeds *Sargassum sp.* and the green seaweed *Ulva* sp. were harvested from the coastal areas of Rameshwaram, Tamil Nadu, India. Copper (Cu), Zinc (Zn), Cadmium (Cd), Iron (Fe) and Lead (Pb) content of selected seaweeds were determined using Atomic absorption Spectrophotometer. In both seaweeds, metal content sequence was observe to follow the trend Fe>Zn>Cu>Cd and Pb was not detected. Biosorption found that absorption of Cadmium from dilute aqueous solution by the native biomass resulted in the adsorption of hydrogen ions as well and the release of other non-toxic light metal ions. The brown seaweed *Sargassum sp.* showed a higher potential for adsorption of Cadmium compared to the green seaweeds *Ulva sp.,* with a maximum uptake capacity of 191.1 µg/g of dried weight of *Sargassum sp.* This study clearly shows that local seaweeds such as *Sargassum* sp. may be used as a potential biomonitor as well as cadmium absorbent from Industrial effluent.

Key words: Biosorption, Biomonitoring, Seaweeds, Heavy metal

SVI/P-21

Biosorptive Remediation of Selenate using an Agro-Industrial Residue

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Selenium enters the aqueous environment through various natural and anthropogenic sources. Higher concentration of selenium in water system leads to the poisoning of fish and wildlife, and threatening of the public health. A variety of treatment technologies have been reported for selenium removal from contaminated waters. However, most of the systems are having technical and/or economical constrains. At this juncture advances in the knowledge of biosorption has gained important credibility during recent years because of its eco-friendly nature, excellent performance, and low cost domestic technique for remediating even heavily metal loaded water. The present study deals with the utilization of agro-industrial waste wheat bran for the remediation of selenium species, Se (VI) by batch mode. The effect of various parameters viz. pH, temperature, initial metal ion concentration and biomass dose was extensively investigated on uptake of these metal ions by wheat bran. The maximum uptake of Se (VI) was found at a pH of 2, temperature 20°C, initial metal ion concentration 1000 g/L and biosorbent dose of 1 g/L. Langmuir, Freundlich and Dubinin-Radushkevich (D-R) isotherm models were applied and all three isotherms fitted well to sorption data. Maximum sorption capacity of wheat bran was 80.65 g/g at 20°C and pH 2.0. Values of mean sorption energy indicated the sorption to be a chemical in nature. The study of thermodynamic parameters revealed that sorption was feasible, spontaneous and exothermic in nature. Pseudo-first-order and pseudo-second order kinetic models were applied to the kinetic data and it was found that the sorption reaction was following a pseudo-second-order kinetics. The mechanism of metal ion adsorption by wheat bran was found to be complex and both, the surface adsorption as well as intra particle diffusion contributed to the rate determining step. Thus, wheat bran was found to be potential and good biosorbent for remediation of selenate from water/ wastewater.

Key words: Selenium, Biosorptive remediation, Wheat bran, Isotherm, thermodynamics, kinetics

SVI/P-22

Lichen Biomonitoring Studies in Rewa and Katni Districts of Madhya Pradesh, India

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The Katni and Rewa districts are situated in Vindhyanchal range of Madhya Pradesh. The districts exhibit unique topography as it comprised of undulated small mountain chains. The unique topography with dry tropical climate supports mostly the dry deciduous and scrub forest. The cultivated orchards of *Mangifera indica* and *Artocarpous* are the few places which show occurrence of evergreen trees. The *Mangifera indica* trees provide excellent habitat for many plant groups including lichens to colonize epiphytically on trunk, branches and twigs. Both the districts exhibit luxuriant growth of lichens on *Mangifera indica trees* in orchards and on avenue trees along the road.

Out of 46 species known from both the districts, 25 are found growing on mango tree. A total of 14 crustose and 10 foliose species grow luxuriantly on mango tree. *Pyxine cocoes* (Sw.) Nyl., a well known toxitolerant foliose lichen together with *Rinodina shophodes* (Ach.) Massal., a crustose lichen grows extensively on mango tree. The mango trees in open canopy forest or growing as avenue trees exhibit poor growth of lichens as compared to the trees growing in dense, moist and shady mango orchard. Both the districts exhibit dominance of toxitolerant lichens belonging to the family Physciaceae together with few sensitive species of blue green alga containing lichens. The distribution pattern of sensitive species growing scarcely on the trees in moist humid habitats can be used in monitoring the environmental changes in both the districts together with assessment of the anthropogenic activities.

Key words: Epiphytic lichen flora, Biomonitoring, Katni and Rewa districts

SVI/P-23

Screening Plant Species for Phytoremediation of Petroleum Hydrocarbon Contaminated Soil

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Fast and cost-effective techniques are required to select plant species and genotypes for use in phytoremediation at hazardous waste sites. Greenhouse screening procedure to aid the selection of plant species would help increase success. Twenty annual plant species were examined for survival and tolerance and assess the degrading efficacy of various fractions of petroleum hydrocarbon in pot experiment contaminated with crude oil. The aim of this research was to select some plant species that could be effective in phytoremediation of a petroleum hydrocarbon contaminated soil. The results revealed that out of 20 plant species only 4 species of grass were tolerant to 10% crude oil contaminated pot soil. The survived plant species were harvested after 180 days interval and analyzed for biochemical parameters. Plant biochemical characteristics measured included foliar protein, sugar and chlorophyll and compared with same species grown in control pots. The results showed that experimental plants produced reduced amount of biochemical. The residual concentrations of petroleum hydrocarbons present in the 10% crude oil contaminated experimental pots were estimated at the time of final harvest. Under the conditions and length of this trial, some variations in rates of TPH degradation were detected. GC analysis of total petroleum hydrocarbons in 10% soil-sand-crude oil mixture pots after 180 days reveals that tolerant plants reduced some fractions of hydrocarbon present in crude oil. Comparison of results with control after 180 days interval suggested greenhouse screening could help to understand the petroleum hydrocarbons removal efficacy of some plants.

Key words: Phytoremediation, Plant selection, Greenhouse, Crude oil, Petroleum hydrocarbon, Biochemical

SVI/P-24

Efficacy of Vermicomposts on Soil Chemical Properties and Nutrient Uptake by Mung Bean (*Vigna radiata* L.)

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An attempt has been made to ascertain the efficacy of different vermicompost on properties of soil and nutrient uptake by *Vigna radiata* L. in two major soil group namely red and black soil of Bundelkhand region of Uttar Pradesh, India. Three different biodegradable wastes viz. cow dung, fresh water hyacinth plant (*Eichhornia crassipes*) and straw with various C/N ratios were used as food for epigeic earthworm *Eisenia foetida.* In the present investigation soil chemical properties and nutrients uptake (N, P, and K) by *Vigna radiata* have been recorded for two seasons i.e. 2006 – 07 and 2007 – 08, respectively. In this study significant better performances were found in cow dung based vermicompost (T2 and T6) in both the soil group, although black soil is better in compare to red soil. Results showed that the application of vermicompost had significant positive effects on soil chemical properties and nutrients uptake of mung bean plant as compare to control.

Key words: Bundelkhand region, Environment safety, Land degradation, Organic farming, Soil health

SVI/P-25

Accumulation of Heavy Metals and Biochemical Constituents in *Eichhornia crassipes* (Mart.)

Exposed with Industrial Waste Water

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Among the liquid industrial waste, tannery waste poses a serious threat to our environment. In the present study, an attempt has been made to evaluate the heavy metals content in tannery waste water from common effluent treatment plant in Unnao district (U.P.), India. The waste water was potentially toxic rich with heavy metals in the order of Cr>Ni>Zn>Cu. *Eichhornia crassipes* Mart. plants exposed to various concentrations (0, 25, 50, 75 and 100%) of tannery waste water and observed for visible effects, tissue concentration of heavy metals (Cr, Cu, Ni and Zn), biochemical constituents (pigments, total protein, sugar) and enzymes (amylase, catalase and peroxidase) activity. *E. crassipes* showed high accumulation of Cr among other heavy metals. The accumulation was dose dependent more in root than leaves. The pigment contents, protein, sugar and enzymes activity (amylase, catalase and peroxidase) were inhibited by undiluted tannery waste water; severity was less at diluted waste water concentrations (25, 50 and 75 %). Proline and relative water content were maximum at 25% waste water and showed declined trend with increasing concentration of waste water. Visible symptoms of toxicity in *E. crassipes* at undiluted effluent were yellowing of leaves, curling of leaf margins after wilting and fragmentation in roots. Therefore, study concluded that *E. crassipes* accumulated high content of heavy metals (Cr>Ni>Zn>Cu) exhibit visible symptoms of toxicity and alteration in biochemical constituents. These findings may be helpful in phytoremedial approaches to excess heavy metals in waste water.

Key words: *Eichhornia crassipes* Mart., Tannery waste water, Heavy metals, Biochemical constituents, Enzyme activity, Phytoremediation

SVI/P-26

Syncephalastrum spp. New Bio-absorbent of Metal ions from Polluted Water

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Thirty one fungal species were isolated from polluted water and sediments from Gomti River, Lucknow, India. The isolated fungi belonged to genera *Aspergillus niger, Aspergillus flavus, Alternaria alternata, Cunninghmella echinulata, Fusarium sp., Penicillium chrysogenum, Rhizopus arrhizus* and *Syncephalastrum spp.* These fungi were screened for their resistance to heavy metal. Majority of isolates were resistant to copper (Cu), zinc (Zn), chromium (Cr), lead (Pb) and cadmium (Cd). The level of resistance depended on the isolates tested as well as the site of its isolation. Minimum inhibitory concentrations (MIC) were also determined for Cu, Cr, Zn, Pb and Cd. Isolate of *Syncephalastrum* were the most tolerant to heavy metals and exhibited luxuriant growth. These fungi have shown a high level of resistance to all metals tested, which makes them a suitable potential candidate to remove metals from contaminated wastewaters.

Key words: Polluted water, Heavy metal ions, Removal

SVI/P-27

Heavy Metal Tolerance of Filamentous Fungi Isolated from Polluted Water

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Eighteen microorganism represented by isolate of yeast and filamentous fungi were isolated from heavy mental contaminated sites in Sitapur. These isolate belonged to the genera *Aspergillus, Alternaria, Fusarium, Rhizopus, Cunninghmella, Mucor* and *Trichoderma.* They were screened for their resistance to heavy metals. The observation revealed that majority of the isolate were resistant to lead, chromium, copper and zinc whereas *Cunninghmella* could also grow on medium supplemented with higher concentrations of chromium.

Key words: Heavy mental, *Cunninghmella,* Chromium

SVI/P-28

Bio-Remediation of Chrome-VI of Tannery Effluent using *Trichoderma* Species

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The tannery effluent carrying hazardous Cr (VI) species due to the oxidation of Cr (III) species was found to pollute the soil and the ground water of Kanpur city where large number of tanneries are located. In the present communication, biosorption of chromium ion Cr (VI) onto the cell surface of *Trichoderma* fungal species (*T. viride*, *T. koningii* and *T. atroviride*) in aerobic condition was investigated. Batch experiments were conducted with various initial concentrations of chromium ions to obtain the sorption capacity and isotherms. The results obtained at pH 5.5 of chromium solution were 70.09% reduction by *T. koningii*. It was found that the sorption isotherms of fungi for Cr (VI) appeared to fit Freundlich models. The results of FT-IR analysis suggested that the chromium binding sites on the fungal cell surface were most likely carboxyl and amine groups. The fungal surfaces showed efficient biosorption for Chromium in Cr^{+6} oxidation state. Best results for sorption were obtained at 5.5-5.8 pH, at low or high pH values; Cr (VI) uptake was significantly reduced.

Key words: Biosorption, *Trichoderma* spp., Chromium, Bioremediation, Tannery waste water treatment

SVI/P-29

Importance of Microbial Diversity in Nitrogen Removal from a Constructed Wetland

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Plant-based systems, such as wetlands and other ecological treatment systems are promising, sustainable alternatives to conventional wastewater treatment. Constructed wetland technology is currently evolving into an acceptable, economically competitive alternative for many wastewater treatment applications. Constructed wetland systems use a consortium of physical, chemical and biological processes (such as filtration, sedimentation, adsorption, bio-conversion and uptake by micro-organisms and wetland macrophytes) to remove different pollutants. The diverse vegetation provides surfaces for the attachment of microbial films, aids on the filtration and adsorption of wastewater constituents, transfers oxygen into the water column, and controls the growth of algae by restricting the penetration of sunlight. Constructed wetlands are principally using the same natural degradation processes and nutrient uptake but they are acting as "extensive systems". The high degree of biodiversity present in these systems allows multiple and various degradation pathways for several classes of compounds, and therefore higher performances in comparison with the technological treatment plants in which only few families of specialized bacteria and fungi are grown. Nutrient enrichment in receiving aquatic environment can cause excessive algae growth and lead to eutrophication. The nutrients that are of primary concern in wastewater treatment are nitrogen and phosphorus. Nitrogen can exist in various forms, the major forms of nitrogen of concern for management of wastewater are oxidized nitrogen (NO_3^- and NO_2^-), ammonical nitrogen (NH_3 and NH_4^+), nitrogen gas (N_2) and organic nitrogen. Nitrogen removal in constructed wetlands mainly occurred by a two-stage biological nitrification-denitrification process. Nitrogen is primarily removed from the wastewater through volatilization of ammonia, ammonification, nitrification, denitrification and plant uptake. Ammonification is the biological transformation of organic nitrogen to ammonia nitrogen. In nitrification uses aerobic bacteria (*Nitrosomonas* bacteria) to convert ammonia to nitrite and then to nitrate - nitrogen by *Nitrobacter* bacteria. Nitrification occurs only after the carbonaceous biochemical oxygen demand (CBOD) of the wastewater has been sufficiently depleted. The purpose of present study was to assess the composition and structural diversity of the microbial biomass, explore different aspects of microbial activity with respect to wastewater properties, and interaction with environmental parameters. From this particular pilot plant study we will extrapolate and speculate performance of nitrifying microbial species that promote greater nitrogen removal, and could lead to increased efficiency of ecological treatment systems. Potential nitrification and denitrification rates of bacteria and fungi associated with the roots of herbaceous species (*Typha latifolia, Scirpus* sp. and *Polygonum hydropiper*) of wetland plants were studied under laboratory conditions. Potential nitrification rates were determined from the rate of NO_3^- accumulation in microcosms containing wastewater and live plants. These results demonstrate that microbial diversity play an important role in nitrogen removal from a constructed wetland to improve the water quality and applied for wastewater treatment. Usefulness of this technique will be discussed in relation to management of wastes from small sized communities.

Key words: Carbonaceous biochemical oxygen demand, Nitrate, Ammonical nitrogen

SVI/P-30

Screening and Characterization of Arsenate Tolerant Rhizobacteria with Reference to Mobilization and Immobilization of Arsenic in Rhizosphere

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For screening of arsenate tolerant plant growth promoting rhizobaterial strains thirty one rhizobacterial isolates were isolated form rhizosphere of *Oryza sativa* collected from arsenic contaminated area of Purbosthali, Bardhaman (W.B.). Out of thirty one, only six rhizobacterial strains were found to tolerate higher arsenate (AsV) concentration (> 1000 g ml^{-1}) in the form of sodium arsenate. These arsenate tolerant rhizobacterial strains were characterized in reference to plant growth activities, resistance to metals and antibiotics, catalase production etc. All the six stains ATRB-1, ATRB-2, ATRB-3, ATRB-4, ATRB-5 and ATRB-6 were found to tolerate high concentration of Arsenate (>1000 g ml^{-1}), however, the strains ATRB-1 and ATRB-2 showed tolerance up to (>3000 g ml^{-1}) of arsenate. Antibiotic susceptibility profile of different strains was found to be at different extent of resistance and sensitivity for various antibiotics. The strains ATRB-2, ATRB-3 and ATRB-5 were found to produce indole acetic acid and catalase, however, the strains ATRB-1 and ATRB-3 showed phosphate solubilization. These selected arsenate tolerant rhizobacterial strains with plant growth promoting activities could be utilized to increase mobilization for bioaccumulation of arsenic in plants used in phytoremediation of arsenic and immobilization in reducing level of arsenic in edible part of crop.

Key words: PGPR, Arsenic, Bioaccumulation, IAA, Rhizobacteria

SVI/P-31

Soil Lichens as Indicator of Trampling in High Altitude Grassland of Garhwal, Western Himalaya, India

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Lichen, a symbiotic amalgamation of a fungus (mycobiont) and algae (phycobiont) or cyanobacteria (cyanobiont), are known to be more sensitive indicators of ecosystem functioning and disturbances than any other cryptogamic and vascular plant community. Various lichen groups e.g. habitat subsets (corticolous-on bark and terricolous-on soil), lichen guilds or morphological groups (fructose, foliose and dimorphic) and functional groups (cyanolichens) are sensitive indicators of ecosystem health and human-related impacts.

Temperate Himalayan habitats, despite their stressed climatology, harbour some of the unique biodiversity of the region, vital for overall ecosystem functioning and stability. Lichens due to their desiccation- tolerance are able to survive in high altitude Himalayan habitats and had utilised majority of available microhabitats and substrate relives. Present study examines the terricolous lichen community in Chopta-Tungnath, temperate-alpine grassland of Garhwal Himalaya, in order to identify potential elements (species/ growth form) as indicator of trampling induced by live-stock grazing and tourist movements.

Chopta-Tungnath lies between 30°28'39"– 30°29'51" N latitude and 79°12'9" - 79°13'21" E longitude in Rudraprayag district of Uttarakhand. Typical mountainous topography with elevation rising from 2700 m to 4001 m above mean sea level, acidic soil pH (4 to 5.5), daily orographic precipitation at higher altitudes and annual monthly temperature ranging from 19°C to37°C (–15°C at higher altitudes) determine the vegetation of the area which is broadly classified as temperate mixed oak and coniferous forest through sub-alpine forest to alpine scrub or grassland along the altitude gradient. Lichen constitutes an important component of the vegetation inhabiting nearly all the terrestrial and boreal domains.

Terricolous lichens were sampled from twelve sites distributed in three stratified macrohabitats, along increasing altitudinal gradient. A total of twenty soil lichen species belonging to ten genera, six families and four morphological groups (i.e. leprose, foliose, dimorphic and fruticose) were identified. Soil lichen diversity was negatively correlated ($r=0.70;\ p<0.05$) with altitude. Among the four growth forms fruticose growth form was indicator of trampling induced live-stock grazing, distinguishing low grazed high altitude (3400-4001 m) areas with highly grazed low (2700-3000 m) to mid altitude (3000-3400 m) areas ($r=–0.81;\ p< 0.01$). The effect of trampling was more intense at more moist, mid to higher altitudes which receive daily rainfall through orographic precipitation.

Terricolous lichen diversity in the study area was found constrained by vascular plants at lower altitudes, human-related impacts (tourism and livestock grazing induced trampling) at mid-altitudes and habitat characteristics (low soil cover) at higher altitudes.

Key words: Grazing, Himalaya, Lichens, Orographic, Terricolous, Trampling

SVI/P-32

Role of Adsorbents in Removal of Synthetic Dyes

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The present paper deals with the treatment of wastewater produced by dyeing of fabric using malachite green and methyl red. The dyes are water soluble, cost effective, and easily applicable on fabrics and are extensively used.

Due to the presence of dyes in the textile effluents, it is highly colored. Discharge of effluents into water bodies is objectionable as they reduce the penetration of sunlight into the water which retards biological activity. In addition it also causes serious environmental effects.

For the present study, adsorption is selected as the effective and suitable practical method for decolorisation. Different low cost adsorbents like Brick powder, Wood charcoal, Activated charcoal, Lemon charcoal are used to carry out adsorption with the two dyes chosen. The adsorption for the two dyes is observed in the following order:

Key words: Activated charcoal, Lemon charcoal, Wood charcoal, Brick powder

SVI/P-33

Isolation, Identification of Two Highly Efficient Gram-Negative Hexavalent Chromium-Resistant Bacilli and their Bioremediation of Hexavalent Chromium

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Chromium (Cr) being a heavy metal is very hard and stable in the natural environment and hence widely used in industrial operations. Since hexavalent chromium (Cr VI) is carcinogenic in nature, humans are subjected to serious health hazards due to its exposure. Thus there is an urgent need for removal of chromium from environment specially from industrial effluents. Microbial bioremediation could be an alternative to the costly chemical separation process. In this study two Gram-negative chromium resistant bacilli were isolated (and arbitrarily named as T2 and S2) from chromium contaminated tannery wastes, having Cr VI concentration of 2 mg/L (much above the statutory limit of 0.05 mg/L). Minimum inhibitory concentration (MIC) values of pure monocultures were first evaluated. The characterizations of the two bacteria were done by thorough biochemical tests, antibiotic assays, cross metal reactivity, plasmid curing and cysteine quantifications. 16s rRNA gene sequencing was conducted and accession numbers were received after submission to NCBI GenBank. Growth curves of these isolates were performed in LB and M9 media and chromium uptake evaluated with time. These isolates were used for bioconversion and bioaccumulation of toxic

hexavalent chromium. Various parameters such as pH, hexavalent chromium concentration and inoculum percentage were varied to observe optimum bioconversion and bioaccumulation of hexavalent chromium of the said strains when grown in M9 Minimal Salt Media. Chromium concentration was quantitatively assayed by 1,5-Diphenylcarbazide and confirmed by atomic absorption spectrophotometeric analysis. After observing scanning electron microscopic photographs (with and without metal-stress) and chromium peak in Energy Dispersive X-ray spectroscopic microanalysis, it could be concluded that high inoculum percentage of T2 helps remediate a moderate amount of hexavalent chromium (8-16 ppm) very fast over a wide range of pH values at 35-37 $^{\circ}$ C. This was grown in MOPS-buffered inorganic media to find out whether the isolate was a chemolithotroph, so that its probable use of hexavalent chromium as electron source could be explained. Optimum temperature and pH were found out for T2 and it grew in a wide range of temperature and pH. Finally, it was used for metal uptake from soil to preserve normal plant growth. Exceptionally encouraging results were obtained.

Key words: Chromium resistant bacteria, Diphenylcarbazide, Atomic absorption spectrophotometer

SVI/P-34

Efficiency of *Amaranthus spinosus*: A Common Roadside Plant as an Air Pollution Bio-Marker

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SO_2 and NO_2 gases are highly soluble in the intercellular fluid in the plant leaves. Thus the increased level of these gases in the roadside air due to automobiles exhaust pollution induces the entry in the leaves. Then lipid peroxidation can be initiated by free radical attack on the poly unsaturated fatty acid compounds of the membrane lipids and once initiated, it becomes auto catalytic and a series of chain reactions occur. With the rise in free radical concentrations the antioxidant levels also increase in general to response of plants towards air pollution. Therefore the determination of antioxidant levels seemed to be an excellent tool to monitor the early phytotoxic action of pro-oxidative compounds, such as air pollutants. In this study the antioxidants (-carotene, phenolic compounds and ascorbate) level of very common roadside weed namely, *Amaranthus spinosus* was studied. This specific plant was collected from a road of Kolkata namely VIP road with very heavy traffic load. As control the same plants were collected from a residential area (Salt lake) having much less air pollution. It was observed that all the three anti oxidants were present in higher concentration in the plants growing at VIP road. Total protein and amino acid contents also increased by 74.55% and 100% in plants growing on VIP road, respectively which might be due to the efficiency of this plant to utilize the poisonous gases like SO_2 and NO_2 to produce excess amino acid as well as proteins in their leaves. Since proteins are structural components of the cells and play the role of major H^+ ion buffer, in plants the buffering capacity of proteins appear to play a significant role in determining their resistance to acidic gaseous pollutants. The SDS PAGE patterns of leaves of plants growing on VIP road also showed few new protein bands with probable molecular weights of 82,500 and 93,500, which might have a specific role in combating air pollution stress.

Key words: Air pollution, *Amaranthus spinosus*, Antioxidants, Total proteins content, Total amino acid contents

SVI/P-35

Assessment of Heavy Metal Copper (Cu) Pollution through Mosses

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With increasing concern about pollution as a factor in ecosystem disturbance, there is need to assess the effects and relative sensitivity of the various groups of plants to different pollutants. Bryophytes frequently accumulate chemicals to concentrations far exceeding those in the ambient environment. Their unique way of nutrient acquisition has far reaching consequences for the ecosystem in which they grow. Mosses are able to retain large quantities of metals and have been used as a monitoring as well as remediating agents. They are broadly categorized in two groups 'sensitive and tolerant'. Sensitive species show the signs of injury or changes in the morphology of gametophore on increased level of particular elements in the environment. Tolerant species can accumulate large amounts of particular element in the gametophore (higher than the amount present in substrates). These plants are used to remediate polluted soils naturally and inexpensively. Heavy metal ions are mainly accumulated by passive ion exchange and chelation mechanisms and polyuronic acids in the cell walls are partly responsible for the high capacity.

In the present study collection of bryophytes from urban areas was carried out to identify tolerant and sensitive species. Quantitative analysis of plants and soil substrata for the presence of copper (Cu) was carried out to compare element accumulation from five different sites of India namely Srinagar (Garhwal, Uttarakhand) (site 1), Bhawali (near Nainital, Uttarakhand) (site 2), Chakrata (Uttarakhand) (site 3), Shimla (Himachal Pradesh) (site 4) and Munnar (Kerala) (site 5) was undertaken. The highest content of Cu was found in *Pogonatum perichaetiale* (23.60 µg/g in plant sample) from Munnar (site 5) and *Trachypodopsis serrulata* (124.53 µg/g in the substratum) from Bhawali (site 2). These plants are collected near the agricultural fields in the urban areas and probably the sewage and the pesticides are the major source of Cu that accumulates in these plants.

Key words: Mosses, Copper, Pollutants, Remediation

SVI/P-36

Integrated Low Input Nutrient Management by Biofertilizers in Wheat-Maize Cropping System

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Biofertilizers have been used as sources to improve plant nutrients in sustainable agriculture. A field experiment was conducted during rabi and kharif from Nov 2008 to April 2009 and May 2009 to Aug 2009 at Saurikh of district Kannauj (U.P.) with the application of biofertilizers viz. *Azotobacter, Azospirillum*, Phosphate Solubilizing Bacteria (PSB) in combination with chemical fertilizers on wheat-maize cropping system. Among these different 9 treatments, T_9 and T_8 treatments showed maximum grain yield in wheat and maize respectively.

Key words: Biofertilizers, Cropping system, PSB, *Triticum aestivum, Zea mays*

SVI/P-37

Biodegradation of Detergents through Aquatic Fungi

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Commercial detergents are diverse group of chemical that are best known for their wide use in laundry industries and commercial household cleaning product. After use, residual (surfactant) detergents are discharge into sewage system directly or indirectly into surface water and most of them end up dispersed into different environment compartment of soil and water. "Water" is facing lots of problem due to these domestic sources. These toxic effects of surfactants on various aquatic organisms are well known. Most of aquatic organism species of fungi biodegrade surfactants at higher level. As we know fungi's have excellent potential for metal accumulation, particularly genera of *Rhizopus, Aspergillus, Streptoverticillum and Sacchromyctes.* In general most of commercial detergents (surfactant) are biodegradable and amount of it can be commercially reduced by secondary treatment of Municipal sewage waste water plant. This discharge waste water polluted with massive quantities of surfactant could be a serious effect on the ecosystem. Future studies of commercial surfactants toxicities and biodegradation are necessary to withdraw highly toxic and non-biodegradable heavy metal for commercial use as a result makes a eco-friendly environment.

Key words: Biodegradation, Surfactant, Detergent, Toxicity, Sewage waste water

SVI/P-38

Root Cortical Cells Sequester Maximum Cadmium in *Cyamopsis tetragonoloba* as Revealed by X-ray Microanalysis

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Cyamopsis tetragonoloba (L.) Taub. (cluster bean) (Leguminosae) is a multipurpose legume of commercial interest. Endosperm is a source of gum which is edible and is used as an important binding agent in pharmaceutical industry. The plant grows in various parts of northern and north west India where soil is contaminated with heavy metals such as lead (Pb) and cadmium (Cd). It is important to locate the metal contaminants in the plants and recognize the tissues where these toxic metals are sequestered. Therefore, a pot culture study was undertaken on cluster bean plants to find out the concentration of Cd in the underground and above ground parts and recognize the potential sites of metal deposition and sequestration.

Plants were raised in 0-200 mg/kg cadmium sulphate ($CdSO_4$). Various growth parameters, toxicity symptoms and ultrastructure features were examined at different concentrations of cadmium. At 100-200 mg Cd in soil, plants showed modification of root architecture – reduction in root length, root biomass and disruption of primary root system. Atomic Absorption Spectrophotometry (AAS) showed higher cadmium concentrations in roots in comparison to shoot systems in all the treated plant samples. The results showed positive correlation with the higher treatments. Energy Dispersive X-ray Microanalysis (EDAX) revealed that Cd was localized on the root surface of all the plant replicates treated with 150-200 mg Cd. Multiple peaks for Cd were seen in the spectra at 200 mg Cd in soil. Maximum concentration was found at the root apical meristem suggesting the role of Cd in arresting the cell division and elongation. Electron micrographs of root cortical cells of Cd treated plants revealed that the cell structure was affected by increased Cd levels showing cell wall and membrane damage at 200 mg Cd. Maximum Cd was localized at cell membrane and vacuolar regions in the root cortical cells in comparison to other regions in all the treated plant sections.

The studies clearly suggest that the roots accumulate maximum cadmium in the soil and the cell membrane and vacuoles in the root cortical cells play an important role in Cd sequestration in cluster bean plants.

Key words: *Cyamopsis tetragonoloba,* Cadmium, Energy dispersive X-ray Microanalysis

SVI/P-39

Phytoremediation Potential of *Portulaca tuberosa* Rox. and *Portulaca oleracea* L. Naturally Growing in an Industrial Effluent Irrigated Area in Ahmedabad, Gujarat, India

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Heavy metal contamination in the environment due to various anthropogenic activities is a serious problem. Phytoremediation is a novel, solar-driven and cost-effective technology for the remediation of heavy metal contaminated environments through exploitation of plants ability to accumulate heavy metals in their harvestable shoot parts. In the present investigation, two naturally growing plant

species of *Portulaca* i.e. *P. tuberosa* and *P. oleracea* were collected from two different field sites in Ahmedabad, Gujarat, India. One is irrigated with industrial effluent and other with tube well water, and analyzed for heavy metal accumulation in different plant parts viz., roots, stem, leaves and flowers. Concentration level of all the investigated heavy metals (Cu, Ni, Mo, Se, Hg, Pb and Al) was higher in industrial effluent and soil irrigated with it as compared to that present in tube well water and soil irrigated with it. Plants collected from effluent irrigated areas showed high accumulation of all the investigated heavy metals in all plant parts with the maximum being in roots and the least in flowers. Interestingly, both species of *Portulaca* demonstrated hyperaccumulation of multiple elements viz., Cu, Ni, Hg and Pb. Apart from this, selective hyperaccumulation of Se and Al was shown by *P. tuberosa* and *P. oleracea*, respectively. Total shoot concentrations (fi g g^{-1} dw) of Mo were about 399 and 668 in *P. tuberosa* and *P. oleracea*, respectively. It shows plants have good biomass and have high regeneration potential; hence appear to be suitable for phytoremediation of metal contaminated areas.

Key words: Industrial effluent, Lead, Mercury, *Portulaca oleracea, Portulaca tuberosa,* Selenium

SVI/P-40

IAP and Kriging: A Future Prospect for Use of Lichen Biomonitoring in Land-Use Planning In India

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The paper deals with a lichen biomonitoring technique, Index of Atmospheric Purity (IAP) and a geostatistical technique, Kriging (for spatial autocorrelation which can be used to make better estimates for unsampled data points) to produce a map. These two techniques are used in combination to see the future prospect for land-use planning in a developing country like India. An area of about 1962.5 km^2 was chosen for the study in Barak valley of southern Assam in India. The area exhibited various land-use patterns; hills and tea gardens, forests, rural and urban residential areas, cement, paper industry, and stone crushing industry, and agricultural lands. For calculation of IAP values, seventeen sites were selected randomly on a regional map provided by local office of urban planning. The coordinates of all the sites were taken physically using GPS. The epiphytic lichens were collected from all these sites, and data was taken regarding number of species, frequency, and abundance from a particular host tree at each location. The IAP value was calculated for each location applying a mathematical formula consisting of ecological index (Q) and a frequency-coverage factor (f). The IAP values were categorised and plotted in a map using kriging by geostatistical software. It is observed that the emerged map corresponds with the local land-use pattern resulting in different degree of air pollution. It is suggested that this method is a reliable tool for identifying areas of different degrees of air pollution at a large scale and simultaneous planning of its use in present and future. The biomonitoring studies using lichens, which are still in its elementary stages in India, can prove to be a big boon if worked out extensively for its various applications, of which land-use planning may be one.

Key words: Lichens, IAP, Kriging, Land-use map

SVI/P-41

Algal Communities from Panchgram Papermill Area, Assam and its Possible Potentials for Bioremediation

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Algae are of considerable importance in the natural environment as initial colonizer and primary producers. With an increase in anthropogenic activities, algae are adversely affected both in terms of diversity and physio-chemical adaptability especially in the polluted areas like industrial areas. Among the industrial pollution one of the major sources of pollution is the pollution generated from paper industry. In Barak Valley, Cachar Paper Mill at Panchgram is one of the most polluting industries in this region. A number of chemicals are used in the industry for bamboo processing and paper making involving mercury cell (Hg+), Sodium hydroxide (NaOH) i.e. caustic soda, Hypochloride acid, Black liquor, White liquor, Chlorine dioxide and a number of sulphur compounds which gets their entry in different terrestrial and aquatic habitats in and around the paper mill area. Accumulation of these toxic wastes in these habitats is a matter of serious concern as they enter food chain and causes health hazards. Application of a remediation approach becomes imperative when the build up of these toxic substances in water and soil is beyond permissible limits.

Algae are one of the important candidates which can be applied for bioremediation purpose and disintegration of pollutants. In the present paper, a preliminary survey of various algal communities have been made in different habitats of the paper mill including lagoon, lime mud, bamboo dust and bamboo chips, solid waste deposits and other adjacent areas to understand the potential species for bioremediation application. A total number of 14 algal species are reported from this polluted zone showing a dominance of major blue green forms like *Lyngbya, Cylindrospermum, Scytonema, Oscillatoria, Spirulina* and other green algae and one red algal species in the paper mill area. The physio-chemical attributes of soil and water samples are also presented. The present study emphasises the reported the blue green algal species as the tolerant forms and has possible potential for bioremediation. The preliminary assessment of the disintegration of paper mill waste in lagoon and solid waste has been made and presented here.

Key words: Algae, bioremediation, Paper mill pollution

SVI/P-42

Bioremediation of Tannery Effluent by Mono- and Mixed-culture of Wetland Plants

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Wetland plant species exhibit different metal removal efficiencies when grown in mono-and mixed-culture for purification of wastewater. In this context an experiment was conducted to investigate the Cr removal and accumulating potential of wetland plants *(Bacopa monnieri, Cyperus flabelliformis, Typha latifolia and Scirpus lacustris)* under monoculture and mixed culture from tannery effluent collected from common effluent treatment plant (C.E.T.P), Unnao, India. The phytotoxic effect of effluent was studied on tolerance index, physiological, cytological and root anatomical parameters of the plants. The plants treated under mono-and mixed culture removed significant amount of Cr from the effluent in the following order: *B. monnieri* (97.33%), *C. flabelliformis* (93.18%), mixed plant culture (90.72%), *T. latifolia* (89.68%) and *S. lacustris* (88.78%). Mono-and mixed-culture treatment of plants accumulated significant amount of Cr in their tissues; however accumulation was more in monoculture than in mixed-culture. Tolerance index of plants reduced in response to effluent treatment followed by reduction in chlorophyll and protein content and mitotic index, however, an increase in micronuclei was observed in plants. Phytotoxicity was more pronounced in monoculture than mixed culture due to greater accumulation of metal. It was noteworthy although *B. monnieri* accumulated maximum amount of Cr but showed least toxicity followed by *C. flabelliformis* < *T. latifolia* < *S. lacustris* under mono-and mixed culture treatment respectively. In addition various root anatomical variations were observed in plants as an indicator of effluent toxicity. On the overall performance of plants it is concluded that B. monnieri is a reliable alternative for metal bioremediation of tannery effluent.

Key words: Wetland plant, Tannery effluent, Mono and mixed culture, Phytotoxicity

SVI/P-43

Role of Contaminated Soils in Inhibiting Seed Germination of Certain Plants

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Contamination of soil and ground water from anthropogenic sources is a major concern in many developing countries. Seed responses to environmental, chemical or physical factors has determined those that stimulated or inhibit germination. During the present investigations five plants i.e. *Azadirachta indica, Lantana indica, Nerium indicum, Ricinus communis* & *Thevatia perruviana* were investigated for the role of contaminated soils in inhibiting their seed germination in vitro by allowing the seeds to respond to different contaminated soils through pot experiments for a said period. Cent percent inhibition was affected in seed germination of *Azadirachta indica, Lantana indica* & *Thevatia perruviana* due to contaminated soils obtained from residential, commercial & public sectors respectively. The seeds of *Nerium indicum* resisted contaminated soils of commercial & industrial sectors by showing minimum 33.33 per cent inhibition which indicating its tolerance. The concept of using plants to clean up contaminated environment was renewed & developed. Certain plants are found to be hardy, tolerant & exist in contaminated areas. There is a need to identify hyperaccumulator plants tolerant to contaminated soils; that can be applied in phytoremediation of such soils. This is sustainable, in expensive & fast emerging process as a viable alternative to conventional remediation methods & will be most suitable for a developing country like India.

Key words: Contaminated soils, Phytoremediation, Hyperaccumulator plants

SVI/P-44

Identification of Suitable Phytoextractors and Phytostabilizers for Fly ash

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About 500 million tones (Mt) of fly ash is produced worldwide annually, out of which nearly 70 % is disposed off in landfills and fly ash dykes. The continued dumping of fly ash on land has turned millions of hectare of arable land into waste land. *In-situ* phytoremediation of fly ash disposal site, by establishing vegetation seems to be the best possible alternative for restoration of such sites. Although a lot of work has been done in the area, but from economic point of view there is still a need to identify such plants that can establish themselves either with minimum input or without any input (organic or inorganic fertilizers). In the present study twenty plant species belonging to different growth habits (trees, shrubs, grasses and herbs) were grown on fly ash dyke to evaluate their performance under field conditions. No amendments were given. The uptake and accumulation of heavy metals by different species, in different parts (root, stem, leaf and flower) was studied at an interval of six months for two years. Plant survival and growth performance was recorded at regular intervals. Several tools like translocation factor (TF), bioconcentration factor (BCF) and Metal accumulation index (MAI) were used to identify plants suitable for phytoextraction and/or phytostabilization purpose. The results indicate that heavy metal accumulation in different plant parts varied among species and also with age and season. Out of the twenty studied species: five species were found to phytostabilize the heavy metals; seven species were capable of phytoextracting the heavy metals; another five species were unable to survive; and the remaining three species needs further

investigation to identify their potential.

Key words: Fly ash, Heavy metals, Bioconcentration factor, Translocation factor, Metal accumulation index

SVI/P-45

Electrochemical Sensing of Tea Polyphenols by Chloramine-T Modified Electrodes

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Tea is the most popular energy drink. It is prepared from two leaves and one leaf bud and internodes of the *Camellia sinensis*. The quality of tea is determined by the polyphenol contents of tea leaves which is around 30% of phenolic compound on the dry weight basis. The health benefits of tea are favorable in preventing cardiovascular diseases, neurological diseases, cancer etc due to antioxidant activity of polyphenols in tea. Green tea has greater amount of polyphenols, particularly a group of flavan-3-ols commonly known as catechins. Green tea mainly consists of monomeric phenolic compounds like (-)-epigallocatechin gallate (EGCG), (-)-epigallocatechin (EGC), (-)-epicatechingallate (ECG) and (-)-epicatechin (EC). But black tea contains dimeric theaflavin and polymeric thearubigins due to oxidation of catechin during fermentation of tea leaves, whereas oolong tea contains both forms of polyphenols as it is partially oxidized during processing.

Chloramine T is reduced to p-toluene sulphonamide (p-TSA) as alcohol (e.g. phenols, polyphenols etc.) is oxidised to aldehyde. We have developed an electrochemical sensor for detection of polyphenols in tea infusion using Chloramine T as a detector. The electrode system was dipped in 0.1 M Phosphate buffer (pH 6.8) and measurement was noted using AutoLab electrochemical analyzer (PGSTAT-12).The amount of polyphenol was detected by measuring the current response with respect to standard curve of catechin hydrate. The range of detection is 0.3 to 4.1 mg/gm of polyphenols in various tea samples using glassy carbon electrode. It was observed that the polyphenols content was highest in green tea and lowest in black CTC tea. The method of detection was simple and could be applied for evaluation of tea quality.

Key words: Tea, Polyphenols, Sensor, Chloramine T, Amperometry

SVI/P-46

Hyper Arsenic Accumulating Lichens in India

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Biological monitoring can be very effective as an early warning system to detect environmental changes. This approach is based on the assumption that any changes taking place in the environment have a significant effect on the biota. Lichens are one of the most valuble biomonitors to atmospheric pollution. They can be used as sensitive indicators to estimate the biological effects of pollutants by measuring changes at community or population level, and as accumulative monitors of persistent pollutants by assaying their trace element contents. Arsenic (As) pollutants are directly related to water pollution but due to weathering of soil, rock, burning of coal and industrial activity their courses into atmosphere and causes serious effect on human health and plants. In the present study 18 localities were surveyed under three districts (Dhar, Katni and Rewa) of Madhya Pradesh and found that past mining activities, stone crushers and agricultural activities are responsible for increasing concentration of As in air. In these areas the lichen species such as *Lepraria lobificans*, *Phaeophyscia hispidula* and *Pyxine cocoes* accumulated As as 51.96, 19.6 and 33.4 $\mu g\ g^{-1}$DW respectively. The foliose lichen *P. cocoes* growing on trees near coal based thermal power plant of Raebareli district accumulated As between 8.9 to 77.29 $\mu g\ g^{-1}$DW and its concentration in lichen thallus increasing with decreasing distance from the power plant. In West Bengal *P. cocoes* and *Graphis ceylanica* accumulated the highest As with compare to other metals and both the species exhibit concentration of As as 48.1 and 16.10 $\mu g\ g^{-1}$DW respectively. Among the foliose growth form of lichen (*P. cocoes*, *P. hispidula*) are hyper accumulator of As than the liprose form (*L. lobificans*) and crustose growth form (*G. ceylanica*).

Key words: Arsenic, Lichen biomonitoring, India

SVI/P-47

Arsenic Accumulation by Plants grown on Arsenic treated soil: A Comparative Study

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This study evaluated the ability and mechanisms of plants species to accumulate arsenic (As) in a soil spiked experiment with 25ppm, 50ppm, 75ppm and 100ppm As. The study included nine pteridophytes and four non-pteridophytes species. Among all the species *P. vittata* was the most hyperaccumulator species. The non-Pteris species includes *Cristella dentata, Adiantum capillus veneris, Nephrolepis tuberosa, Nephrolepis cordifolia, Nephrolepis bissrata, Ampelopteris prolifera, Collysis elliptica, Microsorium punctatum and Microsorium altenifolium*. The non pteridophytes are *Vetiveria zizinoides, Phragmitis australis, Helianthus annus* and *Withania sommnifera.* The experiment identified *Adiantum capillus veneris, Cristella dentata, Nephrolepis tuberosa, Nephrolepis bissrata, Nephrolepis cordifolia* and *Phragmitis australis* having potential to tolerate arsenic. The plants were analysed for the extent of oxidative stress, as a result of arsenic accumulation. They were able to detoxify the arsenic stress through induction of anti-oxidant defence system. An increase in

glutathione and ascorbate content with increase in As concentration in the medium, indicates its ability to counteract As stress. The results indicate tolerance potential of these species against As stress.

Key words: Hyperacummulator, Species, Arsenic, Antioxidant, Stress, Pteridophytes

SVI/P-48

Analysis of Metal Binding Sites of Cation Diffusion Facilitator Protein to Enhance the Phytoremediation Efficiency of Plants

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Cation Diffusion facilitator (CDF), the intermembrane transporter proteins are ubiquitously present in the three domains of life i.e., plants, bacteria and animals and play a vital role in the movement of metal ions from the cytoplasm to the apoplast or the subcellular structures. It has often been found that the well known plants used for phytoremediation have a low biomass yield. Two approaches can be used to increase phytoremediation efficiency of plants with high biomass. One is to increase the specificity of the metal uptake protein for a particular metal of interest while the other alternative can be to increase the number of metal ion uptake protein for cloning measures. However, the former can only be achieved if the binding sites of the metal ion uptake proteins are identified and well characterized. Since the CDF transporters are too large for NMR applications and difficult to prepare for X-ray crystallography, we applied computational approaches to identify and analyze the binding sites of CDF proteins. The retrieved structures from the protein data bank as well as modeled structure were docked with different metals to identify if there are any conserved binding sites. The present work can be significant owing to the difficulties associated with the structural knowledge of CDF proteins in wet laboratories.

Key words: CDF protein, Metal transporters, Phytoremediation, Metal binding

SVI/P-49

Phytoremediation of Arsenic Contaminated Ground Water by Submerged Aquatic Plants

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Arsenic - a toxic metalloid and known carcinogen is widely distributed in many parts of the world both from natural and anthropogenic sources. It can exist in four oxidation states (-3, 0,+3, and +5), arsenate [As(V)] and arsenite [As(III)] are the most commonly existing forms of arsenic species in aqueous environments. A large population in arsenic contaminated areas can be exposed to toxic amount of arsenic through direct and indirect ingestion i.e., drinking arsenic contaminated water and consuming crops grown from arsenic polluted soils, respectively. Phytoremediation remediation is low-cost technology for removal of toxic metals and metalloid from water and soil using aquatic and terrestrial plants respectively. In this study, the arsenic removal potential of two submerged plants (*Hydrilla verticillata* (l.f) Royle and *Vallisneria spiralis* L.) was evaluated using ground water sample (total arsenic :10-350 ppb) collected from arsenic contaminated Gangetic plains. Results indicate that after 24 h of treatment *V. spiralis* could accumulate 95.3 - 98.4% of the As present in water samples in concentration dependent manner. While *H. verticillata* could accumulate 95.02-97.5% of the As present in water samples. Plants attenuate arsenic toxicity through synthesis of phytochelatins during Phytoremediation. Post phytoremediation ground water samples exhibit as >10 ppb. A chlorine treatment is suggested prior to use for drinking. However, no chlorine treatment is required for other domestic uses.

Key words: Arsenic, Groundwater, Phytoremediation Submerged plants

SVI/P-50

Use of Tobacco Plants as Bioindicators to Assess the Ambiant Ozone in Algiers (Capital city of Algeria): A preliminary Study under Climatic Conditions (2008-2009)

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Motor vehicles are a major contributor to air pollution in many areas in Algiers, the capital city of the Algeria. Then emit a cocktail of pollutants including nitrogen oxides, volatile organic compounds, polycyclic aromatic hydrocarbons PAHS, metals and particulates. Ozone is potentially important in this Mediterranean region, especially during summer; the climate in this area is favourable for the formation of high concentrations of O_3 by photochemical reactions. Little is known about the air pollutants, such as ozone in Algiers, however, the availability of air pollution monitoring stations based on automatic analysers is still limited to only few districts of Algiers. Little studies have been conducted to measure surface O_3 levels in urban areas around Algiers. The extension of air pollution monitoring requires large investments and maintenance costs, it is thus important to integrate the bioindicators for the detection and evaluation of air pollution. The use of bioindicators plants constitutes novel tools to monitor air quality that be developed in the case of Algeria.

In this study, the highly sensitive 'Bel W3' cultivar of tobacco (*Nicotiana tabacum* L.) is used for characterizing ozone air pollution in terms of visible injury symptoms. Two

campaigns have been carried on to evaluate ozone air pollution during July to August 2008 and June to October 2009.

Pots with Ozone-sensitive Bel-W3 tobacco plants were placed to ambient concentration of ozone at six locations in the central Algiers, three sites in city center, characterized by important avenues with high traffic activity (cars, taxis, and public transport vehicles); and three sites in residential area, with no significant local sources of air pollution. Visible leaf injury was assessed by determining a percentage value of leaf area injured by ozone on six tobacco plants and these plants were replaced at biweekly intervals from June through September. Weekly values of Leaf Injury Index were calculated.

The results of this preliminary study show that 03 is present at phytotoxic levels in the studied sites. The average percentage of leaf necrosis ranged from 2% to 30%. The highest Ozone injury has been observed for tobacco Bel W3 in the sites in residential locations, while a lower O_3 injury was observed in city center. An O_3 injury observed in site of el Madania in residential area in summer of 2009 was lower than during the previous summer.

Key words: Ozone, Phytotoxicity, Tobacco plants, Mediterranean region, Algiers

SVI/P-51

Novel Rice Cultivars with Low Grain Arsenic Level Safe for Human Consumption

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Arsenic contamination of rice has lead to a disaster unfolding as South East Asia. Rice is consuming by nearly half of the world population and its irrigation with arsenic contaminated groundwater is posing health hazard through dietary human exposure. Simulated pot experiments were conducted on four rice (*Oryza sativa* L.) genotypes (Triguna, IR-36, PNR-519 and IET-4786) to examine the effects of As^V on amino acids and mineral nutrient status in grain along with antioxidant response to arsenic exposure. Rice genotypes responded differentially to As^V exposure in terms of amino acids and antioxidant profiles. Total amino acid content in grains of all rice genotypes was positively correlated with arsenic accumulation. While, most of the essential amino acids increased in all cultivars except IR-36, glutamic acid and glycine increased in IET-4786 and PNR-519. The level of non-protein thiols (NPTs) and the activities of superoxide dismutase (SOD; EC 1.15.1.1), glutathione reductase (GR; EC 1.6.4.2) and ascorbate peroxidase (APX; EC 1.11.1.11) increased in all rice cultivars except IET-4786. During hydroponic study, some transporters were up-regulated in all rice cultivars at lower doses of As species, except IET-4786. Phytochelatin synthase, GST and γ-ECS showed considerable variation in their expression pattern in all genotypes, however in IET-4786 they were generally down-regulated in higher AsIII stress. A significant genotypic variation was also observed in Specific Arsenic Uptake (SAU; mg kg^{-1}dw), which was in the order of Triguna (134)>IR-36 (71)>PNR-519(53)> IET-4786(29). Further, application of As^V at lower doses (4 and 8 mg l^{-1}As) enhanced the accumulation of selenium (Se) and other nutrients (Fe, P, Zn and S), however, higher dose (12 mg l^{-1}As) limits the nutrient uptake in rice. In conclusion, low As accumulating genotype, IET-4786, which also had significantly induced level of essential amino acids, seems suitable for cultivation in moderately As contaminated soil. Some fungi such as *Trichoderma* sp. isolated from rice rhizosphere from arsenic contaminated soil of West Bengal showed arsenic bioremediation potential as well as plant growth promoting activity for rice.

Key words: Amino acids, Arsenic, Mineral Nutrients, Rice, *Trichoderma* sp.

Session SVII

Plant Microbe Interaction

SVII/L-1

Good and not so Ugly Environmental *Escherichia coli* Occur as Natural Plant Growth-Promoting Soil Bacterium

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Currently, it is presumed that *Escherichia coli* is not a normal inhabitant of the soil. Soilborne *E. coli* strains were isolated from broad range of 7 geoclimatic zones of India, indicating that *E. coli* can survive and thrive under different extreme soil conditions. Diversity among *E. coli* strains from widely separated geographic regions using enterobacterial repetitive intergenic consensus (ERIC)-PCR did not reveal any relationships between the genotypes and the source of isolation. Inoculation of maize (*Zea mays* cv. Arkil) seeds with *E. coli* NBRIAR3 (NBRIAR3) significantly enhanced plant growth and nutrient uptake, when compared with uninoculated control. Presence or absence of NBRIAR3 did not affect significantly diversity indexes, using substrate utilization patterns on the Biolog Eco plates. Clone libraries based on 16S rRNA gene from rhizosphere of maize plants demonstrated rather similar phylotype diversity from the uninoculated control and NBRIAR3-treated rhizosphere soil, which further indicated that NBRIAR3 did not exert a major influence on the overall bacterial diversity. The methodological approach described in this study supports the idea that *E. coli* should be treated as native soil bacterium instead of as an "indicator" of the possible presence of other fecal coliform bacteria.

Key words: *Escherichia coli,* growth promoting bacterium, *Zea mays* cv. Arkil

SVII/L-2

The Importance of Soil Life in Sustainable Agriculture

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The use of chemicals in order to increase the agricultural production often causes environmental pollution. The minimalization of these chemicals can be the basic task on the way to preserve our nature.

The different human activities led to the dramatic decreasing of soil life. Beside this effect the acidification of soils is observed, especially in cases when the N-fertilization is intensive.

Dependence of soil life on cultivation methods does not seem to be clear in all cases. The slow, but continuous acidification of soils, the irrigation, the foddering, the organic matters in soils determine not only the soil life, but the ratio between the harmful and useful soil organisms.

In case of suitable inoculums the examination of methodology that will be used in the agriculture can be the following task. The tolerance of bacteria to the different chemicals determines the costs, as well as the applicability.

The marketable forms also can be different. The solution is the most simple in use and the most problematic in logistic. To bring the products in to solid form can be the way to simplify the use, and logistic of different bacteria containing bio-fertilizers. The question is: what will be the surveillance of different strainsfi

Tree bacteria, *Azotobacter chroococcum, Bacillus megaterium*, and the *Pseudomonas putida* were examined in our experiments. Special emphasis was given to the resistance and the surveillance after the solid phase production.

Key words: *Bio-fertilizer,* Surveillance*, Resistance*

SVII/O-1

Preservation of Wood from Wood-Decay Fungi by Chitosan

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Wood decaying fungus is one of the serious problems in wood industry. One of the alternatives to protect the wood from wood decay fungi is using the chemical compound which is environment friendly like chitosan. The bio-control mode of action of chitosan elicits natural defense responses within plant to resist against insects, pathogens, and soil borne diseases. The aim of this research is to determine that chitosan can preserve the wood from wood decay fungi effectively. There are two kinds of DAC of chitosan, DAC 90% and DAC 95%. Each kind of DAC is conducted onto three concentrations, 0.1%, 0.5% and 1%. Each concentration was inoculated to four kinds of wood sample (*Shorea* sp., *Cryptomeria japonica*, *Pinus mercusii* and *Albizia* sp.) before fungi inoculation. The first fungi that used in this research were *Gloeophyllum trabeum*, *Laetiporus sulphureus* and *Antrodia cinnamomea*. Chitosans are believed to act both as fungistatic agents and as fungicides at higher concentrations.

Key words: Wood decay, Bio-control, Chitosan, Fungistatic agents

SVII/O-2

Assessment of Role of Soil based Cyanobacterial Biofertilizer for Terraced Hill Rice Culture

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Cyanobacteria are common in Indian rice-fields, and it is unequivocally proved that they contribute nitrogen for the growth of the crop in various ways. Many physical, chemical and biological factors affect the growth and succession of cyanobacteria. Laboratory studies are good for understanding the role of individual parameters and work well in close chamber experiments. Cyanobacteria play an

important role in enriching paddy field soil by fixing atmospheric nitrogen and supplying vitamin B complex and growth promoting substances which makes the plant growth vigorously. Cyanobacteria fixes 20-30 Kg/N/ha and increase 10-15% crop yield when applied at 10 Kg/ha. Biofertilizers are supposed to be a safe alternative to chemical fertilizers to minimize the ecological disturbance.

The present study is therefore directed towards the assessment of cyanobacterial biodiversity from NE Region of India falling under two biodiversity hotspots viz. Himalayan and Indo-Burma which are earlier completely unexplored due to remote areas and to investigate their cultural and biochemical properties for exploitation as a biofertilizer in a very effective manner particularly for terraced hill rice culture conditions. Out of 450 unialgal cyanobacterial isolates encountered from almost all possible habitats of NE region of India, 150 were screened for ammonia excretion and best 5 isolates were identified for development of soil based biofertilizer. The process for refinement of technology is under critical observation particularly for performance in paddy fields.

Key words: Biofertilizer, Cyanobacteria, Rice culture

SVII/O-3

Arbuscular Mycorrhizal Fungi: The Mutualistic Engineers

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Soil is not a pile of dirt but are treasure house of earthy material and home of many micro-organisms as it was rightly said that "we think that we are standing on the earth but reality is that we are standing on the roof of another world". Rhizospheric region of the soil is one of the important room where plant, soil and microbes interact. Although these interaction are of many types but among these, mutulisitic interactions are of great importance. Arbuscular mycorrhizal symbiosis is one of the mutualistic relationship among the plants, soil and other microbes since they are one of the oldest living organisms playing important role for maintaining biodiversity of plants in any ecosystem whether it is forest, grassland or agriculture. As we are looking for the conservation of plant biodiversity, we need to look into the below ground engineering done by these tiny organisms. AMF are not only engineering nutrient management but also doing multifunction such as soil binding through glomalin, metal sequestration, carbon sequestration,phytoremediation, phytoprotection, metabolic engineering and many more yet to explore. Thus they are rightly called wonder living fossil.

Key words: Mycorrhiza, Mycorrhizal fungi, Symbiosis

SVII/O-4

In vitro Screening of the Antimicrobial Activity of Extracts from Naturally Growing Lichens Against Human Pathogenic Bacteria

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Lichens are widespread in the nature and may be long-lived. However, many species are also vulnerable to environmental disturbance, and thus useful in assessing the effects of ozone depletion, metal contamination and air pollution. Lichens are well known for their unusual secondary metabolites which have a great variety of effects, including anti-inflammatory, analgesic, and antimicrobial activities. However, only very limited number of Indian lichens have been screened for their antimicrobial activity against human pathogenic bacteria. The bactericidal activity of extracts from lichens *Usnea longissima* and *Everniastrum cirrhatum* were screened against clinical pathogenic bacteria. The lichens were collected from the temperate regions of Uttarakhand and identified to their species level. The secondary metabolites present in the lichens were identified by Thin layer Chromatography. The aqueous, acetone and ethanol extracts of the lichens was tested against five clinically important strains of human pathogenic bacteria, three gram positive (*Staphylococcus aureus, Streptococcus faecalis, Bacillus stearothermophilus),* and two Gram negative (*Pseudomonas aeruginosa and Escherichia coli).* The *in vitro* antimicrobial activity was estimated by Kirby- Baeur technique of disc diffusion method and was screened along with control. Acetone and ethanol extracts of the investigated lichens showed relatively strong antimicrobial activity against all gram positive bacteria and one gram negative bacteria (*Pseudomonas aeruginosa)*, whereas aqueous extracts were found to be inactive. It was found that the inhibition zone of tested bacteria against extracts varied between 07 – 24 mm (diameter of inhibition zone). Our results indicated that the tested lichens had relatively strong antimicrobial activity against the tested human pathogenic bacteria, which may be used in the treatment of various diseases caused by these and similar bacteria. Our findings have validated the use of the lichens for the treatment of various infections in man and livestock.

Key words: Antimicrobial activity, Lichen extracts, Pathogenic bacteria, Bactericidal

SVII/O-5

Production of Ligninolytic Enzymes by a Newly Isolated Basidiomycete *Ganoderma cupreum* AG-1 and its Role in Decolorization of Azo Dye

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Many fungi (Particularly the white rot fungi) are well studied for treatment of a broad range of textile dye effluents due to the versatility of the lignin degrading enzymes produced by them. A white rot fungus strain AG-1 was isolated from decayed wood. The strain was identified as a Genus *Ganoderma cupreum* AG-1, based on the morphological characteristics and a complete sequence analysis of its 18s rRNA gene and ITS region. The AG-1 was capable of decolorizing a variety of 15 azo dyes using basal nutrient medium. Reactive violet 1 (P3R Purple) dye was selected as a model novel dye. Various process parameters like composition of basal nutrient medium, pH, additional carbon source and nitrogen source, C/N ratio and initial dye stuff concentration were optimized to develop an economic decolorization process. Optimization of the medium resulted in an enhanced decolorization of dyes and increased production of laccase and MnP. *Ganoderma cupreum* AG-1 was able to decolorize more than 1200 ppm of the dye in 4 days. The amount of decolorization obtained was around 97%. The crude enzyme when used for the in vitro decolorization studies resulted in more than 90% decolorization within 24 hours. The results suggest that *Ganoderma cupreum* AG-1 is a highly potential producer of the industrially important ligninolytic enzymes.

Key words: Decolorization, Reactive violet 1, *Ganoderma cupreum* AG-1, Laccase, MnP

SVII/O-6

Monoculture Practice Inside Nambar Reserve Forest, Golaghat, Assam, India and its Impact on Mycoflora Population

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The present communication deals with a comparative study of soil fungi present in the soils of monoculture plantation and natural vegetation sites of Nambar reserve forest, Golaghat, Assam, India. Soil is rich habitat for the growth of micro organisms with fungi as one of the dominant group. Fungi live, multiply and die or disintegrate in the soil and thus they provide rich organic matter, which could be recycled as plant nutrition. Many exotic plantation practices are detrimental to critical environmental factors such as soil physical properties. Exotic monoculture tree plantations do not help maintain landscape and biological diversity. Study reveals that the population as well as the no. of species of soil fungi and herbaceous plants in exotic species cultivation sites are less than the natural vegetation sites. Therefore, monoculture of exotic tree species, as *Tectona grandis* and *Acacia* sp. within the reserve forest should not be encouraged. Exotic tree species retard the growth of soil fungi and also inhibit the growth of ground flora and may lead to the extinction of some species of herbs.

Key words: Monoculture, Exotic species, Organic matter, Soil fungi, Nambar Reserve Forest

SVII/O-7

Methylotrophic Bacteria Community along an Altitude and Soil Vertical Profile in Two Tropical Dry Deciduous Forests

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Methylotrophic bacteria utilize methane, methanol and other C-1 compounds as sole source of carbon and energy. They are ubiquitously distributed in natural ecosystem, agriculture field and in the waste land under reclamation. Their distribution was studied at increasing altitude in a dry deciduous forest of Panchamarhi hills (22–15′to 22–45′) and in a vertical soil profile of another dry deciduous forest (Hathinala) in Sonbhadra area (24–18′07′′N to 83–5′57′′E) during the early winter season when the temperature and soil moisture was moderate. An attempt was made to correlate the viable methylotrophic bacterial population with the C/N ratio temperature, and moisture regime of soils.

Population of methylotroph bacteria at different altitude varies in the range of 4.2×10^7 -3.7×10^7 per gram dry soils. The viable methylotrophic population decreased with the increasing altitude, which indicated a negative correlation among them. The presumption that C/N ratio might be regulating the population, increased with the decreasing population. A parallel increase in soil moisture content with that of population was noticed from lower to higher altitude. Although pH also decreased from three to seven hundred metres high altitude but at higher elevations the pH value shifted towards the neutral from acidic pH.

Unexpectedly the methylotrophic bacterial population increased with increasing depth up to 10 cm in a vertical soil profile. Several explanations may be proposed for such an increase *viz* inhibitors and ammonia produced during the decomposition of litters on the soil surface, accumulation of methane in the soil pores at subsurface soil (10 cm) etc. The methylotrophic bacterial population gradually decreased in the soil depth from 10-30 cm, however the decrease in population was more pronounced at higher depth. The population abruptly decline between 25-40 cm depth and further increase in vertical profile showed a little decrease in the bacterial population. Unlike the latitude the bacterial population decreased along with the C/N ratio which might be regulating the distribution of methylotrophic community at soil depth. Although a little variation in the soil moisture content with a slight increase in pH at soil depth was noticed but these two environmental factors did not seem to play a major role in the distribution of methylotrophic population.

Soils at increasing altitude and decreasing depth in vertical profile are two distinct variables which have different environmental parameters and nearly stable methylotrophic community, depicted a little deviation from environmental regimes.

Key words: Methylotropic bacteria, C/N ratio, Soil depth, pH

SVII/O-8

Genetic Diversity of Endosulfan and Tebuconazole Treated Cyanobacterial Species

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The electrophoretic patterns for three different cyanobacterial cultures treated with different concentrations of xenobiotic compounds-Endosulfan and Tebuconazole derived from three different decamer primers were analysed to provide diagnostic fingerprints for each culture and their genetic differences based on RAPD markers and amplification of the 16s rRNA gene. The RAPD primers OPAH-02, OG-04 and OPB-09 generated markers specific for *Anabaena fertilissima* Rao*, Aulosira fertilissima* Ghose and *Westiellopsis prolifica* Janet respectively. Visible differences in the banding patterns of the treated cultures after four and sixteen days of the xenobiotic treatments were noted as compared to their respective untreated cultures by RAPD-PCR. The study revealed that RAPD markers could be used to identify and establish genetic differences in the species. Moreover, toxic effects of the compounds on the cyanobacterial strains were also revealed by PCR amplification of the 16s rRNA gene. The presence or absence of the 1.5 kb band after four and sixteen days treated cultures produced as a result of 16s rRNA gene amplification was indicative of the toxicity of the compounds applied at various concentrations.

Key words: Cyanobacteria, Endosulfan, Tebuconazole, RAPD, 16s rRNA

SVII/O-9

Production of Poly--Hydroxybutyrate (PHB) Biopolymer by a Diazotrophic Cyanobacterium *Aulosira fertilissima*

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Biopolymers such as polyhydroxyalkanoates (PHAs) are a class of secondary metabolites with emerging importance in the field of environmental, agricultural and biomedical sciences. To date, high-cost commercial production of PHAs is being carried out with heterotrophic bacterial species. In this study, a photoautotrophic N_2-fixing cyanobacterium, *Aulosira fertilissima* has been identified as a potential source of poly-β-hydroxybutyrate (PHB). Under photoautotrophic growth condition, the test cyanobacterium was found to accumulate the homopolymer of PHB only up to 6.4% of dry cell weight (dcw). PHB accumulation was found to be stimulated under N and P deficiencies and in presence of exogenous carbons. An accumulation up to 65.9% (dcw) was recorded when the cyanobacterium was cultured in acetate (0.3%)- and citrate (0.3%)-supplemented medium. *Aulosira cultures supplemented with* 0.5% citrate under P-deficiency followed by 5 days of dark incubation also depicted a PHB accumulation up to 50.7% (dcw). In this study, PHB content of *A. fertilissima* reached up to 70.1% (dcw) under N-deficiency with 0.1% citrate supplementation, whereas under P-deficiency with 0.5% acetate an accumulation of 77.2% (dcw) was recorded. This is the highest value reported so far for PHB-producing photoautotrophic organism. In contrast to heterotrophic bacteria, the carbon requirement in *A. fertilissima* for PHB production is lower by one order magnitude. Absence of any impurities in the extracted samples suggests that photoautotrophic cyanobacteria could be considered as low-cost PHB producers for various applications.

Key words: *Aulosira fertilissima,* Chemoheterotrophy, Mixotrophy, N-deficiency, P-deficiency, Poly-*β*-hydroxybutyrate

SVII/O-10

Biodegradation of Congo Red Azodye by *Aspergillus* spp. Isolated from Dye Contaminated Soils

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In Textile dyeing effluent containing recalcitrant dyes are polluting water resources due to their colour and undesirable formation of toxic or carcinogenic intermediates such as aromatic amines. Therefore elimination of dyes from textile dyeing effluents currently represent a major ecological concern. Since conventional treatment based on chemical or physical methods are quite expensive, alternative strategy of microbial degradation of azodyes has been opted. In the present study fungal degradation of congo red azodye is selected. About 19 different fungal species were isolated and studied, from the dye amended soil collected from different places. Among them 3 species of *Aspergillus* namely *A. niger*, *A. flavus*, and *A. fumigatus* are more efficient in dye degradation. Degradation was assayed in terms of percentage of decolorisation, under different optimized conditions of temperature, pH, microbial biomass and Carbon source. The rate of degradation was significant at 30°C, and at a pH of 4. The activity was enhanced with the addition of glucose to the fungal medium. At the end of 24 hrs of incubation of fungal culture, the extent of decolorisation of congo red was maximum when compared to the control.

Key words: Congored, Degradation, Decolorisation, *Aspergillus* species, Optimization

SVII/P-1

Plant Growth Promoting Rhizobacteria (PGPR): A Potential Microbe for Agriculture and Environment Sustainability

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Sustainable agriculture is vitally important in today's world because it offers the potential to meet our future agricultural needs, something that conventional agriculture will not be able to do. This type of agriculture uses a special kind of farming techniques in which the resources of the environment can be fully utilized and at the same time ensuring that no form of harm was done to it. This kind of agricultural technique should be environment friendly and ensures safe and healthy agricultural products for human consumption. Microbial communities are responsible for fundamental processes that drive the stability and productivity of agro-ecosystems. Several research investigations are addressed at improving understanding of the diversity, dynamics and importance of soil microbial communities and their beneficial and co-operative roles in agricultural productivity. However, this communication describes only the contribution of plant growth promoting rhizobacteria (PGPR) in safe and sustainable agriculture development.

PGPR are group of bacteria that promotes plant growth and yield via various plant growth promoting activities as well as bio-fertilizers and bio-control agents. During the last couple of decades given the negative environmental impact of artificial fertilizers and their increasing costs, the use of beneficial soil microorganisms such as PGPR for sustainable environment and safe agriculture has increased globally. PGPR as a biofertilizers are well recognized as an integrated plant nutrient management for sustainable agriculture and hold a great promise in the improvement of agriculture yields. Thus, the PGPR offer an environmentally sustainable approach to increase crop production for future generation.

Key words: Agriculture, Biofertilizers, Biocontrol, Environment, Rhizobacteria

SVII/P-2

Studies on Morphological, Biochemical and AM Colonization Variability in *Withania somnifera* (Ashwagandha) Collected from Different Geographical Locations of the Country

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Withania somnifera (Linn) Dunal commonly known as Ashwagandha is known for its medicinal value. The plant holds a special place in Ayurveda system of Indian medicine. In order to substantiate the health claims, the herb has drawn considerable scientific attention. Various accessions of *W. somnifera* were collected from different geographical locations such as Mandsaur, M.P. (JA 20, JA 134), CIMAP, Lucknow (Poshita, Nmitli), Delhi (wild variety), Maharashtra (wild variety), Rajasthan (wild variety), Punjab (wild variety) and Jammu (WS-R-06) of the country. All the accessions were screened for variability in their morphological (height, branching pattern, leaf shape etc.), biochemical (chlorophyll and protein content) and associations of VA-mycorrhizal fungi. A considerable variability in the branching pattern among various accessions was observed. Protein content ranged significantly among the accessions investigated. It ranged from 0.28 mg g^{-1} to 0.44 mg g^{-1} (fresh weight) in leaves of plants from Madhya Pradesh and Rajasthan, respectively. Total chlorophyll content ranged from 1.62 mg g^{-1} to 2.17 mg g^{-1} fresh weight leaf tissues, the lowest being in Maharashtra and highest in M.P., respectively. Thin feeder roots of all the accessions were collected and investigated for variability in their association of VAM fungi. All the root samples investigated were found to be colonized with VAM association. Percent root colonization ranged from 30% to 56% in plants from Punjab and U.P. Intercellular and intracellular hyphae, vesicles and arbuscules of VAM fungi were observed in cleared and stained roots of plants. Considerable variability in formation of arbuscules and shape and size of vesicles was observed. Number of chlamydospores in the rhizosphere soil varied from 145 to 232 AM spores 100/gm soil samples collected from surrounding roots of *W. somnifera* accessions. *Glomus* sp were found to be the dominant VAM fungi among all the rhizosphere soil samples investigated. Association of VAM may help in increase of withanolides content in *W. somnifera*.

Key words: *Withania somnifera,* VAM, *Glomus* sp.

SVII/P-3

Interactive Effect of Environment and Cyanobacteria in Altering 'Usar' Soil Properties

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To investigate the interaction of environment and cyanobacterial genera in altering soil properties, two sets of experiments were done with sterilized as well as natural saline/alkaline soils. A soil pot experiment was conducted in open field for one year, kept at a height of 1 meter on iron cage to avoid surface contamination. Cyanobacteria characterized by a great morphological diversity and their widespread distribution reflect a broad spectrum of physiological properties and tolerance to environmental stress. Three genera of cyanobacteria i.e. species of *Nostoc*, *Anabaena* and *Calothrix* were inoculated in both the soils. Several other genera like- *Oscillatoria*, *Microcoleus*, *Phormidium*, *Lyngbya*, *Scytonema*, *Mastigocladus*, *Oedogonium*, and *Chlamydomonas* were observed in both sterilized as well as natural soils. Occurrences of such genera were expected because of air and rain contamination. A change in soil chemical properties was also observed. This result highlights information on methodological as well as

physiological approaches along with suggestions of interactive effect of environment and cyanobacteria in amelioration of 'Usar' soils (saline-alkaline) properties.

Key words: Cyanophycean algae, Diversity, Environment, Saline-alkaline soils, Usar soil

SVII/P-4

Isolation, Quantification of Pigment and Phycobiliproteins in Non-Heterocystous Filamentous Cyanobacterial Isolates

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Total seventy five non-heterocystous filamentous cyanobacterial isolates obtained from fresh water cyanobacterial repository of IBSD, Imphal, Manipur were screened for pigmentation. Fifteen isolates were screened and selected on the basis of pigment production and growth potential. These isolates are *Phormidium angustissimum, Phormidium tenue, Limnothrix vacuolifera, Limnothrix redekei, Oscillatoria acuta, Oscillatoria simplicissima, Oscillatoria willei, Hydrocoleum lyngbyaceum, Microcoleus chthonoplastes, Spirulina platensis, Lyngbya truncicola, Lyngbya laxespiralis, Plectonema nostocorum, Plectonema notatum* and *Plectonema boryanum.* All these isolates were obtained from different ecological habitats of North east Region of India falling under Indo Burma biodiversity hotspots. Pigment analysis in respect of chlorophyll-a, carotenoids, phycobiliproteins such as, phycocyanin, phycoerythrin, allo-phycocyanin were investigated. Five isolates namely; *Phormidium* IBSD-173 (chl.a: 3.14 µg/ml; carotenoids 0.07 µg/ml; phycocyanin 23.0 µg/ml; allo-phycocyanin 15.5 µg/ml; phycoerythrin 9.3 µg/ml), *Limnothrix* IBSD-120 (chl.a: 4.38 µg/ml; carotenoids 0.22 µg/ml; phycocyanin 17.4 µg/ml; allo-phycocyanin 2.00 µg/ml; phycoerythrin 5.90 µg/ml), *Limnothrix* IBSD-105 (chl.a: 0.95 µg/ml; carotenoids 0.23 µg/ml; phycocyanin 9.6 µg/ml; allo-phycocyanin 2.20 µg/ml; phycoerythrin 7.5 µg/ml), *Phormidium* IBSD-42 (chl.a: 1.33 µg/ml; carotenoids 0.06 µg/ml; phycocyanin 7.8 µg/ml; allo-phycocyanin 3.1 µg/ml; phycoerythrin 1.7 µg/ml), *Hydrocoleum* IBSD-104 (chl.a: 0.90 µg/ml; carotenoids 0.04 µg/ml; phycocyanin 2.8 µg/ml; allo-phycocyanin 2.40 µg/ml; phycoerythrin 3.40 µg/ml) were selected on the basis of their specific attributes for commercial exploitation as well as natural colourant materials.

Key words: Acidic habitat, Cultural studies, Cyanobacteria, Phycobiliproteins

SVII/P-5

Improvement of Wheat Growth and Nutrient Uptake by Phosphate Solubilisers

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A pot experiment was carried out for evaluating the effect of Phosphate solubilising bacterial inoculants viz. 5BacillusP, 5BacillusM, 42BacillusP, 42BacillusM and 5BacillusM+42BacillusM in combinations with different levels of Single super phosphate (50% and 100%) and Udaipur rock phosphate (50% and 100%) on wheat growth. Stimulatory effects of 42BacillusP, 42BacillusM and 5BacillusM+42BacillusM in combination, on population count, on dry weight of shoot, on total N and total P content were recorded at 50% Single super phosphate as compared to 100% Single super phosphate application. A significant correlation was observed between dry weight of shoot, total N and total P content at 70 days of sowing. The available P content of soil was also increased at 35th day of sowing while it decreased at 70th day of crop growth. The result suggests that 42BacillusM was able to dissolute more P and hence improved plant growth.

Key words: Phosphate solubilising bacteria, Single super phosphate, Udaipur rock phosphate

SVII/P-6

Microbial Properties of Alluvial Soil with Depth Profile in Eastern Part of Raniganj Coalfield

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The nature of the first few millimeters of a soil horizon strongly affects water infiltration rates, generation of runoff, and soil detachments and nutrients status. Whilst much is known about the physical and chemical properties of soil surface at this scale, little is known about the microbial activity beyond this surface layer, particularly in mining area. Soil microbial communities are of crucial importance for the functioning of ecosystem development during mining reclamation. The basic objective of the study was to assess the pre-mining status of microbial communities in different depth profile of alluvial soil in eastern part of Raniganj Coalfield. Soil samples were taken from different depth profile from topmost surface horizon up to 10 - 15 m depth, at an interval of 1 m between horizons. The examined microbial properties included soil Dehydrogenase (DHA), Phosphatase, β-glucosidase (β-glu) activity and Vesicular arbuscular mycorrhiza (VAM) spore density and their correlation with physio-chemical properties of soil. A linear regression analysis was carried out to correlate soil physicochemical properties with the soil microbiological activity.

A significant decrease in dehydrogenase, phosphatase, β-glucosidase activity and VAM spore density with increments of soil depth profile were found. A high microbial activity was observed on the topmost surface profile up to (0.15 m) in the study area. The values of the microbial parameters studied tended to decrease as depth increased. It was found that beyond surface horizon, there is

negligible microbial activity in soil profile.

Values of DHA, Phosphatase and β-glu presented high correlation coefficients (r = 0.935 to 0.998 from, p<0.01) with available organic carbon, nitrogen and organic matters content in the study. However, there was negative correlation between DHA, Phosphatase, β- glu and VAM spore density with the trace metals (Fe, Zn, Mn and Cu) present in the soils. The results of the study showed that available C, N and Organic matter are the most influencing factors which govern the microbial activity in the surface soils, but as the depth increased the contents of these nutrients decreased and the microbial activity also decreased.

Key words: Mined land reclamation, Dehydrogenase, Phsophatase, β-glucosidase activity, VAM spore density

SVII/P-7

Biodiversity of Chlorococcales from Sulwade Barrage of River Tapti of Dhule District (M.S., India)

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Sulwade Barrage is constructed on river Tapti, with a capacity of 65.09 lack cubic meter (133.00 meter) of storage water. River Tapti shows variety of rich algal forms of various groups in its abundant freshwater ecosystem. There is less attention on chlorococcales from this region. To fulfil this lacuna in this field, the present investigation was carried out by selecting Sulwade Barrage. In present investigation sixteen taxa were recorded viz. *Pediatrum ovatum* (Ehr.) A. Braun, *P. duplex Meyen* var. subgranulatum Raciborski, *P. biradiatum* Meyen, *Tetraedron trigonum* (Nageli) Hanspring, *T. lobulatum* (Naegeli) Hanspring, *Coelastrum microporum* Naegeli, *Tetrastrum heteracantum* (Nordstedt) Chodat., *Scenedesmus acuminatus* (Lagerh.) Chodat, *S. bijugatus* (Turpin) Kuetz, *S. dimorphus* (Turpin) Kuetz, *S. dimorphus* f. *tortus* Smith, *S. longus* Meyen var. *dispar* (Berb.) Smith, *S. obliqus* (Turpin) Kuetz, *S. opoliensis* P. richter var. *mononensis* Chodat, *S. quadricuda* var. *longispina* (Chodat) Smith and *S. quadricauda* var. *parvus* Smith.

Key words: Chlorococcales, Sulwade, Tapti

SVII/P-8

Variability and Diversity of Arbuscular Mycorrhizal Fungi in Different Grasses of Dhubela Natural Forest

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Geologically Dhubela natural forest comes under the Vidhyan and Deccan traps of rock system. Chief soil types are brown loam locally called 'Bhuri mitti' which is the most common soil, black soil locally known as 'Kali mitti' which form the soil of the area. Soil derived from Vindhyan rocks is shallow and rather barren, being loam in which sand is often in excess. The soil and the other climatic conditions are responsible for the tropical dry deciduous type of the forest. Since Dhubela natural forest is dry deciduous forest dominated by trees species such as *Acacia arabica, A. catechu, Albizia lebbeck, Azadirachta indica, Bauhinia malbarica, Butea monosperma, Cassia fistula, Delbergia sissoo* etc. shrubs viz. *Jatropha curcas, Solanum nigrum, Zizyphus nummularia* etc. Herbs viz. *Cassia tora, Euphorbia hirta, E. geneculata, Sida cordifolia, Parthenium hystroporus, Tridax procumbens, Anthesteria ciliatea, Apluda mutica, A. varia, Iscilema laxum, Acrachne racemosa, Brathiochloa intermedia, Cymbopogon martinii, Cynodon dactylon, Dactylocteium aegyptieum, Dichanthium annulatum, Elusine indica, Eragrotis cilliaris, E. pilosa, E. viscosa, Eragrotiella nordoides, Heteropogon contortus, Paspalidium flavidum, Phalaris minor, Poa annua, Rostaria pumila, Sorghum halepense, Saccharum spontineous, Sehima nervosum, Sporoblous diander, Vetiveria zizanioides* etc. Present study deals with the occurrence of arbuscular mycorrhizal fungi in some grasses growing in the forest. It was observed that there was significant variation in the AMF associated with different grasses. However, maximum number of AMF species was recorded with *C. dactylon* and minimum with *S. diander*. *Glomus* with 17 species dominated among the AMF species. Other than *Glomus*, 9 species of *Acaulospora*, 2 species of *Scutellospora* and single species of *Gigaspora* were also recorded.

Key words: Arbuscular mycorrhizal fungi, Forest, Grasses

SVII/P-9

Effect of Molasses on the Growth and Rhizosphere Mycoflora of *Cajanus cajan* L.

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Molasses becomes unsuitable for fermentation if stored for longer periods. In the present study effect of molasses have been tested on the growth and rhizosphere mycoflora of *Cajanus cajan* (Tur). The untreated molasses of sugar factory of 50%, 10% and 5% concentration was used for irrigation of different experiment at regular intervals. Observations were recorded on germination of seed, number of leaves, size of leaves and petiole and compared with that of control set. Rhizospheric mycoflora was also screened to observe molasses effect on the R/S ratio. Inhibition in growth with higher R/S ratio was observed in 50 % treatment of molasses.

Key words: Molasses, *Cajanus cajan,* Germination, Rhizosphere, Growth, Mycoflora. R/S ratio

SVII/P-10

Interaction Studies among Beneficial and Pathogenic Microorganisms

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The soil rhizosphere is diverse habitat where variety of microbes inhabits and interacts in various fashions. The microbial interactions play vital role in different environmental processes and are very useful for various applications. The present paper deals with the interactions among beneficial microbes (*Azotobacter, Pseudomonas, Bacillus, Trichoderma* and *Penicillium*) and pathogenic fungus *Fusarium oxysporum*. The antagonist fungus like *Trichoderma, Penicillium* were found to inhibit *Fusarium oxysporum* by 44 % and 59% respectively. The interaction among beneficial bacteria namely *Azotobacter, Pseudomonas,* and *Bacillus* were effective in controlling growth of *Fusarium oxysporum* by 23 %, 27 %, and 27% respectively. The interaction among all the tested beneficial bacteria was found to be neutral. In a pot based interaction study on *Trigonella* highest % germination was seen with AMF+*Trichoderma (86%)*, while maximum survival *(94%)* and AMF root infection was observed with the combination of beneficial bacteria and antagonist fungi.

Key words: Rhizosphere, Antagonist, Rhizobacteria

SVII/P-11

Weed Plants as Nutrients in Improving Microbial Population in Rhizosphere and Yield of Groundnut

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To know the response of weed composed *Eupatorium* and *Crotolaria* green manure to traditional FYM, different organic manures such as *Eupatorium* compost, *Crotolaria* green manure and FYM were added into soil at the rate of 5t/h and mixed thoroughly to get homogenous concentration. The results revealed increased microbial population over traditional FYM and control. *Eupatorium* maintained a bacterial population equal to *Crotolaria* green manure (CGM) till the end of 90 days which was higher than traditional FYM and control. The Fungal and Actinomycetal population exceeded by log1 in *Eupatorium* till 90 days when compared to CGM. The yield of groundnut in terms of Number of pods in CGM showed the highest followed by *Eupatorium*, control and FYM. While Weight and kernel percentage of pods in *Eupatorium* showed the highest next CGM, FYM and control. The application of weed composed *Eupatorium* and *Crotolaria* green manure enhanced biological stability in soil. This may gradually lead to protection of soil quality.

Key words: Weed *Eupatorium*, Weed *Crotolaria*, Nutrient, Yield, Microbial population

SVII/P-12

Management of Charcoal Rot (*Macrophomina phaseolina)* of Urd Bean (*Vigna mungo* L.) by *Trichoderma harzianum*

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Urd bean (*Vigna mungo* L.) is an important and well known short duration Kharif pulse crop of India and their Subcontinent. The yield of Urd bean is highly affected by several biotic and abiotic factors. Among the biotic factors, *Macrophomina phaseolina* (Tassi) Goid, is an important and major devastating soil-borne phytopathogen which causes charcoal rot in Urd bean which results in enormous yield losses every year. Keeping this in mind, an experiment was designed for biological management of disease by using *Trichoderma* spp. *Trichoderma* spp. are well known free-living, opportunistic, avirulent plant symbionts and are very common in soil and root ecosystems. Different strains of Trichoderma were screened against the pathogen and the growth inhibition was recorded by using dual culture plate technique and volatile substances released by them. Among all the screened isolates, only 6 strains showed their efficacy to inhibit radial growth (varied up to 40-72 %.) of *M. phaseolina* as compared to control. Among them *Trichoderma harzianum*-3 was found to be most effective and appears to be mycoparasitic over the pathogen. *T. harzianum*-3 also showed better competitive saprophytic ability (CSA) than other strains used in the experiment. Because of high CSA, *T. harzianum*-3 enhances root growth of the plant which may result in enhanced uptake of nutrients from the soil and due to such enhancement plant growth promotion and crop productivity was increased up to 15-30%.

Key words: *Vigna mungo, Macrophomina phaseolina, Trichoderma* spp., Mycelial inhibition, Volatile substances, Competitive saprophytic ability

SVII/P-13

Microorganisms Caused to Rotting of Grape Root Infected by Phylloxera in Khojavend Region Condition

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Root samples infected by phylloxera, grape varieties Tebrizi, Xindogni and Bayanshirae collected from farms of Khojavend region were analyzed and species composition of microorganisms causing to the second pathologic process-rotting were determined.

The amount of microorganisms obtained from roots, of Tebrizi grape variety was 100%. The phytopathogenes belonging to *Cylindrocarpon* genus were 22%, whereas phytopathologenes of *Gliocladium* genus were 11%, whereas phytopathologenes of *Fusarium* genus were 23%. At the same time 10% of phytopathologenes were detected belonging to bacteria of *Pseudomonas* genus, to bacteria of *Bacillus* genus-20%. Also among phytopathogens of this grape variety 5% were saprophytic fungi from *Penicillium* genus, 4% were fungi from *Mucor* genus, 3% were fungi from *Molissia* genus and 2% were fungi from *Rhacodiella*

genus. Spreading rates of phytopathogens from *Fusarium* (23%) and saprophytic fungi from *Penicillium*(5%) genera were more wider.

Pathogens obtained from roots, of *Xindogni* grape variety infected by pests were 100%. These were fungi from *Gliocladium* genus - 14%, fungi from *Cylindrocarpon* genus-15% and fungi from *Fusarium* genus - 32%. At the same time 25% of bacteria were from *Bacillus* genus. There were 3,5% saprophytic fungi from *Penicillium* genus, 2,5% fungi from *Mucor* genus, 2% fungi from *Molissia* genus, 3% fungi from *Rhacodiella* genus and 3% fungi from *Absidia* genus on roots of grape variety *Xindogni*. As it was observed spreading rates of phytopathogens from *Fusarium* genus (32%) and saprophytic fungi from *Penicillium* genus (3,5%) were more wider. Spreading rate of bacteria from *Bacillus* genus (25%) was also higher.

The amount of microorganisms from roots of Bayanshirae grape variety was 86%. These were fungi from *Gliocladium* genus - 14%, fungi from *Cylindrocarpon* genus - 16% and from *Fusarium* genus - 10%. At the same time, phytopathologen fungi from *Pseudomonas* genus were determined to be 22% and bacteria from *Bacillus* genus were 23%. Also 4% of saprophytic fungi from *Absidia* genus were observed. Spreading rates of phytopathogens from *Gliocladium* genus (16%), saprophytic *Absidia* genus (1%) was higher on the roots infected by pests. Bacteria from *Bacillus* genus has a wider spreading value (23%) in comparison to other genera.

Key words: Phylloxera, Microorganisms, Phytopathogenic fungi, Phytopathogenic bacteria, Saprotrophic fungi

SVII/P-14

Study on Effect of Various Herbicide Concentrations on Radial Growth of Biocontrol Agent *Trichoderma spp.* and Pathogen *Sclerotium rolfsii*

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Nine different pre emergence i.e. alachlor, butachlor, anilophos, metribuzin, pretilachlor, metolachlor, pendimethalin, oxadiargyl, oxyfluorfen and one preplant incorporation (fluchloralin) herbicides were evaluated for their effect on radial growth of *Trichoderma spp* and *S. rolfsii*. In three different concentrations i.e. 0.5 X (half of the recommended), X (recommended), 2X (double of the recommended) and periodic observations were recorded on the radial growth with a view to find out the action of herbicides against *Trichoderma spp* and *S. rolfsii.*

Radial growth of *S. rolfsii* was stimulated by pendimethalin at X and 2X and metolachlor at 0.5 X concentrations under *in vitro* conditions. Herbicide oxadiargyl inhibited the radial growth of bioagent and its higher concentrations was more inhibitory than the lower one. On the basis of visual observations, fluchloralin X and metribuzin 2X slightly reduced the sporulation of bioagent whereas it was slightly stimulated by pendimethalin X.

Herbicide alachlor stimulated the total mycelial growth of bioagent and reduced the mycelia growth of pathogen. This differential action of alachlor could be a promising achievement for combined management of weeds and soil borne crop diseases.

Key words: *Trichoderma spp., Sclerotium rolfsii,* Biocontrol, Herbicide

SVII/P-15

Diversity of Arbuscular Mycorrhizal in Rice (*Oryza sativa* L.)

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A study was conducted to investigate the arbuscular mycorrhizal (AM) fungal association with rice crop (*Oryza sativa* L. variety IR-36). Four rice growing sites around Sagar i.e. Deori (S_1), Rehli (S_2), Maharajpur (S_3) and Barman (S_4) were selected. Mycorrhization was observed in three distinguished seasons i.e. rainy, winter and summer. The results revealed that higher AM spore population was observed in summer as compared to other two seasons, irrespective of sites. Among the different sites, maximum AM spore count was recorded at S_2 (590, 917 and 994 spores 100 g^{-1} soil in rainy, winter and summer seasons, respectively) and minimum at S_3 (250, 420 and 562 spores 100 g^{-1} soil in rainy, winter and summer seasons, respectively). A total of 22 AM morphotypes belonging to three genera (*Acaulospora*, *Gigaspora* and *Glomus*) were recorded from the marked sites, which consisted of 7 species of *Acaulospora*, 1 species of *Gigaspora* and 14 species of *Glomus*. Among the recorded AM species, *G. dimorphicum*, *G. fasciculatum*, *G. gerdemanii* and *G. occultum* were found in all the three seasons at S_1. *A. foveata*, *A. nicolsonni*, *A. scrobiculata*, *Gigaspora albida*, *G. claroideum*, *G. fasciculatum*, *G. intraradix* and *G. mossae* were found in all the three seasons at S_2. *Gigaspora* albida and *Glomus deserticola* was totally absent in all three seasons at S_3. *A. nicolsonii*, *G. hoi* and *G. mossae* were recorded in all the three seasons at S_4, while the presence of remaining AM morphotypes was meager in one/two seasons in all sites. Irrespective of seasons, highest value for Shannon Weaver diversity index (H') was found at S_2 (2.33), followed by S_1 (2.09), S_4 (2.04) and S_3 (1.89).

Key words: Mycorrhization, *Oryza sativa*, Shannon weaver diversity index

SVII/P-16

New Reports from Class Loculoascomycetes to the Fungal Flora of Maharashtra

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The present paper deals with three species of lignicolous fungi from class Loculoascomycetes as new record for fungi of Maharashtra, viz., *Herpotrichia pandei* Bose, *Tubeufia pezizula* (Berk & Curtis) Eriksson & J. Zhue yue, *Lecanidion atratum* (Hedw.ex Fries) Endlicher. All are new additions to mycoflora of Maharashtra state.

Key words: New reports, Lignicolous, Locouloascomycetes, Maharashtra

SVII/P-17

Impact of Metal Pollution on Fungi

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Contamination of natural ecosystems by metalloids (like arsenic and chromium) is a very sensitive environmental issue due to its adverse impacts on soil, water and human health. The problems of arsenic contamination in groundwater and chromium poisoning of surface water have been considered of calamitous proportion because huge population is at high risk of these metalloids' poisoning. Use of arsenic and chromium contaminated waters for irrigation of agricultural soils has led to extensive contamination of cultivable lands and exacerbating the potential for food chain contamination. The objective of the present study was to investigate impact of metalloids (arsenic and chromium) on the morphology of fungi. A plate test study was conducted to assess toxicity of these metalloids on radial growth of five different fungal isolates (FNBR-03, FNBR-06, FNBR-13, FNBR-14 and FNBR-19) which were isolated from arsenic and chromium contaminated soils. Arsenic (V), Arsenic (III) and chromium (VI) was amended in fungi growth media using sodium arsenate, sodium arsenite and potassium dichromate salts, respectively to achieve different concentrations ranging from 10 to 100 mg/L. The fungal isolates were inoculated on metalloids enriched media plates and radial growth was observed on 3rd, 7th, 14th, 21th and 28th days. The radial growth (cm) of tested fungi was found to decrease with increase in the concentration of these metalloids. All fungal isolates showed better growth in different concentrations of trivalent and pentavalent forms of arsenic as compared to hexavalent form of chromium, which showed substantiate tolerance of tested fungal isolates towards arsenic. Highest radial growth was recorded on day 28th in sterile isolate (FNBR – 13). All test fungi also exhibited variability in the morphological changes (colour of colony, appearance of hyphal growth, changes in sporulation patterns, etc.) in their colonies upon exposure to these metalloids. These phenotypic changes were found specific to trivalent and pentavalent form of arsenic only as compared to hexavalent form of chromium. It was concluded that these fungal isolates can be used for the biodetection of arsenic contamination of soils. Future needs of testing these fungal isolates with other metals were also identified.

Key words: Fungi, Arsenic, Chromium, Pollution, Soil

SVII/P-18

Diversity of Arbuscular Mycorrhizal (AM) Fungi in Degraded Mangrove Forests of Western Coast of India

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Mangrove forests play an important role in environmental and ecological aspects. They are often the first line of defence, helping to secure the coasts against erosion and storms and serve as a link between terrestrial and marine ecosystem. Mangrove trees act as sinks which concentrate pollutants such as sewage, toxic minerals, pesticide, herbicides, etc. These forests are rich in primary productivity and harbour a diverse species of terrestrial and aquatic organisms which help in increasing the nutrient content of the soil. AM fungi in association with plants helps in increasing plant access to immobile phosphorus by solubilizing it, and hence increasing plant growth rate. Fungal hyphae network helps in the absorption of many micronutrients. AM fungi have a great tolerance to contaminated soils which could in turn help in the removal of toxic materials from entering into food chain. The diversity of AM fungi is well reported from mangroves especially from Sunderbans of eastern coast that depends on tidal waves, inundation and other environmental factors. The species composition and diversity of AM Fungi communities has the potential to determine plant population and plant community structure. Functionally, AM fungi are implicated in plant tolerance to various types of physical and chemical stresses in soil, including soil- water salinity and helps in their rehabilitation. Presently, mangrove forests are one of the most threatened habitats in the world due to environmental pollution (industrial and domestic) and AM fungi could be helpful in their eco restoration.

The aim of our work was to study the diversity and status of AM fungi in different polluted sites of mangrove forests around the western coast of India. Samples of rhizosphere soil and rootlets of mangrove trees were collected from different locations in Mumbai, Navi Mumbai and Raigad districts of Maharashtra. The soil was analyzed for pH, EC and macronutrients (N, P and K) and AM spore diversity. The rootlets of trees were stained in trypan blue to study the infection percentage of AM fungi. The study revealed that the spore diversity and infection of AM fungi was closely related to soil organic carbon and salinity level. Sites affected with industrial pollution had least number of AM spores. The association of AM fungi with mangrove trees could be exploited for the improved growth and productivity of mangrove forests.

Key words: Mangrove forest, AM fungi, Spore diversity, AM infection, Salinity level

SVII/P-19

Role of Agrochemicals and Keratinophilic Fungi in Environmental Pollution

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Medical mycology has a direct relationship with environment because the great majority of fungi causing mycoses are present in environment and leading a saprophytic existence there. The present study is aimed to see the effect of 2 agrochemicals i.e. Dithane M-45 and Topsin M-70 on mycelial growth of selected keratinophilic fungi i.e. *Chrysosporium keratinophyllum, C. tropicum* and *Geotrichum candidum*. Agrochemicals were used in 100 ppm, 200 ppm, 400 ppm and 600 ppm concentrations among which 200 ppm was most effective and showed maximum inhibitory effect on mycelial growth of keratinophers. Dithane M- 45 caused maximum inhibition at lower as well as higher concentrations. At 200 ppm conc. *C. tropicum* showed maximum inhibition (78.07%) followed by *G. candidum* (77.28%) and *C. keratinophyllum* (73.41%) whereas Topsin M – 70 at 200 ppm conc. caused maximum inhibition of 69.49% in *G. candidum*, 64.57% in *C. tropicum* and 59.49% in *C. keratinophyllum*.

The continuous use of these chemicals may hinder the colonization of organic wastes by microbes in soil resulting in accumulation of keratinous substrates which in turn may form a reservoir from which infection of man and animals could result.

Key words: Agrochemicals, Keratinophilic fungi, Mycelial growth

SVII/P-20

Effect of Cyanobacterial Culture along with Low Temperature on Seed Germination and Growth of Crop Plants

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Seeds are a vital component of the world's diet. Present work is set out to provide understanding of the factors affecting seed germination. The crops under study are staple and therefore cultivation is in heavy demand to meet the needs. There are many barriers to the cultivation of those crops by traditional means where crops can be totally destroyed by unexpected changes in environmental/weather conditions or pest infections etc. Also these crops are grown in defined agricultural areas. The innovation in this study is that along with vernalization, cyanobacteria which are known to be strong nitrogen fixer have been used in the germination process as a medium. Practical applications suggested after this study that if farmers soak seeds in harvested cyanobacteria bloom scum from water bodies and germinate seed with more vigor, less dormancy period and agronomic traits it will benefit the crop. If this is combined with chilling temperature a further enhancement can be expected for rice. Cyanobacteria can be directly added to the nursery beds used to produce seedlings for transplantation. The results of this study suggest the low temperature treatment may be key to shortening the plant life cycle of the three staple crops. This result can be attributed to vernalization which is a well defined process in plant physiology.

Key words: Vernalization, Cyanobacteria, Germination

SVII/P-21

Building Deteriorating Fungi as Biocontaminant and their Impacts on Human Health

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Building structures provide specialized microclimate and ecological niches in their ecosystems for the settlements growth and proliferation of the fungal organism. Fungal disease present in the building is referred as sick building syndrome (SBS), a term used to describe the consequences of the poor indoor air quality(IAQ) and appear in the form of fatigue, nausea, headache, dizziness, irritability, lack of concentration and memory loss, irritated eyes, nose and throat mucosa, skin reddening, asthma like symptoms, breathlessness and cough attack (Raw, 1989). Microbial volatile organic compounds reportedly can diffuse through building construction and useful in locating concealed mould growth. Mycotoxins produced by the fungi have multiple toxic effect viz. Carcinogenic, immunotoxic, mutagenic, neurotoxic, and teratogenic. In the present study *Aspergillus* was the most common species, found in both indoor air as well as building material and caused serious manifestation called "Aspergillosis" and production of the fungal balls referred as "Aspergilloma". During present investigation various fungi present in indoor environment especially from humid locations were identified viz. *Alternaria* 80%, *Aspergillus* 75%, *Geotrichum* 42%, *Mucor* 20%, *Penicillium* 62%, *Trichoderma* 40% and *Rhizopus* 13%. In this survey *Alternaria* was the most common inhabitant of building walls and indoor environment followed by *Aspergillus, Penicillium, Rhizopus* and *Trichoderma* whereas *Geotrichum* and *Mucor* occurred only in the indoor air not on the walls. Rooms which are most often affected by mould contamination are bathrooms, kitchens, basements balconies, ceilings, tiles as well as the exterior walls and floors covered by various types of materials. Fungi are responsible for 80% of total building material degradation. Fungi attack almost all building materials such as wallpapers, gypsum wall, boards, emulsion paints and wood material etc. Hence in order to evaluate the human health risk, it is not only important to take into account the concentration of different building fungi that are in contact with the population but also to identify fungal spore.

Key words: Fungi, Building deterioration, Biocontaminant, Indoor pollutants health

SVII/P-22

Studies of Va-Mycorrhiza Associated with Wasteland Weeds of Durg District (C.G.)

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The use of fungi for the improvement of plant growth is increasingly being implemented in agriculture and several fungi have been commercialized for this purpose. VAM offer a great promise in the sustenance of vegetation and crop improvements, however, *in vitro* production of VAM fungi is not successful yet. Weeds although is a major problem, may be used as tool for mass multiplication and commercialization of VAM propagules. A study of common wasteland weeds of Durg (C.G.) for indigenous VAM fungi resulted in 12 different VAM spore types, which were purified and maintained in pot for inoculum production. On basis of % root colonization, spore count and host specificity *Blumea lacera* was selected for mass inoculum production of VAM fungi for commercialization.

Key words: VAM, Weeds, Mass production, Spore count, % root colonization

SVII/P-23

Significance of Arsenic Hypertolerant Bacteria *Staphylococcus* sp. Strain *NBRIEAG-6*, as a Bioinoculants for Concurrent Plant Growth Promotion and Arsenic Translocation by *Brassica juncea* (L.) Czern.

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Arsenic, which is derived from both natural geothermal and anthropogenic sources, is widely distributed in the environment. Due to its toxicity to humans, arsenic causes serious health problems in many parts of the world, and removal of this metalloid has become essential for keeping drinking water safe and preserving aquatic and soil environment. Recent recognition of the need to develop low cost environment friendly technologies for soil and water treatment has stimulated interest in studies on the bioremediation. Bacteria capable of removing arsenic from their surroundings could thus be ideal candidates for bioremediation, and could therefore be used as an alternative or to supplement existing physico-chemical methods of arsenic removal. In this study, arsenic tolerant bacteria *Staphylococcus* sp. strain *NBRIEAG-6* was characterized based on the 16S rDNA homology and phylogenetic analysis. The role of this bacterial strain determined in facilitating arsenic translocation in the [*Brassica juncea* (L.) Czern.], to elucidate the potential of arsenic phytoremediation in combination with arsenic-tolerant bacterial strain *NBRIEAG-6*. The data revealed that the plants exposed to different concentration of sodium arsenate (5mg L^{-1}, 10 mg L^{-1}, 15mg L^{-1}) in soil bioaugmented with *Staphylococcus* sp. strain *NBRIEAG-6* have accumulated 4.86 µg g^{-1}dw arsenic in shoot and 40.78 µg g^{-1}dw arsenic in root at 5 mg kg^{-1} arsenate concentration and 12.06 µg g^{-1}dw arsenic in shoot and 59.97% µg g^{-1}dw arsenic in root at 10 mg kg^{-1} arsenate concentration vis-à-vis 1.90 µg g^{-1}dw in shoot and 31.36 µg g^{-1}dw in root at 15mg kg^{-1} of arsenate concentration. This strain has also exhibited the capability of producing IAA (41.07% µg mg^{-1}), siderophores, ACC (5.10% µM αKB mg^{-1} h^{-1}) and solubilizing inorganic phosphate (101.64% µg ml^{-1}) in specific culture media. The pot culture experiments clearly demonstrated the beneficial effects of *Staphylococcus sp.* strain *NBRIEAG-6* with significant increase ($p < 0.05$) in the plant growth attributes in untreated control soil. Furthermore, the protective effect of the *Staphylococcus sp.* strain *NBRIEAG-6* against arsenic phytotoxicity was evident in plants grown in soil treated with sodium arsenate. Thus, it is suggested that the *Staphylococcus sp.* strain *NBRIEAG-6* owing to its intrinsic abilities of plant growth promotion, and attenuation of arsenic by phytostabilization, could be used for bacterial phytostabilization of this toxic metalloid from contaminated sites.

Key words: Arsenic, Bacteria, Bioremediation, Phytostabilization

SVII/P-24

Trichoderma: A Potent Biocontrol Agent Against Parasitic Fungi

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Trichoderma, being a saprophyte adapted to thrive in diverse situations, produces a wide array of enzymes. By selecting strains that produce a particular kind of enzyme, and culturing these in suspension, industrial quantities of enzyme can be produced. *T. reesei* is used to produce cellulase and hemicellulase. *T. longibratum* is used to produce xylanase. *T. harzianum* is used to produce chitinase. Several strains of *Trichoderma* have been developed as biocontrol agents against fungal diseases of plants. The various mechanisms include antibiosis, parasitism, inducing host-plant resistance, and competition. Most biocontrol agents are from the species *T. harzianum*, *T. viride* and *T. hamatum*. The biocontrol agent generally grows in its natural habitat on the root surface, and so affects root disease in particular, but can also be effective against foliar diseases. *Trichoderma* species are frequently isolated from forest or agricultural soils at all latitudes. G. E. Harman**,** Cornell University, Geneva, studied that Most *Trichoderma* strains have no sexual stage but instead produce only asexual spores. However, for a few strains the sexual stage is known, but not among strains that have usually been considered for

biocontrol purposes. The sexual stage, when found, is within the Ascomycetes in the genus *Hypocrea*. Traditional taxonomy was based upon differences in morphology, primarily of the asexual sporulation apparatus, but more molecular approaches are now being used. Consequently, the taxa recently have gone from nine to at least thirty-three species. The fungus secrets cellulase and chitinase enzymes which reacts with cell wall of the disease causative pathogenic fungi or bacteria and dissolve the same. *Trichoderma* utilize the protoplasm as a source of food and multiply its spores. By this method the spores of the pathogenic fungi are destroyed. It destroys the fungal pathogens by secreting toxic substances such as Glyotoxin, Viridin and Trichodermin. *Trichoderma* possess innate resistance to most agricultural chemicals, including fungicides, although individual strains differ in their resistance. *Trichoderma viride and Trichoderma harzianum* are the potential antagonistic fungus which prevents the crops from diseases viz. Root rots, Wilts, brown rot, damping off, Charcoal rot and other soil born diseases in crops.

Key words: Bioicontrol, *Trichoderma*, Antagonism, Mycoparasitism, Biofungicide

SVII/P-25

Role of Immobilized Cyanobacteria in Ameliorating Lead Toxicity

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Cyanobacteria are not only useful as "biofertilizers" but are also capable of abating various kinds of pollutants in soil and water. Nowadays, microbial mats that were dominated by the cyanobacteria were constructed for specific bioremediation applications. With this aim the metal uptake studies of Lead in *Scytonema* revealed that heavy metal Pb was taken up in significant quantity. The percentage of uptake of Lead by free cells was 70%, but in case of immobilized cells uptake was 91%. The uptake of Lead was higher in immobilized condition in comparison to free cells, due to encapsulation in calcium alginate, which has abundant metal binding hydroxyl groups. These hydroxyl groups bind the metal ions easily and prevent them from entering the cells in full concentration**.** This study indicates that even under natural conditions in rice fields these cyanobacteria are found as a sheath embedded in mucilage forming a immobilized layer and therefore could be playing a very important role in protecting the cyanobacteria from the toxic effects of heavy metals and maintaining the nitrogen economy of the fields in spite of the presence of heavy metals.

Key words: Cyanobacteria, Immobilization, Lead, Amelioration

SVII/P-26

Response of *Acacia nilotica* and *Azadirachta indica* towards Dual Inoculation of *Rhizobium* and VAM fungi

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The growth performance by two forest tree species viz., *Acacia nilotica* and *Azadirachta indica* were evaluated under net house conditions. Seedlings were raised in sterilized soil inoculated with Rhizobium and VAM fungi separately. The growth performance, biochemical effectiveness of these symbionts towards protein and sugar content has been evaluated during the pot experiment. Under the experimental conditions, the increase in growth parameters was higher in plants treated with both inoculants as compared to single. The effective tree inoculation of these symbiotic organisms at nursery stage of *Acacia nilotica* and *Azadirachta indica* spells its necessity for better plantation results.

Key words: *Rhizobium,* VAM, *Acacia,* Phosphorus, Symbiosis

SVII/P-27

Role of Marine Bacteria in Anticancer Property

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Marine bacteria were isolated from seawater, sediment, marine invertebrates and seaweeds collected from different coastal areas of the Andhra Pradesh. The anticancer activities were investigated by using the MTT [3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide] assay and Tryphan blue dye exclusion assay. Marine bacteria showed activity against the MCF-7 (breast cancer) cells, HT-29 (colon cancer) cells and HeLa (cervical cancer) cells in different concentrations i.e. 10 µm to 50 µm concentrations. Cells were cultured in DMEM (Dulbecco's Modified Eagle Medium) medium. Cytotoxicity was detected by IC50 value and also percentage of inhibition of cells.

Key words: Marine bacteria, Anticancer activity, MTT, Tryphan blue, Breast cancer cells, Colon cancer cells

Session SVIII

Waste/Water Management

SVIII/L-1

Ecotechnologies for Sustainable Urban Water Management: An Investigation into Plants and Soil Media for Optimising Nutrient Uptake from Wastewater in Intermittently Loaded Experimental Mesocosms

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Municipal wastewater and urban storm water are potential pollution sources to downstream waterways and may seriously impact aquatic ecosystem health in rivers, estuaries and marine bays. In subtropical Australia we have been monitoring the effectiveness of constructed wetlands for the treatment of wastewater in particular the removal of nutrients. Our research has focused on the suitability of media and plant species to ensure long term sustainability and effective performance in nutrient removal by bioretention systems. Bioretention systems are intermittently inundated 'subsurface flow wetlands' designed to drain within a few days, they support herbaceous plant types, shrubs and trees that can tolerate waterlogged media and drought. These ecotechnologies are being incorporated into the urban landscape to treat storm water runoff.

Over the past 6 years we have investigated the performance efficiency of six different media types including amendments for enhanced phosphorus adsorption, and eight different plant species. Total Phosphorus removal was highest (94-99%) in sand media amended with Water Treatment Residuals, followed by sandy loam (92%), then sand amended with Red Mud or Krasnozems (86-89%) and lowest in sand-gravel 44%. Total Nitrogen removal was highest in the sandy loam (79%) but relatively poor in all the sandy media types (around 50%).

Of the herbaceous plants the grass *Pennisetum alopecuroides* and the sedge *Carex appressa* had the highest growth rates and biomass yield. After 2 years mean shoot biomass was similar for both *Pennisetum* and *Carex* around 830g; whilst mean rhizome/root biomass was 302g and 385g respectively. Root volume was similar in both species around 2000mL. Plant growth was similar for all media. Cropping shoots enhanced shoot growth in *Pennisetum* and *Carex.* Over 3 years cumulative shoot biomass for *Pennisetum* following 5 harvests for a single plant yielded 2400g. After 2 years mean shoot biomass in the shrubs was around 300g for *Callistemon pachyphyllus* and 800g for *Melaleuca quinquenervia;* whilst root biomass was 150g and 500g respectively.

In terms of nutrient removal, plant uptake measured over 2 years accounted 12-18gP/m2/y and 51-64gN/m2/y. These high removal rates are attributed to luxury uptake from the effluent loadings and shoot harvesting in *Pennisetum* and *Carex.*

Key words: Bioretention, Nutrient removal, Plant uptake, Phosphorus sorption

SVIII/O-1

Optimal Nutrient Management through Algal and Macrophyte Interplay in an Urban Lake in Bangalore

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Lakes play a crucial role in maintaining the ecological integrity in an urban environment. The algae and macrophytes present in lakes purify water substantially and regulate the nutrient levels. However, increasing urban population and consequent pressure on environment have tremendous detrimental effects on urban ecology including urban lakes. Continuous influx of untreated sewage in the urban lakes carry enormous amount of pollutants, leading to profused growth of invasive macrophytes such as water hyacinth. They are consequently taken over by alligator weed (*Alternanthera*) indicating higher nutrient concentrations. Water hyacinth hinder the aerobic functioning of lakes by restricting sunlight penetration and affecting algal photosynthesis.

This communication evaluates the influence of the algae and macrophytes in the regulating the nutrient status in Varthur lake, Bangalore. The algal community, macrophyte growth and extent with reference to physico-chemical parameters of the lake were monitored from July, 2008-10 in different seasons at selected locations. The analysis of seasonal data revealed that during summer extensive growth of macrophytes hampers the normal treatment ability of the lake due to the blockage of air-water interface influencing oxygen diffusivity. However, during monsoon in the absence of macrophytes, lake functions as aerobic lagoon. The abundant algal growth brings down the nutrient levels favoring higher growth of algal community characterized by small cells (<10μm). Euglenophyta (>30μ) were concentrated mostly at stagnant zones. Chlorophyll-a concentrations are among the highest (3.73–13.55 μg/l) reported for Varthur lake which is an outcome of high proportions of Chlorophyta (*Chlorella* sp. 80%) abundant throughout the year and to some extent Euglenophyta due to eutrophied conditions. Out of 32.7 tN entering everyday 1.17 t/day is transformed into algal biomass and 0.15 t/day is absorbed by macrophytes. The nutrient content in the algae showed higher proportion of N (5.2-7.14 g/100 g dry wt.) compared to the macrophytes [1.23 (*Cyperus* sp.) – 4.11 (*Lemna* sp.) g/100g dry wt.], indicating higher nutrient uptake and accumulation. The lake system behaves as an aerobic-anaerobic lagoon in pre monsoon and anaerobic–aerobic system in post monsoon. Significant seasonal changes persisted in water quality due to change in redox conditions and dissolved oxygen levels at various macrophyte's locations depending on nutrient levels.

Key words: Wastewater, Algae, Macrophytes, Nutrients, Pollution

SVIII/O-2

Water Management Systems using Fuzzy Logic

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Water quality management is an important issue of relevance in the context of present times. Water quality indices are computed for classification of water wherein the integration of parametric information on water quality data and the expert's knowledgebase on their importance & weights are considered. Considerable uncertainties are involved in the process of defining water quality for specific usage. In the context of Fuzzy logic, there is a probabilistic theory in finding the quality of water source. This paper gives the information of data quality and various Fuzzy descriptions in the Water quality management. Water quality indices are computed for classification of water wherein the integration of parametric information on water quality data and the expert's knowledgebase on their importance & weights are considered. Considerable uncertainties are involved in the process of defining water quality for specific usage. The paper presents modeling of cognitive uncertainty in perception of experts or consumers and statistical uncertainty in the field data while dealing with these systems with recourse to fuzzy logic Case study 1 presents fuzzy description of water quality in river Ganga for bathing purpose following partial implementation of pollution control strategies while Case study 2 arrives at per capita water consumption of the consumers of the study area in Coimbatore, India for their level of satisfaction.

Key words: Water quality, Fuzzy set theory, Water consumption, Linguistic terms, Fuzzy number, Degree of match, Degree of certainty

SVIII/O-3

Exploitation of Waste Materials for the Removal of Tartrazine, A Yellow Menace from Industrial Effluents

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Natural environment is a fabulous portrayal of a complete ecological unit but this wilderness is in the verge of annihilation due to massive human intervention. Water is indispensable to all forms of life but recently it has become the most poorly managed resource of the world. The most active member causative of the deleterious upshot of water quality is the dying agent which is used in many industries. Among dyes, azo dyes due to their stability and the property of giving vivid colours make them one of the most important members of dye family. Tartrazine, considered as yellow menace, has been banned in many countries. This appears to cause the most allergic and intolerance reactions of all the azo dyes. It is a coal-tar derivative and widely being used in cosmetics, foodstuffs, medicines and textile. In the present work the ability to remove Tartrazine from aqueous solutions through adsorption has been studied using waste material, water hyacinth, a prolific colonizer and the result has been compared with its adsorption on hen feathers, a by-product of commercial poultry processing plant. Adsorption is an embracing term for the science related to the refinement of water. Due to the high degree of purification achieved this process is mainly used at the end of treatment sequence. Here the effect of different parameters like pH, concentration of the dye, temperature and adsorbent dosage has been studied. Results were evaluated by the Freundlich and Langmuir equation at different temperatures and determined the characteristic parameter for each adsorption isotherm. The Langmuir parameters were used to analyze Gibb's Free energy (ΔG^o), change in enthalpy (ΔH^o) and change in entropy (ΔS^o). For the proper interpretation of experimental data kinetic measurements of adsorption of the dye at different temperatures were carried out. By rate expression and treatment of data it was established that the adsorption of Tartrazine over water hyacinth and hen feathers follows a first order kinetics. Mass transfer model was used to explain the transport mechanism involved at solid-liquid interface. Thus aim of this work is to increase the usage of waste materials which otherwise cause disposal problems. This effort might be more productive to see this approach as a symbol of a new era of conservation and efficiency, which may allow all of us to live more responsibly and more sustainably, without making sacrifices so severe.

Key words: Adsorption, Mass transfer, Dyes, Thermodynamics, Adsorption isotherm

SVIII/O-4

Nitrogen and Phosphorus Fluxes to Ganga River at Varanasi: Role of Atmospheric Deposition and Modifying Influence of Terrestrial Catchment

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The solute chemistry of a river depends on a number of processes occurring within its catchment. Some chemical constituents are imported into the river system through weathering and surface run-off. A number of other elements and ions are added into the system through surface discharge and atmospheric deposition. This study was designed to investigate (i) atmospheric deposition of Nitrogen (N) and Phosphorous (P) at eight sites selected along a 30 Km long tract of Ganga river at Varanasi, (ii) the synchrony in atmospheric deposition of these nutrients ions with their concentrations in mid-stream river water and, (iii) the modifying influence of five woody perennials (*Bougainvillea spectabilis, Cassia fistula, Ficus benghalensis, Ficus religiosa* and M*angifera indica*), growing in the catchment, on N and P loading in the river.
The results showed significance between site differences in atmospheric deposition of NO_3-N (6. 76 - 27.50 Kg ha^{-1} yr^{-1}, NH_4-N (2.38 – 12.06 Kg ha^{-1} yr^{-1}) and PO_4-P (0.32 – 2.17 Kg ha^{-1} yr^{-1}) with consistently rising inputs downstream. Nutrient

concentrations in mid-stream water showed significant correlation and seasonal synchrony with their inputs through atmospheric deposition. Furthermore, all the five species of woody perennials considered in this study significantly reduced the nutrient concentrations in run-off (19.50-38.00 5% PO_4; 5.70-27.60 % NO_3; 2.66-13.50 % NH_4), although some species contributed to through fall enrichment. With few exceptions, *B. spectabilis* showed superiority over the other species with respect to nutrient reduction in run-off. Results from this study demonstrate that the external flux of nutrients from atmospheric deposition may constitute a significant portion of the total load and should be considered for the total nutrient budget of the river for successful restoration. Since water resource managers reduce external nutrient loading by minimizing surface-borne inputs only, the study has relevance for successful implementation of Integrated River Basin Management (IRBM) plans.

Key words: Atmospheric deposition, Catchment, Nutrients, Woody perennials

SVIII/O-5

The Policies of Energy Conservation and Solid Waste Management

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Energy conservation is the reduction of quantity of energy used, it supports the eco friendly lifestyle by providing energy, which saves money and at the same time saves the earth. When the amount of energy is decreases, its automatically reduces increasing global warming. Solar power uses the sun's energy and light to provide heat, light, and electricity for homes. It is the primary source of all energy forms on the earth. But now number of techno powers which have been developed to make full use of solar energy such as wind energy, geothermal energy, wave energy, biomass energy etc.

Biomass is the plant and animal waste which is used as the energy. Biomass energy like manure from livestock, plant waste etc can be used to generate electricity, fuel, light, and heat. We get biomass energy directly from plants and indirectly from the animal waste.

Environmental and political factors are driving up the cost of traditional solid waste disposal methods. Use of new refuse disposal technology which partially offsets disposal costs through the sale of energy and recovered materials. After reviewing municipal solid waste problems and the new disposal technology, huge amount of energy can be conserved this is eco friendly and economic.

Key words: Energy conservation, Biomass, Solid waste, Global warming

SVIII/O-6

Potential Use of Constructed Wetland for Waste Water Treatment and Plantation in Catchment for Rehabilitation of Ganga River Ecosystem

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The Ganga is the life-line of million people of our country and a naturally flowing fresh and clean river freely and permanently meets various water requirement of inhabitants on its bank, recharges the ground water all along its flow, improves the fertility of agriculture land through its silt and provides the habitat for hundreds of diverge life forms. Despite the traditional claim about the water of Ganga to have bactericidal, health promoting, non-putrefying and purifying properties, the river is grossly polluted and the level has reached an alarming proportions. The accidental or deliberate release of unwanted chemical, biological and physical materials and/or energy into the surrounding environment can disrupt normal processes occurring in healthy ecosystems. Government of India have taken various time bound programme to reduce pollution load in Ganga and its tributaries however, after spending a huge amount of money, infrastructure and long time desired results could not be obtained due to unplanned implementation of treatment plants in select cities, lack of scientific/technological basis for data collection, preventive measures etc. Now a days there is a pressing need to develop a low-cost technically affordable solution in which plant based management deserves special mention. Plantation and construction of wetland may act as biofilter and can remove nutrients and other pollutants such as heavy metals from the river water. Our aim is to rehabilitate the river ecosystem, using a green, negative carbon technology to check the release of untreated sewage directly into the river and treat at their source. Pollution loaded plants could be harvested from the wetland from time to time and could be digested in a biocomposter for production of biogas and organic manure, thus facilitating the green economy. Bio-compost is a 100 % natural and organic fertilizer thereby facilitate better establishment and growth of plants. Further, there is need to develop a vegetation cover along the back of river Ganga consisting of pollution resistant and abator plants having commercial and economic value for environmental management of pollution. A massive plantation drive in the eco-sensitive zones of the river and its catchments area will help to check siltation in the river and maintain water flow, which will be self putrifying. Various plant product will also generate employment in small scale industrial sector of handicrafts and handlooms, pulp and paper industry as well as soil and water conservation programs. In addition, important medicinal and floricultural plants may also generate economic returns to the people involved in this work. Plants also play an important role in the global carbon cycle, and as such, wetland restoration can help increase carbon sequestration and mitigate greenhouse gas emissions. People involved in the program will be eligible to earn marketable assets, generically called carbon credits, which represent the reduction in green house gas emissions, biogas production and carbon sequestration by plantation. Since the new era of sewage treatment involves development of wetland and river front plantation to help in

restoration of Ganga river quality, involvement of local inhabitants are gravely required. To mobilize and assure their participation, the responsibility will be given to various NGOs industrial associations, voluntary organizations, spiritual organizations, educational institutions, international organizations, professionals and individuals, and people concerned about the Ganga river. However, this all needs a concentrated effort in massive way to protect river Ganga for ecological sustainability of our invaluable life support system.

Key words: Ganga, Green house gases, NGOs, Biocomoposter, Constructed wetland

SVIII/O-7

Ecofriendly Prostheses to Alleviate Environmental Pollution

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Today's environment has Polymers and Plastics as the necessary evil they have become indispensable in all walks of our life, from soap case to space crafts; because of their properties of moldability, strength, durability and corrosion resistant. As they are petroleum based and non biodegradable, their disposal to environment, after the intended use, leads to environmental pollution causing scaring of landscape, unhealthy foul odour. With the advancement in scientific knowledge, and biotechnological skill, scientists are able to design novel biodegradable industrial materials from renewable agricultural feed stocks. Prosthetic devices or prostheses are external prosthetic appliances used to replace the function of a missing body part. In the elderly population, amputation (loss) of the lower extremity most often results from complications of disease processes, such as diabetes, peripheral vascular disease, thromboembolism and vasculitis. The second most common cause of lower limb amputation is trauma to the limb, which is frequently seen in a younger population. For amputees, devices are being designed so that they can provide optimum gait control at usual speed at an affordable price. During the last two decades, polymeric materials such as, thermoplastic polymers, PET, PVC, etc. were extensively used for prosthetic applications. But unfortunately, these polymers were non-degradable and it was very difficult to dispose them off. These materials create environmental problems. Recently, some degradable polymers like PCL, PLA, and poly vinyl alcohol have been extensively used for prosthetic application. But these materials are costly and not easily commercially available. Hence, there is a need to develop eco-friendly plant-based degradable polymers to meet the requirements.

Polyurethanes (PU) derived from polyols like propane-diol, butane-1, 4-diol and polyethylene glycol, etc. have been used but these materials are also not degradable. A degradable PU derived from castor oil is being proposed for use as prosthetic applications. The polyurethanes have been prepared by condensing castor oil with different isocyanates like toluene diisocyanate, diphenylmethane diisocyanate, hexamethylene diisocyanate and isophorone diisocyanate, changing the NCO/OH ratio. To enhance the tensile and other dynamic and mechanical properties along with processability, PU-nanocomposites are prepared using organoclay for better prosthetic application.

Key words: Polymer, Amputation, Prosthesis, Polyurethane, Degradable

SVIII/O-8

Biosynthesis and Characterization of (3HB-*co*-3HV) Co-Polymer from a N_2-fixing Cyanobacterium *Nostoc muscorum* Agradh

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Polyhydroxyalkanoates (PHAs) have attracted considerable interest in recent years as an eco-friendly "green" thermoplastic to overcome the problem of waste plastics, a major hurdle in solid waste management strategy. Amongst 150 different types of PHAs identified so far, the homopolymer of hydroxybutyrate, i.e. poly 3-hydroxybutyrate (PHB) is widespread and best characterized. PHB has, however, limited applications due to its high brittleness, poor processability, low mechanical strength, high melting temperature and slow degradation. Poly (3-hydroxybutyrate-*co*-3-hydroxyvalerate) or P(3HB-*co*-3HV) co-polymer on the other hand, is less stiff and tougher with better tensile strength and greater flexibility.

In this study, production of P(3HB-*co*-3HV) co-polymer by a filamentous N_2-fixing cyanobacterium, *Nostoc muscorum* Agardh was investigated. Under photoautotrophic growth condition, the test cyanobacterium was found to accumulate the homopolymer of PHB up to 7.6% of dry cell weight (DCW) at the stationary phase of growth, however it showed the capability of synthesizing P(3HB-*co*-3HV) co-polymer under propionate/valerate-supplemented condition. Confirmatory study of the extracted polymer was done with ^{1}H-NMR spectroscopy, Fourier-Transform Infrared spectroscopy (FT-IR) and GC-MS analysis. Effects of various cultural and nutritional variables on PHAs accumulation were studied. P(3HB-*co*-3HV) accumulation was found to be maximum at pH 8.5 and a temperature range of 24-32ºC. Addition of exogenous carbons (acetate, fructose and glucose) with propionate/valerate were found stimulatory for the co-polymer accumulation. Most significant enhancement in co-polymer accumulation up to 55% (DCW) was observed when cultures were supplemented with both 0.4% valerate and 0.4% acetate followed by 42% (DCW) under 0.4% propionate and 0.4% acetate supplementation. Co-polymer accumulation further boosted up to 57% (DCW), under phosphorus starvation. The material properties of the

polymers were studied by mechanical tests, surface analysis, differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). The co-polymer extracted from *Nostoc muscorum* exhibited comparable material properties with the commercial polymer, thus advocating its potential applications in various fields. Thus, *Nostoc muscorum* Agradh can be considered as a suitable feedstock for P(3HB-*co*-3HV) co-polymer production for commodity as well as pharmaceutical applications.

Key words: Differential scanning calorimetry, Mixotrophy, *Nostoc muscorum,* P(3HB-*co*-3HV) co-polymer, Polyhydroxyalkanoates

SVIII/O-9

Effect of Cellulase Enzyme in Deinking of Photocopier Waste Paper

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The fast depletion of forest resources and its impact on the ecological balance has forced the paper industry to turn to the use of waste papers. However, in the last few years there has been a considerable increase in the fraction of difficult to deink xerographic and laser-printed papers. Traditional chemical deinking involves the use of large quantities of chemicals, which make the deinking method expensive and exceedingly harmful environmentally. The toner particles usually remain as large, flat, rigid particles that separate very poorly from fibres during the fibre/ink separation stages. On the other hand, the use of enzymes in ecofriendly deinking of the recovered paper avoids the alkaline environment, commonly required in traditional deinking, and favors ink particle detachment from the fibres without discharge of pollutants. In this study, we examined the deinking of photocopier waste paper using a commercial cellulase enzyme. We optimized the parameters of deinking experiments for hydrapulping and flotation process followed by washing. Then we compared these parameters with the traditional chemical deinking in terms of ink removal ability of the process, as well as optical and strength properties of deinked paper. The application of enzymatic deinking improved ink removal efficiency by 24.6% and freeness by 21.6% with the reduction in drainage time by 11.5% with respect to those obtained with chemical deinking. The physical properties of paper, namely burst index and tensile index were observed to improve by 15.3% and 2.7%, respectively and brightness and tear index decreased by 2.1% and 21.9%, respectively. Results of deinking efficiency of photocopier paper showed that the enzyme used in present work performed better than the conventional chemicals used for deinking.

Key words: Deinking, Cellulase, Deinking efficiency, ISO brightness, Residual ink

SVIII/O-10

Assessment on Aqueous Safranine Adsorption onto Chemically Modified Rice Husk in Stirred Tank Reactor: Equilibrium and Kinetic Study

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Contamination of water sources by many organic pollutants is a major factor of global environmental pollution for the number of years. Synthetic dyes are one group of the pollutants and the presence of dyes in the aquatic environment has been of great concern because of their potential health hazards associated with the carcinogenic, mutagenic, allergenic and toxic natures. The use of rice husk as a low cost adsorbent for the removal of dye from wastewater has been explored in a pilot scale experiment. In this study, chemically modified rice husk was used to remove safranine from dye solution. The effects of operation variables, such as adsorbent dosage, contact time; dye concentration, initial pH, and agitation on the removal of safranine were investigated using batch adsorption technique in a 3 litre volume stirred tank reactor. Removal efficiency increased with increase of rice husk dosage and pH, but decreased with increasing safranine concentration. Moreover, it was observed that with increasing rate of agitation, safranine removal efficiency was increased. The equilibrium data were analyzed using linearized forms of Langmuir, Freundlich and Tempkin isotherms, and it was observed that the equilibrium data fitted well to the Langmuir model ($R^2 > 0.988$) than other two models [Freundlich model ($R^2 > 0.966$) and Tempkin model ($R^2 > 0.946$)]. Kinetic study was carried out by applying intraparticle diffusion model, liquid-film diffusion model, pseudo first order kinetic model, pseudo second order kinetic model, saturation model, and bangham model to the experimental data and it was observed that adsorption kinetic followed the pseudo-second-order kinetics ($R^2 > 0.999$).The equilibrium time for the removal of safranine by the rice husk was attained within 90 min.

Key words: Adsorption isotherm, Adsorption kinetics, Chemically modified rice husk, Adsorbent, Safranine solution

SVIII/O-11

Drinking Water Quality Management through Correlation Studies among Various Physico-Chemical Parameters

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Ground water is the principal source of drinking water in our country and indispensable source of our life. The problem of ground water quality is acute. The resulting degradation of water quality in water body creates a condition so that water cannot be used for intended beneficial uses including bathing, recreation and as a source of raw water supply. According to Central Pollution Control Board, 90% of the water supplied in India to the town and cities are polluted, out of which only 1.6% gets treated. Water quality management is fundamental for the human welfare. The statistical regression analysis has been found to be a highly

useful tool for correlating different parameters. Correlation analysis measures the closeness of the relationship between chosen independent and dependent variables. If the correlation coefficient is nearer to +1 or –1, it shows the probability of linear relationship between the variables x and y. This way analysis attempts to establish the nature of the relationship between the variables and thereby provides a mechanism for prediction or forecasting.

Moradabad is a B class city of western Uttar Pradesh having urban population more than 38 lacs. Moradabad is situated at the bank of Ram Ganga river and its altitude from the sea level is about 670 feet. It is extended from Himalaya in north to Chambal river in south. It is at 28°20', 29°15' and 78°4', 79°E. Statistical regression analysis of twelve data points of underground drinking water of IM2 hand pumps at Moradabad, India was carried out to study the correlation between various physico-chemical parameters. Twelve water quality parameters of water of all sites were estimated following standard methods and procedures of sampling and estimation. Comparison of estimated values with W.H.O. standards revealed that water of study area is polluted and water quality management is urgently needed. Regression analysis of these data points suggests that conductivity of drinking water is an important parameter and it is significantly correlated with ten parameters out of twelve water quality parameters studied. It may be suggested that drinking water quality can be checked effectively by controlling the conductivity of water. Present study may be treated as one step ahead towards the drinking water quality management.

Key words: Water quality parameters, Regression equations, Correlation, Water quality management

SVIII/O-12

Supplementation of Wood Ash for *Spirulina* Production in Laboratory Conditions

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Spirulina is a multicellular and filamentous blue green alga that has gained considerable popularity as a protein in health food industry and vitamin supplement to aquaculture diets. The helical shape of filaments is characteristic of the genus and is maintained only in a liquid environment or culture medium. The culture of *Spirulina* is practiced in different media, especially inorganic and decomposed organic nutrients. Different types of *Spirulina* have been cultured to evaluate growth and biochemistry under similar controlled conditions. This work was conducted to evaluate the potentiality of wood ash for the biomass production of *Spirulina platensis*. Different concentration gradients i.e 10%-60% with standard medium was examined to grow *Spirulina* at pH 9.7, temperature 35°C±2 and light intensity 3 Klux. The growth was calculated in terms of specific growth rate and dry biomass obtained after the cultivation of 27 days. Successful results were obtained in 20% concentration level, having 20% wood ash supplemented with 80% prescribed medium i.e. CFTRI medium. The decrease in the growth rate in higher concentrations was found due to the presence of some heavy metals in the medium. However, the nutrient deficiency was tried to compensate by the addition of carbon and nitrogen sources. These results indicate the efficiency of wood ash to add the nutrient supply to the culture medium to reduce its valuable cost and make it a cheaper and economic culture for *S. platensis.*

Key words: CFTRI medium, Specific growth rate, *Spirulina*, Wood ash

SVIII/O-13

Morphometric Plasticity of *Alternanthera philoxeroides* in Pond Ecosystems: A Pilot Study

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Phenotypic plasticity is the study of environment-dependent changes of phenotypic expression. It allows species to cope with environmental heterogeneity and it may play a key role in organism adaptation to changing environmental conditions and pollution stresses. Higher aquatic plants species often show tremendous potential for phenotypic variation but limited genetic variation and can form an ideal study system for examining this phenomenon in nature. Alterations in leaf and stem characteristics in response to environmental changes forms an interesting method to study phenotypic or morphometric plasticity.

This study reports the presence of morphometric plasticity of stem and leaf characters of *Alternanthera philoxeroides* [Mart.] Griseb., a native of South America, which has established itself as one of the most potent invasive wetland weed throughout many parts of the world. Stem internodal length between the $3^{rd} – 4^{th}$ nodes and the $4^{th} – 5^{th}$ nodes, and the area of 4^{th} nodal leaf pair of *A. philoxeroides* was studied across 12 pond ecosystems over 3 sampling seasons (monsoon, winter and summer). The study ponds were so selected that they could be grouped into different subsets according to their pollution or other environmental stresses. The 2-way ANOVA results showed that there was a significant difference between these morphometric parameters studied across the selected pond ecosystems. Seasonal difference also showed to have a significant impact across the parameters studied, monsoon being the season wherein luxuriant growth of the plant was observed.

This study indicates that environmental variations and pollution stress across the 12 study ponds had a significant influence on the morphometric parameters studied in *Alternanthera philoxeroides*. The successful adaptation of *A. philoxeroides* across a wide range of wetland and aquatic habitats may be on account of its high potential of phenotypic (morphometric) plasticity. This was a pilot study to investigate the morphometric plasticity of *Alternanthera philoxeroides* in pond ecosystems and further studies, taking a wider scope of parameters, are needed to establish the theory that phenoplasticity might be a factor responsible for the ecological success of this plant across a wide range of

environmental pollution stress.

Key words: *Phenotypic plasticity, Alternanthera philoxeroides,* Morphometric plasticity, Pond ecosystems, *Wetland*

SVIII/O-14

Recycling of Solid Medical Waste: An Effort for Cost Recovery, Waste Management and Environment Protection (An Experience at a Tertiary Care Hospital in India)

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Waste by definition is "to no purpose" once used but the domestic and a part of biomedical can be utilized or recycled to recover the salvage value or to reduce the waste management and treatment cost and for environment protection In India, the average production of hospital waste is 1.5kg./bed/day, out of which 20% is biomedical in nature. On an average, 1.8 million waste is generated per day from approx. 1.2 million beds of about 11000 hospitals in India. Cost benefit measures of hospital waste, especially the biomedical, are not practiced, therefore emphasis is given on cost containment/cost effectiveness. Therefore the domestic waste such as cardboard, paper, container, glass bottles and a part of biomedical waste such as plastic materials (IV bottle, tube syringes, gloves, bags) and rubber materials after disinfection/sterilization can be utilized by selling, recycling to recover some revenue out of it or to bring down the cost of treatment. Recycling of high cost disposable such as catheterization tube and the benefit can be shared to low socio economic patients. The Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS), Lucknow U.P. India, a tertiary care institute (868 bedded), is pioneer in many management techniques in cost containment/effectiveness/saving, also practicing the methods of waste utilization since many years.

The hospital intended to go for a study with an objective to analyze the out come of measures adopted for hospital solid waste recycling in term of revenue generation and waste management and environment protection. A Retrospective study was carried out in the month of April 2010 and data related to selling of solid waste including some of the biomedical waste (after disinfection/sterilization) and recycling of waste, for the last 03-05 years was collected and analyzed. It was observed that the hospital earned Rs.2.80 Million (USD.58464.00) during 18 months (Jan. 2008 to 15 Jun. 2010) from selling the hospital solid waste materials such as disinfected/sterile plastic/latex materials, card board, glass bottles etc. So far as cost containment in medical care is concerned, the hospital sterilized the plastic/rubber consumable of worth of Rs.137.20 million (USD.2.85 million) during last 05 years which predominantly belong to department of CVTS, Radiology, Nephrology, Nuclear Medicine & OTs. In addition to above, other type of non infected/ disinfected hospital solid waste was utilized for land filling, which is not expressed here in monetary terms but very important from environment point of view. The SGPGIMS hospital is in process of utilization of hospital solid waste including biomedical (after disinfection/sterilization) for the last 05 years and the outcome of which is satisfactory. The recycling of solid waste was found cost contained for waste management and also sufficient amount of money can be recovered. Solid waste utilization practices after proper treatment for cost containment for waste management /cost recovery should be adopted by other large hospitals especially tertiary care where the treatment cost is very high and bulk of solid waste is generated. The sound practice will help to protect the environment also.

Key words: Hospital solid waste, Biomedical waste, Cost benefit analysis, Recycling, Waste management

SVIII/O-15

Environmental Management of Agroindustrial Wastes into Biocompost by *Trichoderma viride* and its Quality Monitored by C:N and Bioassay Test

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Mechanization in modern agriculture caused an acute shortage of live stock population which decreased organic manure in the country. Farm yard manure (FYM) is the traditional source of organic matter added to the soil. Compost was formed from Agro-industrial (organic) wastes press mud cake (PMC), fly ash, distillery spent wash and *Eichhornia crassipes* (Aquatic weed) inoculated by *Trichoderma viride* and mixed in treatments viz- PTDE, T_1, T_2, T_3, T_4 and over the control. Variations in temperature, pH and dynamic mineralisation of N.P.K. were observed. Physical, chemical and biological analysis of composts showed higher potentialities in narrowing the C:N, E.C., pH, moisture content. However, organic carbon content and N mineralized were increased significantly. It is observed that *Trichoderma* hastened the decomposition process and improved the quality of compost than other treatment combinations. Immature and mature compost were evaluated by C:N and bioassay test of *Coriandrum sativum* L. cv *Kalmi and Phaseolus aurues* Roxb, cv. K-851 on 32nd days of composting. Data were analyzed statistically (CD at 5%and 1%).

Key words: Bioassay test, *Eichhornia,* Press mud, Spent wash, Sustainable development, *Trichoderma*

SVIII/P-1

Breakthrough Curve Analysis of Aqueous Safranine Adsorption onto Chemically Modified Rice Husk in Fluidised Bed Column Including Error Analysis

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Safranine containing textile effluents are carcinogenic in nature and play mojar role in heavy metal

pollution. Color and toxic compounds present in such effluents not only reduce the light penetration and photosynthetic activity but also affects the biological metabolism of aquatic ecosystem. This study was an attempt to reduce the toxicity of industrial textile effluents containing safranine dye through adsorption onto a suitable low cost, environmental friendly and highly effective bio-sorbent to remove safranine dye from solution. For this a continuous packed bed column experiment was performed by using alkali treated Rice Husk as a bio-sorbent. Experimental data confirmed that the breakthrough curves were dependent on initial dye concentration, pH of the solution, bed height, and column cross sectional area. Mathematical modelling has been done by Thomas, Adams-Bohart, Yoon-Nelson and BDST models and were applied to the experimental data to determine the characteristic parameters of the column useful for process design. It was observed that except Adams-Bohart model, all other models were in agreement with experimental data. Maximum adsorption capacity of 11.1×10^4 mg/g with Thomas model and 1.97×10^4 mg/g with BDST model was observed at aqueous safranine concentration of 100 mg/l with pH 7 at 4.5 ml/min flow rate. Least sum of square (SSE) and $\chi2$ error analysis were performed to find the best fit model with experimental data and it was observed that BDST model and Yoon-Nelson model gives the minimum SSE and $\chi2$ values at different safranine concentration and pH values respectively.

Key words: Chemically modified rice husk, Aqueous safranine, Fluidized bed, Adsorption, Saturation, Breakthrough curve, Breakthrough time

SVIII/P-2

Diversity of Zooplankton in Relation to Abiotic Parameters of the River Ganga at Bijnor (UP)

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Increasing impact of population and industrial effluents has caused a direct bearing on the hydrobiological status of each aquatic system. The holy Ganga has no exception to this generation. The present study has been aimed to assess the abiotic factors and their effects on the biotic component i.e. Zooplankton in the river Ganga at Bijnor. Samples were collected during the period of 2007-2009. Two study sites were selected for the present study. Site I is control point and site II is the point where industrial effluent is being discharge in the river Ganga. The values of abiotic factors at site I were ranged between pH (8.4-12.7), water temp (14-32^{o}C), conductivity (0.117-0.269 µmohs/cm), DO (5.0-12.5 mg/l), chloride (19.88-112.32 mg/l), Free CO_2 (3.96-79.2 ppm), COD (15.6-340 mg/l) and at site II the values ranged between pH (7.9-11.8), water temp (14-32^{o}c), conductivity (0.105-0.832 µmohs/cm), DO (1.4-5.2 mg/l), chloride (25.56-468.6 mg/l), Free Co_2 (2.11-45.32 mg/l), COD (10.0-369.34 mg/l). In the present study a total of 05 groups viz., Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda of zooplankton were reported from the study sites. A total of 196 species of zooplankton were identified at site I while 141 species of zooplankton were recorded at site II. From the above finding it may infer that water quality has direct relationship with the diversity of biotic communities.

Key words: Zooplankton, River, Ganga, Bijnor

SVIII/P-3

Treatment of Anaerobically Digested Distillery Effluent through Contaminated Soil and Further Optimization

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Distilleries are amongst the most highly polluting industries with reference to water and soil pollution. They generate large quantity of waste water with high pollution load and contain a dark brown recalcitrant pigment called melanoidin form due to maillard amino-carbonyl reaction. A lot of work has been done by using many isolates of fungi and bacteria to decolorize distillery effluent which needs proper screening, isolation and characterization of the isolate and to get maximum decolourization. Optimum nutrient condition is also needed that makes this process costly and cumbersome. The soil which is being polluted by distillery waste water from several years was used as inoculum to achieve maximum decolourization of distillery waste water in absence of any nutritional support. Soil samples were collected from the effluent disposal site which has high pH, good nutrient status and resistant microorganisms as compare to the non contaminated soil. Nearly 60% color removal was shown in 10 days when 10% (w/v) soil has 15% (v/v) waste water was used. Optimization of parameters was studied using statistical experimental designs. In the first step, placket-Burman design was used for screening the important parameters and box-Behnken design was used to determine the optimal level of each of the significant parameters. Optimize parameters including 15 days, pH 6, distillery effluent 15% and soil concentration 30%, were obtain for maximum decolourization of 70% was achieved in absence of any media or external nutrient supplement. From the above study it is concluded that the decolourization of effluent can be achieved by using soil as inoculum without addition of chemical amendments.

Key words: Distillery spentwash, Melanoidin, Decolourization, Inoculum

SVIII/P-4

Amelioration of Chromium Polluted Soil using Organic Amendments

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Tanning has been recognized as a source of serious environmental pollution in many developed countries. Tannery waste waters are ranked as high pollutants among all

other industrial waste. The physico-chemical remedial strategies to clean up sites contaminated by Xenobiotics are not cost effective. Therefore, research is focused on biological methods for the degradation and elimination of these pollutants. So, an attempt has been made on the amelioration of chromium polluted soil by using certain organic amendments. The amendments such as FYM, composted coir waste, vermicompost, *Rhizobium* and pressmud were mixed well in the chromium polluted soil. The test plant paddy was grown in the polluted as well as amendments mixed soil. After 120 days, the growth and yield parameters were analysed. All these parameters were higher in the plants grown in amendments mixed soil than in polluted soil. Among them, the plants grown in composted coir pith showed the better growth and yield performance.

Key words: Heavy metals, Chromium, Phytotoxicity, Soil amendments, Morphological parameters

SVIII/P-5

Temperature and pH Resistant Natural Water Coagulant from Seed Extract of *Trigonella foenum-graecum*

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The ability of seed extracts of *Trigonella foenum-graecum* and *Cuminum cyminum* to act as natural coagulant was tested using natural turbid water. Seed extracts were obtained by using distilled water, and NaCl (0.5M and 1.0M) solution. Only 1.0M NaCl extract of *T. foenum-graecum* had coagulant capability and did not depend on pH values. Further it showed that natural coagulant obtained from *T. foenum-graecum* is temperature resistant (upto 100°C) and pH resistant (pH 4-10). Extract of *C. cyminum* does not have coagulation property. The seed extract of *T. foenum-graecum* showed about 80% coagulation properties, where as the best known natural coagulant such as *Moringa oleifera* and chemical coagulant such as Al_2SO_4 showed around 65% and 95% respectively. This study reveals that seed extract of *T. foenum-graecum* can be used as natural water coagulant.

Key words: Natural coagulants, Water purifier, *T. foenum-graecum,* Fenugreek

SVIII/P-6

Effect of Temperature and Organic Loading Rate on Anaerobic Sludge Blanket Reactor (USBR) for Agricultural Waste Treatment

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Anaerobic treatment of agricultural wastes in an up flow anaerobic sludge blanket reactor (UASBR) was carried out with stepwise increase in organic loading rate (OLR) and temperature. The chemical oxygen demand (COD), total organic carbon (TOC), biogas and methane production was measured at hydraulic retention time (HRT) of 10 to 4 d. Start-up strategy of the reactor was monitored for ten weeks. Agricultural waste having 89% (w/w) moisture contents was thermochemically liquidized for 1hr at 175°C then separated into solid (9%) and liquid (91%). Thermophilic condition was achieved by increasing the temperature from 30-55°C and pH was maintained at 7±0.5 throughout experiment. Maximum COD removal efficiency was 93.67% at an OLR of 12.5 kg-COD/m^3.d and 4 d HRT. A correlation (r=0.84) was found between OLR and COD removal efficiency. Maximum TOC removal efficiency was 79.14% (r=-0.94) at an influent TOC concentration of 3.59 g/L. Biogas and hydrogen yield was recorded to a maximum of 1.364 l/g-COD removed.d (r=0.81), 0.912 L/g-COD removed.d (r=0.83) and average hydrogen contents in biogas were found 63%. The reactor fully acclimatized at 55°C and also achieved stability with high removal efficiency and biogas production. An OLR of 12.5 kg-COD/m^3.d at 4 d HRT was found suitable for the treatment of agricultural waste. The treatment process can also be extendable for more than ten weeks without any measurable problem.

Key words: Agricultural waste, Mesophilic and thermophilic UASB reactor, COD, VFA, TOC, Biogas and Hydrogen

SVIII/P-7

Municipal Solid Waste is a Resource: A Case Study of Municipal Solid Waste at Mirzapur, Uttar Pradesh India

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The objective of the study is to assess the quantitative and qualitative properties of the municipal solid waste at the Mirzapur city to suggest the efficient and proper methods for the collection, transportation, processing, disposal and energy recovery of the municipal solid waste. Study shows that the major component of the solid waste is the organic fraction. A large part is the recyclable material. A very small part is inert and has to dispose but it has been seen that whole solid waste is dumped in low lying areas of the city in an unhygienic, unsafe and nonprofessional manner, the objective of which is only to fill the low lying areas so that these areas can be used in future for the several other types of the land uses. There is no proper recycling and energy recovery from waste take place at Mirzapur. The whole infrastructure is inefficient needs many changes and overhauling.

Most of the urban areas in whole world are today facing the scarcity of the land for disposing the municipal solid waste in a socially acceptable, economically feasible and technologically effective manner to reduce the harm on the environment and health of the people while municipal solid waste have most of recyclable as reusable material only small portion are inert or disposable material.

Key words: Municipal solid waste, Weight volume analysis, Dumping, Waste components, Biodegradable waste, Reuse recycle and inert waste

SVIII/P-8

Waste Water Recycling in Agriculture: Growth Performance of Knol-Khol (*Brassica oleraceae* var. *gonglodes*) under Irrigation with Domestic Waste Water

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Increasing emissions of CO_2 and other green house gases in the atmosphere are thought to be determinant contributor to the climate change and decline of annual precipitation. In certain places, climatic extremes such as drought, floods, rainfall distribution and melting of glaciers has increased at faster rate. The entire world community is alarmed by the possible adverse impacts that the global climate change might have on the quality of life of human beings and their livelihood. At the same time, growing populations, increase of irrigated areas and water over consumption resulted in reduction of surface and underground water and shortage of the available water for agricultural use has been recorded worldwide. Therefore, strategies need to be evolved to combat the climate change by utilizing waste water particularly in agriculture. Being rich in both organic and inorganic nutrients and the productivity boost waste water, it provides the opportunity for round the year cultivation of different crops. Keeping this in view an experiment was conducted to study the growth performance of Knol -khol (*Brassica oleraceae* var. *gonglodes*) cv. Purple Viena under irrigation with different concentrations of domestic waste water (grey water) alone and in combination with recommended dose of fertilizers. This field experiment was carried out in 2009 and involved 4 treatments (T_1 –T_4) with three replications in RCBD design. Before put to use, grey water was stabilized for 20-25 days in open containers. The results show that yield contributing factors (plant weight, bulb weight, bulb diameter, bulb volume and yield (q /ha) of the plots was highest in the plots irrigated with 100% grey water compared to the plots irrigated with stream water and recommended dose of fertilizers. Similar trends were also obtained for various quality parameters (viz. dry matter, vitamin C, protein and carbohydrate contents, photosynthetic pigments and the essential mineral elements (Cu, Zn, Fe, Mn) in the leaf and knob. The values of pH, EC, alkalinity, SO_4, NO_3, total N, P and K, Cu, Zn, Mn and Fe, in the grey water were within the permissible range. This study also shows that irrigation with stabilized grey water did not have any adverse effects on the soil chemistry. It is therefore, concluded that recycling of waste water in agriculture offers a great potential and could be promoted in areas facing acute shortage of water.

Key words: Waste water, Knoll-kohl, Yield, Mineral composition

SVIII/P-9

Potential of Water Lettuce for Polishing of Tannery Effluent

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The liquid waste from the tannery or leather manufacturing industries usually causes significant pollution unless a higher degree of treatment is rendered prior to discharge in the water bodies. BOD, COD, nitrogen, phosphorous, chromium etc. are common pollutant found in the tannery effluent. The effect of pollutants is considerable and malodorous. Excessive nutrients like nitrogen, phosphorous promote the process of eutrophication in the water pools imparting negative effect on its usage of water. Due to its use for tanning process, chromium is considered as a serious environmental pollutant of the plant in question. It has serious deleterious effects (metabolic alterations, tissue death, carcinogenic effect) on plant as well as on human beings. Treatment of tannery waste water is stringent. However, after a high degree of treatment, the treated effluent contains pollutants as mentioned earlier exceeding the permissible limit almost in all cases. Various regulatory boards do not allow to dispose such waste water to any water body unless an appropriate polishing treatment is present. Such options would be based on low cost technology considering the economics and technical feasibility. Phytoremediation, alternatively known as 'green clean' is a novel method for the removal of toxic contaminants from the environment using plants. This concept is well-accepted because of its cost-effectiveness and user-friendly approach. At the same time, it is already becoming effective for polishing of waste water particularly for nutrient removal.

In pursuit of exploring such novel technology, a study has been undertaken in the Environmental Engineering Laboratory, Civil Engineering Department, Jadavpur University, Kolkata to investigate the polishing capacity of natural aquatic treatment system using water lettuce (*Pistia stratiotes*). Young plants were collected from a nearby pond and then washed thoroughly with distilled water and acclimatized in laboratory condition exposing them to modified Hoagland solution. Required numbers of plants were taken from this stock culture for conducting batch experiment with tannery effluent, taken in different small plastic containers of 2L capacity. About 30g of plant species were placed in 1L solution. All experimental set up were exposed to natural sunlight and also under an exposure of fluorescent lamp.

Total chromium removal along with COD, NH_3-N and NO_3-N by this plant was observed at 24h interval. The results showed that the plant could effectively remove total chromium, COD, NH_3-N and NO_3-N to the extent of 85.07%, 22.5%, 70.3% and 58.03% respectively after 48 hours.

Reduction in biomass, chlorophyll a, chlorophyll b, total chlorophyll and total protein were also observed in case of plants treated with tannery waste. Phytotoxic effect is visually observed after a detention period of forty-eight hours.

Key words: Tannery effluent, *Pistia sp.*, Total chromium, Chlorophyll, Protein

SVIII/P-10

Qualitative Study of the Role of Religious Activities Responsible for the River Shipra Pollution

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Ujjain is a place famous for the Lord Mahakaleshwar temple, which is one of the twelve renowned Jyotirlingas and holy city of Hindus. It is located on the bank of river Shipra. The past of river Shipra was very good based on the large volume of water flow and its potential in the survival of animal and plant kingdom along with the other rivers. Presently, the condition of Shipra has drastically changed due to pollution load from different industrial, domestic waste discharge and changes in geographical condition. There is regular dumping of solid and liquid material especially organic waste and municipal waste. Besides it is also used to perform various rituals and/or customs.

The present study deals with the study and evaluation of the different factors responsible for Shipra river deterioration due to religious activities near the banks of Shipra River like Ramghat, Triveni ghat, Magalnath ghat etc. The religious activities go on round the year, mainly include mass bathing ceremony on several occasions. Apart from these common activities, in every twelve years Simhastha is being organized for a period of more than a month and crores of people from different parts of the world visit the holy city. The main activity in focus relates mass bathing with the religious ceremony involving lakhs of people. Due to the mass bathing and other religious activities the water quality of river Shipra is deteriorating every day.

During the study emphasis has been given on qualitative assessment of the river quality, factors responsible for its deterioration, and practical remedial measures to improve the quality and flow characteristics of the river. Parameters for the study included: BOD, COD, DO, pH, TDS, hardness, color, odor etc. From the studies, it has been observed that there is a gradual increase in the pollution load parameters due to religious activities. The present methods available for the water treatment have a number of limitations and are not applicable for the river directly. In future, if proper remedial measures are not implemented, then this holy river may become the story of religious books.

Key words: Geogrophical condition, Remedial measures, Water treatment

SVIII/P-11

Polishing of Secondary Treated Wastewater by Ozonation in Tropical Cities

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Present study aimed to the impact of Ozonation at the different concentration of ozone i.e. 5.0, 10.0 and 15 mgL^{-1}at different contact times from 2 to 20 min. The secondary treated wastewater used in this research was collected from the Bhagwanpur sewage treatment Plant, Varanasi, India. Significant relationships were observed between ozone dose and contact time. An experiment also state that 10 mgL^{-1} ozone for 5 minutes exposure was found most suitable dose for highest degradation of COD, TOC, UV_{254}, color, turbidity and total nitrogen parameters of secondary treated wastewater i.e. 30%, 14.3%, 45%, 60%, 40% and 51% respectively. The biodegradability of the wastewater enhanced to more than 50% and inactivation of microbial biomass ranged between 95–98%. Statistical analysis revealed significant increased in the concentration of the Disinfection Byproducts (DBPs). Aldehydes and carboxylic acids formation varied with dosage only when the ozone dose was increased from 5.0 to10 mgL^{-1}. Thus the observations supported the expectation that the process of ozone might enhance the overall treatment efficiency of secondary effluent treatment.

Key words: Secondary treated wastewater, Ozonation, DBPs, Biodegradation, Ozone dose

SVIII/P-12

Impact of Microbial Colonies on Waste Water Treatment

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Although most organisms in biological wastewater treatment plants are microscopic in size, there are some organisms such as bristle worms and insect larvae that are macroscopic in size. Of the microscopic organisms the bacteria (singular: bacterium) are the most important in wastewater treatment plants and can be seen with the light microscope only under highest magnification. Among microbes community bacteria play a key role that may be aerobic, anaerobic or facultative. Aerobic bacteria require oxygen for life support whereas anaerobes can sustain life without oxygen. Facultative bacteria have the capability of living either in the presence or in the absent of oxygen. Bacteria have the primary role of decomposing wastewater compounds, forming settleable solids, and that times are the source of operational problems. Bacteria plays a huge role in bioremediation by removing of heavy metals from the waste water and are cost effective too. In the present study we

isolated six heavy metal resistance bacterial strains from sewage and performed MIC (minimum inhibitory concentration), Antibiotic sensitivity as well as resistivity and co resistance to other heavy metals were also analyzed. Further, the association of bacterial strains with the higher rhizospheric zone of higher plants will be studied and other water physio-chemical parameters to be analyzed for waste water treatment.

Key words: MIC (minimum inhibitory concentration), Sewage, Wastewater, Bacteria, Heavy metals

SVIII/P-13

Impact of Urbanization on Water Resources and its Management

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The present study is an attempt to examine the urbanization impact on water quality and its possible management. The Central part of Indo-Gangetic basin, Lucknow, geographically located at $26^0 30'$ to $27^0 10'$ N latitude and 80^0 34' to 81^0 12' E longitude is selected for the study. Sampling was performed at 20 different locations of municipal water supply in June 2005 and 2010, to cover the entire city including areas connected with the filtration plants and other areas where direct or indirect ground water supply is practiced. Five locations of the Gomti river water was also selected for the present study. These samples were analyzed following the standard methods for various parameters to know the physico-chemical properties, heavy metal and bacteriological properties. The escalated demand has led to the overexploitation of ground as well as surface water in the entire region. The domestic water supply in Lucknow urban area depends on the Gomti River and ground water. The precipitation in the districts is 45 cm. to 94 cm. which is extremely low and often erratic, due to which the availability of water for domestic and irrigational purposes is severely affected. Water quality at source i.e. at Aishbagh water works is quite satisfactory. However the water received at the users end is severely contaminated and potential health risk to the users in many areas. In some locations the microbiological parameter (MPN count/100ml) for fecal coliform concentration was beyond the prescribed limits in supply water. The concentration of all the parameters at all the locations is increasing day by day due to anthropogenic activity, poor management of Municipal Corporation and lack of awareness in peoples. Though the parameters like Ca, Zn, and Fe showed the increasing trends. However, the concentration of arsenic in Gomti water will reach the level of World Health Organization's permissible limit (10 µg /L) for potable water. The study can be considered as an environmental alarm for water resources in future.

Key words: Urbanization, Physico-chemical, Heavy metal, Bacteriological properties, Water resources, Management

SVIII/P-14

Reclamation of Sodic Soil through Bio-Ameliorant for Sustainable Agriculture

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Sodic soil is defined by high levels of exchangeable sodium that affect approximately 6.9 million ha area in India. Sodic soil is having least organic matter contents and exhibit poor plant growth. This soil is also subjected to increased nutrient losses due to dispersion, erosion and leaching. Such soil can be ameliorated by providing a source of calcium ions (Ca^{2+}) which replace excess sodium (Na^+) from soil cation exchange sites. Although chemical amendments have long been used to ameliorate sodic soils, but the chemical process has become costly during the last two decades in several developing countries. Use of chemical amendments, like gypsum, improves chemical properties of soil, but fails to restore nutritional and biological properties of reclaimed soil. As a low-cost and environmentally acceptable strategy, sodic soil can also be reclaimed through an organic approach generally termed as bioremediation and/or phytoremediation. The incorporation of organic matter into soil aggregates provides better soil stability and restricts dispersion by replacement of Na^+ with other cations at cation exchange sites. Application of organic amendments to sodic soil enhances microbial activity that transforms the organic material into long chain aliphatic compounds capable of binding and stabilizing soil aggregates. Enhanced microbial activity decreases soil pH by producing organic acids. Bio- and Phytoremediation methods have great advantages over chemical amendments in several aspects like (1) no fiscal outlay to purchase costly chemical amendments, (2) promotion of soil-aggregate stability and improvement of soil hydraulic properties, (3) greater plant-nutrient availability in amended soil, (4) environmental conservation in terms of soil carbon sequestration. It is concluded that bio- or organic amelioration can sustainably improve sodic soil productivity after reclamation and help to transform such soils into a useful economic resource that can fulfill the food requirements of growing population.

Key words: Sodic soil, Agriculture, Organic amendment, Bioamelioration

SVIII/P-15

Fly Ash Water Retention with Reference to Agricultural Application

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Recent studies have explored the utility of fly ash in agricultural sector for enhancing nutrient availability in soil. Addition of fly ash would alter the water retention capacity of soil. There are not many studies to investigate water retention characteristics (WRC) of fly ash modified soil. This paper presents experimental studies to understand the variations in

water retention characteristics of a cohesionless soil due to the addition of fly ash. The fly ash used in this study falls under F-class. The WRC have been obtained using tensiometer and volumetric water content sensor. It is noted from this study that fly ash can be effectively utilized to enhance water retention capacity of high permeable soils.

Key words: Fly ash, Class F, Cohesionless soil, Water retention characteristics

SVIII/P-16

Effect of Cod Loading Rate on Performance of an Anaerobic Sludge Blanket Reactor during Anaerobic Digestion of Palm Oil Mill Effluent with Butyrate

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Palm oil Mill Effluent (POME) with concentrated butyrate was treated in a 4.5 L Upflow Anaerobic Sludge Blanket Reactor (UASBR) run over a range of influent concentrations (16.5-46.0 g COD l^{-1}), COD loading rates (1.5-11.5 g COD $l^{-1}d^{-1}$) and 11-4 days hydraulic retention time (HRT) at 37°C by maintaining pH between 6.5-7.5. The process consistently removed 97-99.4% of COD at loading rates up to 1.5-4.8 g COD $l^{-1}d^{-1}$ by varying HRT (11-7.2 days). Conversion of acetate to methane appeared to be rate limiting step. Maximum biogas (20.17 $l^{-1}d^{-1}$) and methane production (16.2 $l^{-1}d^{-1}$) were obtained at COD loading rate of 4.80 $gl^{-1}d^{-1}$ and HRT of 7.2 days. The methane contents in the biogas was in the range of 70-80% throughout the study. Finding of this study clearly indicates the succesfull degradation of POME with butyrate in UASBR.

Key words: Anaerobic degradation, Palm oil mill effluent, Butyrate, Acetate, UASB reactor

SVIII/P-17

A Preliminary Study on *Abelmoschus esculentus* (Okra) Fruit Mucilage as Coagulant in Turbid Water Treatment

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The use of synthetic coagulants is not regarded as suitable due to health and economic considerations. Studies were carried out in laboratory scale on deionised water containing synthetic turbidity of kaolin. The present study used coagulant filtration test using *Abelmoschus esculentus* fruit mucilage extract in 1 M NaCl for turbid water treatment. Jar test experiments were conducted for the coagulation flocculation process. The experiments were carried out in five ranges: 10, 25, 50, 75 and 100 (NTU) in the pH range 6.0, 7.0, 7.5, 8.0 and 9.0 in the dose range, 0.2, 0.4, 0.6, 0.8 and 1.0 (mg/l). The optimum dose of *Abelmoschus esculentus* mucilage extract was to be found 0.2 mg/l. Maximum turbidity removal was recorded when the turbidities of the test solution were maximum i.e. 75 and 100 (NTU) at pH 7.5. The results of this study showed that *Abelmoschus esculentus* fruit mucilage extract had higher efficiency in removing higher turbidity in compression with low turbidity. Thus it acts as best natural coagulant. The dominant mechanism behind turbidity removal by *Abelmoschus esculentus* mucilage extract was adsorption and change neutralization and intra particular bridging.

Key words: Turbidity, Kaolin, *Abelmoschus esculentus*, Coagulant, Flocculation

SVIII/P-18

Vermicompositing as an Eco-Tool in Management of some Aquatic Weeds

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Natural biodegradation and decomposition of some noxious aquatic weeds is enhanced from 65% to 75%, thus significantly reducing the composting time by several weeks by an eco-friendly technique of vermicompositing. The Vermi-process experiments showed that two floating weeds, water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*) and one ditch bank weed, Cattail (*Typha angustata*) could be managed beneficially by converting easily into good quality vermicompost within 2 to 3 months. These composts recorded 0.69-1.45% total nitrogen, 0.36-0.84% total phosphorus and 0.84-1.53% total potassium, indicating its good quality as organic fertilizer. Composting is, thus, a biological degradation process aided by earthworms in which several kinds of organic materials are converted from 'unstable product' which is likely to decompose further, creating environmental insanitation to an increasingly more 'stable product' whose value is upgraded as nutritive materials for the soil. Control of these aquatic weeds by large scale utilization for making marketable vermicompost is a cost effective beneficial technique, better than expensive chemical and biological control techniques.

Key words: Aquatic weeds, Environmental protection, Vermicomposting, Cattail, Water hyacinth, Water lettuce

SVIII/P-19

A Pyroaurite Type Sorbent for Removal of Arsenate from Water by Column Process

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In an attempt to evaluate the suitability of synthesized pyroaurite like compound (PLC) and modified PLC, i.e., pyroaurite type sorbent (PTS) for the removal of pentavalent arsenic (arsenate) from water, a comparative study of these two adsorbents was carried out by column process. Arsenic was analysed using Perkin-Elmer AAnalyst 100 AAS using MHS system. In column tests, PLC and PTS could remove 60.5 and 64.8% As (V) respectively at initial metal

concentration 0.1 mg/l, pH 6.0, temperature 25°C, bed height (BH) 60 cm and flow rate 1.0 ml/min. The order of arsenate removal with these chemical adsorbents was found to be PTS > PLC. The impact of various parameters affecting the adsorption efficiency such as initial arsenate concentration, bed height, temperature and pH were studied.

Key words: Sorbent, Adsorbent, Adsorption efficiency

SVIII/P-20

Microbial Ecology of Certain Plant Species Due to Solid Waste Pollution

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Rhizospheric microbes are known to have effects on the mineral nutrition of plants. The interdependence of plants and fungal biodiversity has important conservations, implications in management of soil. Seasonal influence of the succession of micro fungi and changes in edaphic factors affect the appearance of restricted plant species. During the present study microbial ecology of certain plant species growing under both natural and solid waste polluted conditions was being carried by adopting "warcup soil plate method". Soil samples collected from both natural and polluted habitats of plant species. *Ficus benghalensis, Withania somnifera, Abutilon indicum* and *Datura stramonium* were analyzed for occurrence of microbes. About 18 fungal isolates were identified in rhizospheric zone of the plants. Among which species viz. - *Aspergillus flavus, Aspergillus nigher, Mucor globosus, Mucor racemosus, Rhizopus nigricans* and *Fusarium chlamydosporum* were found to be tolerant towards polluted conditions. Maximum 5.52% occurrence of *Aspergillus flavus* indicated its role as bioindicator of polluted soil samples. Soil is the most important factor of plant habitat. Soil microbes play significant roles in recycling of plant nutrients, maintenance of soil structure, detoxification of noxious chemical and control of plant pests and plant growth. Recent work has indicated that the stimulation of microbial activity in the rhizosphere of plants can also stimulate biodegradation of various toxic organic compounds. Changes in microbial community structure in response to solid waste pollutants are not well known and research into long term effects of solid waste pollutants application is needed. Hence the present findings are of some significance in determining microbes as bioindicators of pollution which are being present in the rhizospheric zone of certain plant species investigated by us.

Key words: Solid waste pollution, Rhizosphere, Microbial ecology, Bioindicators

SVIII/P-21

Suction-Water Content Relationship of Sand-Fly Ash Mixture

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The study of unsaturated soil is indispensable for many of the field problems like permeation of water through vadoze zone, deciding irrigation requirement for various crops, evapo-transpiration determination, deciding fate of contaminants in the geoenvironment etc. The reliability of unsaturated soil modeling depends on its precise characterization, which includes the development of a graphical relationship between water content (gravimetric or volumetric) and soil suction. Suction-water content relationship (designated as SWR) is a crucial input parameter for irrigation planning, crop yield modeling, hydrological simulation, and solute transport simulation through the vadoze zone. It is believed that each material has got a unique SWR that may get influenced by different factors. The present study aimed to investigate the influence of addition of fly ash on SWR of a locally available sandy soil. It can be noted that the fly ash has been reported to improve the growth of some plants by providing some essential nutrients. SWR has been obtained for sand, fly ash and three sand-fly ash amendments by using a tensiometer by following spot measurement procedure. The study indicates that the water retention capacity of sandy soil increases with the increase in fly ash content.

Key words: Sandy soil, Fly ash, Gravimetric water content, Suction-water content relationship

Session SIX

Environmental Issues

SIX/L-1

Current Trends and Future Prospective of Herbal Health Drinks

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Currently there has been an increased interest globally to identify antioxidant compounds that are pharmacologically potent and have low or no side effects for use in preventive medicine and the food industry. As plants produce significant amount of antioxidants to prevent the oxidative stress caused by photons and oxygen, they represent a potential source of new compounds with antioxidant activity. Traditional herbal medicines form an important part of the healthcare system of India. Ayurveda, supposed to be the oldest medical system in the world, provides potential leads to active and therapeutically useful compounds from plants. Considering the growing interest in assessing the antioxidant capacity of herbal medicine in this review we discuss about rarely reviewed few plants reported to have antioxidant properties. Some of the plants reviewed are part of multi-herbal preparations while others are used singly. Certain herbs like Ashwagandha, Tulsi, Mulethi, Awala, Shatavari, Gokharu, Arjun, Giloy, Safed musli, Kalimirchi, Haldi, Amaranthus paniculatus, Aerva lanata, are used for health drinks play a vital role in health benefits and is another emerging area of research.

Key words: Antidiabetic, Antioxidants, Ayurveda, Flavonoids, Indian herbs

SIX/L-2

Ecosystem Services by Ecologically Dominant ant Species in Agroecosystems

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The benefits received by man in the form of an array of vital ecosystem services are under threat due to biodiversity depletion at all levels. Therefore studies need to be focused on the key taxa which are implicated in providing important ecosystem services. Ants (Family Formicidae) are ubiquitous in the terrestrial ecosystems and perform many important ecosystem functions which directly or indirectly contribute to plant fitness, reproduction and protection from insect pests. The present study focuses on two main ecosystem services contributed by ants-regulating service provided through insect herbivore suppression and supporting service provided via soil improvement. Since plant-insect interactions comprise a major biological interface in terrestrial ecosystems and provide the basis of ecologically sound management of agricultural pests in agroecosystems, investigations have been carried out to elucidate some aspects of the behavioural ecology of ecologically dominant ant species and tritrophic associations involving ant-crop plant insect herbivores. Ant-inclusion and-exclusion experiments have been carried out under field conditions to study the impact of predatory ant species on insect herbivores of some important vegetable crop plants. Field observations revealed that six ant species, the most important being *Pheidole sp*. preyed on the crop-damaging stages of the diamondback moth, *Plutella xylostella* (Linn.) (Lep, Plutellidae) and the black cutworm, *Agrotis ipsilon* (Hufnagel) Lep. Noctuidae), in cauliflower (*Brassica oleracae* L., Brassicaceae) agroecosystem. A significant difference was found in the leaf area damaged by the larvae in the ant-excluded plants in caparison to the ant-included plants. Worker ants of *Camponotus compressus* Fabricius, ecologically dominant on sponge gourd plants [*Luffa cylindrica* L. (Cucurbitaceae)], engaged in high frequency of deterrent encounters with the major insect herbivore, *Raphidopalpa foveicollis* Lucas (Coleoptera: Chrysomelidae) and caused a significant reduction in the residence time, as well as dose-and time dependent reduction in the frequency of visits of the herbivore on crop plants. Analysis of ant nest soil of these ant species revealed that the nest maintenance activities of ant colonies contribute to soil fertility. The enormous potential of this important taxon in providing future benefits to mankind in the form of valuable ecosystem services and thus facilitating in the feeding of the nine billion people expected to inhabit this planet by 2050, would be discussed.

Key words: Insect herbivore suppression, Soil modification, Crop plant production, Tritrophic associations

SIX/L-3

Environmental Education: Knowing and Acting do not Always Go Hand in Hand

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With the abundant information available to the mass public today, everyone knows about global environmental problems. It could be thus assumed that raising knowledge about these problems will promote actions to protect the environment.

A representative sample of 1400 Chileans was surveyed on environmental knowledge and actions to protect the environment. The effect of information on respondents' actions was exactly the opposite of what was expected. Specifically, the survey showed that the more informed one is about global environmental problems, the less one acts to protect the environment.

Perhaps, what is preventing us from thinking soberly and effectively about the environmental problems is our narrow egoistic perception. It blinds us from seeing the broader perspective, from being able to evaluate the full gravity of the situation. Moreover, our ego blinds us to the fact that we are causing this to ourselves, and are therefore able to prevent it. Thus, to change the menacing trend of global environmental

problems, we must first change our indifference to them.

Key words: Abundant information, Environment, Egoistic perception

SIX/O-1

Mitigation of the Effects of Climate Change through Transition to Alternative Energy Sources

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Earth, our only home, is warming certainly and unequivocally due to human activities and some of the impacts of global warming are already known. Climate change is a reality. If the present rate of emission of the GHG continues, the atmospheric CO_2 concentration is predicted to double by the year 2010 and triple by 2100. These changes are beginning to affect the entire world, from low-lying Islands in the tropics to the Polar Regions. Everybody, including policy makers, scientists, corporate sectors and also general public has to wake up and contribute because it concerns all of us and our very existence on the planet as civil society is at stake.

The greatest challenge in realizing a sustainable future is energy consumption. Today, we are mostly dependent on non-renewable fossil fuels which are the major cause and source of pollution and climate change. It is still possible to avert the worst consequences of climate changes while expanding our energy supplies and meeting other developmental changes by taking mitigation measures. India has already developed a national strategy, firstly to mitigate and adapt to climate change and secondly to further enhance the ecological sustainability of the country's path to development. In fact, mitigation of climate change is intrinsically and intricately linked to long term energy and economic security. Conserving energy is a national cause for us today. Energy savings does not mean just efficient equipment, appliance and gadgets but a change in the habits and altitude towards energy in general.

In the present paper, an effort has been made to analyze real and major solutions for the reduction of emissions through planned transition of low-carbon economy by deploying renewable and clean energy sources including solar, wind, water, nuclear, biomass/biogas, biofuels, hydrogen as fuel etc. since fossil fuels are finite and availability can only be for limited time periods. National Action Plan for climate change will also be discussed.

Key words: Climate change, Pollution, Energy

SIX/O-2

Botanical Pesticides: A Sustainable Alternative to Chemical Pesticides against Termites

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Although the use of synthetic pesticides has helped in achieving green revolution through increased crop production, in recent years due to many reasons there has been considerable pressure to look for alternatives to synthetic pesticides. Sustainable agriculture focuses at reducing the incidence of pests and diseases without disturbing nature's balance. It aims to develop low cost and ecologically safe strategies. In the context of agricultural pest management, botanical pesticides are well suited for use in organic food production and may play a great role in the production and protection of food in developing countries. The use of locally available plants in the control of pests is an ancient technology in many parts of the world. Termites are a serious pest not only for wooden structures through out the world but also responsible for damage of crop production. They are responsible for huge economic losses in agriculture and urban environment. Nowadays, synthetic pesticides are the main method being employed for termite control. The biological alternatives should be explored to minimize the use of chemicals. The present study deals with the efficacy of aqueous and methanolic leaf extracts of various plants against termites in laboratory conditions. Termite mortality experiments were conducted using no-choice bioassay. The data pertaining to the mortality percentage recorded after regular intervals will be presented in the paper.

Key words: Termite, Botanical, Sustainable, Pesticide, Chemical

SIX/O-3

Soil Ecology under Different Nutrient Management

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Of late, nutrient management with aims to produce optimum crop yield without deteriorating soil health (physical, chemical and biological) is foremost important in chemical based farming system. Biological indicators of the soil quality are highly responsive over short periods of changes in land management, and can provide advanced warning of long term changes in soil health. Three sets of experiments, thus undertaken to study the baby corn productivity and soil ecology under various approaches of nutrient management at Agricultural Experimental Farm of Indian Statistical Institute, Giridih, Jharkhand, India during the years 2008 and 2009.

Baby corn yield was maximum where full recommended dose of fertilizers (RDF) was applied through inorganic sources in all three experiments. However, yield decreased at various percentages as some proportion of RDF was substituted either through organic manure (vermicompost or FYM) or biofertilizers (*Azospirillum* or arbuscular mycorrhiza or both).

First, vermicompost amended plots had higher residual soil fertility, organic carbon (OC), cation exchange capacity (CEC) and soil biological activities such as microbial activities (basal soil respiration, microbial biomass

carbon, microbial quotient and metabolic quotient), microbial load (bacterial and fungus population) and enzyme activities (urease and acid phosphatase) as compared to without vermicompost amended treatments. The maximum residual soil fertility (NPK), OC, CEC, but minimum biological activities were recorded due to application of 150 % RDF. Second, application of equal proportions of organic and inorganic (50:50) sources of nutrients improved soil physical, chemical and biological properties (soil health). Nonetheless, deterioration in soil health was recorded due to application of 100 % RDF through inorganic sources. And third study, soil biological activities and enzyme activities were highest when crop received biofertilizers only (T_{13}; absolute control + AM + *Azospirillum*), followed by T_{14} (50 % RDF + AM + *Azospirillum*). Nonetheless, biological activities of soil declined significantly with the increase in percentages of RDF. Co-inoculated plots built up higher residual soil fertility, enhanced OC and had higher soil biological activities.

Key words: Nutrient management, Biofertilizers, Organic manures, Inorganic fertilizers, Soil health

SIX/O-4

Croton bonplandianum as Prospective Control for Parthenium hysterophorus

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Parthenium hysterophorous is a deadly weed infesting both cropped and non-cropped areas throughout the country under varied agro-climatic and soil conditions. This obnoxious weed attracted much attention due to its allergic and allelopathic potentials. Various physical and chemical methods for controlling this weed did not yield substantial results. Biological control promises potential, perhaps most effective solution to our *Parthenium* control problem. Biological control aims to reduce the abundance of a weed to a level at which it can be either tolerated or managed by other measures. It is unrealistic to expect that bio control will eradicate a weed, although the final equilibrium populations may be so low that the particular weed seems to most untrained observers to have disappeared.

The genesis of the present study was the observation that *Parthenium hysterophorous* plants were very scanty or nearly absent in fields infested with *Croton bonplandianum.* Effect of *Croton bonplandianum* on seed germination of *Parthenium hysterophorous* was studied using crude *Croton* extracts, in petri plates lined with filter paper, under lab conditions.

Of the three extracts considered during the present study leaf extract seems to be most detrimental. Only the 3 day extract supported some germination. In general no germination was observed in the course of present study with various leaf extracts. The root and shoot extract seems to inhibit *Parthenium* seed germination and delays the process. The observations made during present study supports the view that *Croton bonplandianum* which interferes with *Parthenium* can be exploited as an ecofriendly herbicide. The weeds leachates exert allelopathic influence on the germination of *Parthenium* and hence can replace the indiscriminate use of synthetic herbicides to control this obnoxious weed.

Key words: *Parthenium hysterophorous, Croton bonplandianum,* Crude *Croton* extracts, Seed germination

SIX/O-5

Development of Eco-friendly Technologies by Utilization of Native Isolates of Endophytes with Commercial Bioregulators to Increase the Yield and Vase Life of Gladiolus

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An experiment was conducted to assess the commercially available regulators/nutrient mixtures along with biological cultures of *Psuedomonads florescens* and *Trichoderma herzianum* on the yield and quality of gladiolus flowers. The following were the treatments taken for assessment T1-Himedia (Nutrient mixture); T2-*Psuedomonads* + *Trichoderma*; T3-Biovita (Seaweed extract); T4-Himedia + (*Psuedomonads* + *Trichoderma*); T5-Himedia + Biovita; T6-Biovita + *(Psuedomonads* + *Trichoderma)*; T7-Himedia + Biovita + *Psuedomonads*; T8-Control. The corms were planted in the field in RBD with three replications. The treatments were imposed during the critical stage of 3 leaves and 6 leaved stage of the crop. The plants were recorded for their qualitative and quantitative parameters during the flowering and harvest. The strains of endophytes were obtained from G.B. Pant University of Agriculture and Technology, Pantnagar. The nutrient solution of Himedia was obtained from Himedia laboratories. The results suggested that the plants treated with *Psuedomonads* + *Trichoderma* + Himedia (T4) both as soil and foliar spray recorded the highest spike length of 96.33 cm which meet the export standard grade A in the international market, whereas with regard to shelf life the lowest physiological weight loss (16.44) was recorded in the treatment with *Psuedomonads* + *Trichoderma* (T2) at 4 DAH. The lowest spike length was recorded in the control (66.33cm) and the treatment Himedia + Biovita + *Psuedomonads* + *Trichoderma* (T7*)*. The analysis of biochemical parameters like peroxidase, catalase, polyphenol oxidase, proteins, phenols and sugars also revealed a positive correlation with increased shelf life in the treatment with T2 and T4 in interaction with Himedia nutrient mixture. Also the microbial analysis for CFU /ml of *Psuedomonads* and *Trichoderma* revealed higher colony development in the treatment T2 and T4, while with Biovita it failed to develop sufficiently. The synergistic and antagonistic effect of Himedia with *Psuedomonads* and Biovita was also established under *in-vitro* culture conditions. The overall experiment results suggested that the

endophytes (*Psuedomonads* and *Trichoderma*) apart from acting as a biocontrol agent also explicit the role of growth regulator due to its inherent auxin property which resulted in the increased spike length of the gladiolus to meet the export standards. It also increased the shelf life to overcome the market risk which is common in flower crops.

Key words: Gladiolus, Eco-friendly endophytes, Bioregulators, Vase life

SIX/O-6

Enhancing Growth in *Dalbergia sissoo* Roxb. Seedlings with Application of Inorganic and Biofertilizers

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The investigations were conducted to generate information on effect of inorganic and biofertilizers on growth performance in *Dalbergia sissoo*, an important commercial tree species of India. The treatments comprised of all possible thirty-six combinations of three levels of nitrogen (0, 30 and 60 kg N ha^{-1}), three levels of phosphorus (0, 75 and 150 kg P_2O_5 ha^{-1}) and four biofertilizers levels (No biofertilizer, VAM, *Rhizobium* and VAM + *Rhizobium*) laid out in factorial split design with three replications. Growth in shoot and root was significantly enhanced in plants inoculated with VAM and *Rhizobium* as compared to uninoculated control. Among different doses of nitrogen and phosphorus, when applied singly, 30 kg N and 75 kg P_2O_5 ha^{-1} produced seedlings with highest growth parameters. Nitrogen x biofertilizers and phosphorus x biofertilizers interactions were significant effect for most of the growth characters Nitrogen x phosphorus x biofertilizer interaction effect was also significant for nodulation and most of the growth characters indicating the great potential of combining inorganic and bio-fertilizers for achieving higher growth.

Key words: *Dalbergia sisso*, Biofertilizers, Nitrogen, Phosphorus, VAM, Rhizobium

SIX/O-7

Antifungal Potential of Two Common Weeds Against Plant Pathogenic Fungi – *Alternaria sps.*

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Herbal fungicides are gaining interest because of their cost effective and ecofriendly attributes. If this antifungal potency resides in weeds, it will be a great advantage. The present investigation is therefore undertaken to test the efficacy of two common weed i.e. *Lantana camara* (Lantana) and *Parthenium hysterophorus* (Congress grass) against *Alternaria sps.* which is responsible for causing different plant diseases especially in vegetable plants such as tomato, potato, brinjal etc. Leaf extracts of both the weed plants were tested for their antifungal potential. The antifungal activity was tested by agar well diffusion method. Three different concentration of extracts viz. 10mg/ml, 15mg/ml and 20mg/ml were used. Maximum inhibition was seen in *Lantana camara* at 20mg/ml concentration and at the same concentration *Parthenium hysterophorus* showed less inhibition than *Lantana camara*. The chemical fungicide nystatin was used to compare the results. Thus the results revealed that 20mg/ml concentration for both the weed was the best concentration to be used. The antifungal components from these plants can be used as an alternative to develop novel fungicides by replacing some chemical commercial antifungal for the disease cause by *Alternaria sps.*

Key words:*Lantana camara, Parthenium hysterophorus, Alternaria,* Antifungal potential, Ecofriendly fungicides

SIX/O-8

Environment and Tourism – Need for Sustainable Approaches

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Tourism is now one of the fastest growing economic sectors and one of the world's largest industries. For many countries tourism is seen as the main instrument for regional development, as it stimulates new economic activities. At the same time green and environmental issues are becoming increasingly important. Tourism and environment are intricately related. The environment of a tourist destination, its socio-cultural attributes, resources and heritage value constitute the basic background elements for the evolution, growth and development of tourism in that area. The increasing tourism activities in a tourist destination often result in overuse and degradation of the environment and resources of tourism which in turn lead to a decline in the growth of tourism, and loss of tourism value of the destination. Tourism in a destination depends on the carrying capacity, resilience of the environment and the intensity of tourist activity.

The studies on tourism with regard to the environment reveal its negative impacts in terms of loss of biodiversity, deforestation, congested settlements, landscape alterations, slums, pollution of air, water and soil, siltation of water bodies, loss of wetlands, loss of land titles, social alienation, change in lifestyle and traditions, etc. It also has negative impact on the natural resources as it contributes to soil erosion, increase pollution and discharges into the sea, natural habitat loss and increase pressure on endangered species. The much talked about economic gains are captured by a handful of people, while the social costs are borne by the entire community.

The environment, being the major source of tourist product, should therefore be protected in order to have further growth of tourism and economic development in the future. The paper provides a theoretical framework for

sustainable tourism. Sustainable tourism is tourism development that avoids damage to the environment, economy and cultures of the locations where it takes place. Sustainable tourism is a kind of approach to tourism meant to make the development of tourism ecologically supportable in the long term Sustainable tourism is a responsible tourism intending to generate employment and income along with alleviating any deeper impact on environment and local culture. The aim of sustainable tourism is to ensure that development is a positive experience for local people; tourism companies; and tourists themselves.

In this paper, we have proposed broad solutions in the shared interest of local communities, tourism businesses, and tourism consumers to maintain the natural wealth and social heritage of the tourist destination irrespective on the country in question.

Key words: Tourism, Environment, Degradation, Sustainable tourism, Biodiversity, Economic growth, Community

SIX/O-9

Flood: A Natural Water Resource!

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In India, the ever depleting fresh water resource has lately reached a catastrophic dimension. The exploding population together with improve quality of life has put to constraint on this valuable natural resource. With every passing year, the situation is turning from grim to worse so much so that the large metropolitan cities are hardly being able to provide the required fresh water to its population. The onus of the current situation not only lies with the people involved but has a crucial bearing due to haphazard planning, poor management and weird technical drawbacks.

India is blessed with "Monsoon System" with huge amounts of fresh water being available to the maximum extent of the country for at least 3 months in a year. Nevertheless, most of this monsoonal water drains out as river outflows or gets evaporated from flooded regions. Eventually, this flood water is lost into the ocean or sky without us being able to utilize it. We can enhance our fresh water resource by optimizing the planning such as formation of National Water Grid Projects, Linking of Rivers and canals and as surplus water in our ponds, lakes and reservoirs.

Floods are usually considered to be a bad omen for all the masses as it brings miseries, hardships and losses amounting to millions of rupees every year. In all probability, the flood water has never been looked as a resource in order to upgrade our nation's water condition. Most of the plans about this flood water are constrained by age-old thinking that the flood-water is waste water affecting our life in a measurable way. Can this water be utilized as a major water resource for the country like India, Bangladesh, Nepal, Sri Lanka, Pakistan and other adjoining areasfi

The present paper discussed the issue in the light of changing water scenario in which rain water harvesting and development of nationalized water grid as a recharge mechanism of underground water table has been planned. It is envisaged that the proposed plan can be started for the pilot project in any metropolitan city which has abundant population with quickly depleting water table. In this regard participation by government agencies and affected people is equally important as they are the one who are going to get the benefitted.

Rain water harvesting has not remained as the buzz word only but has become the need of the hour. The present situation suggest that if we would not immediately take some permanent step to recharge our ground water resource in the coming years, potential drought like conditions might arrives which would eventually put to strain the densely populated parts of the country. Monsoon flood water, surplus rain water, water from the waterlogged areas and drain water can be used as an alternative source by appropriate planning in order to recharge the areas where the water tables are quickly depleting.

Out of the above, the flood water can be an effective remedial tool as this huge monsoonal pouring may provide sufficient amount of fresh water provided we plan its optimal usage by implementing latest technologies such as remote sensing, surface mapping and understanding the sub surface profile.

Key words: Floods, Water-harvesting, Recharge, Monsoon, Remote-sensing

SIX/O-10

Environmental System and Disaster Management Case Study: Flood and Bank Erosion of Downstream R Panchanoi North Bengal, India

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The extreme environmental event, either natural or man induced, which exceeds the tolerable magnitude within or beyond certain time limits, make adjustment difficult is called a hazard. There is a distinction between the environmental hazard and disaster. Disaster is such a hazard which only causes great damage to human beings as well as plants and animals. Flood is an important cumulative exogenous atmospheric planetary hazard which is caused due to cumulative effects of weather events and it is found as an acute environmental hazard in north Bengal. The studied area of Sukna, Darjeeling is such area which is nearer to Siliguri township area, situated at the bank of R Panchanoi downstream (tributary of R Mahananda). Almost the yearly occurrence of flood as well as river bank erosion makes a real measurable condition for the inhabitants of the Dagapur tea estate.

We find that the heavy downpour in a very short span of time, the high rate of sedimentation in the river bed and mostly the human interference play the major role for the execution of such an devastating flood and high rate of bank

erosion. Not only that the increasing tendency of deforestation at the sight of river bank of R Panchanoi, has been accelerated the rate of bank erosion. It passively increases the rate of surface run off which also accelerates the rate of soil erosion and passively the amount of bed load. A considerable number of people become homeless some of them lose their only crop practicing land or their vegetable garden due to the enormous bank erosion. Not only that a number of cattle even villagers died in last flood occurred on October, 2007. Now the Dagapur tea estate factory, the only source of income for the slum villagers, will be severely affected in future flood occurrence, if no serious measures are taken immediately.

The Govt. has already taken some specific measures to prevent such problem in that particular region. Ware crating spur, revetment wall, finger tip spur etc has already been introduced at regular basis. But all those protection measures are not so efficient to solve the purpose positively. As a result the process like bank erosion and bank failure are going on. So it can be said that though the preventive measures have already been taken but they are not sufficient to solve the real purpose, i.e. there is a lack of sustainable disaster management and as geographer it is our responsibility to suggest some way out to find the goal and it is only possible, when we give stress on the channel as well as valley configuration reach wise, ie. micro level variation of the studied area of the problem site. Not only that it is also necessary to make a mass awareness to reduce the tendency of deforestation, unscientific agricultural practices in the adjacent region of the studied reach of the river. At the end it is also to be said that the soft engineering method may be the right one to introduce here in future to secure the little smile of the local poor inhabitants, live here in the vulnerable portion of the studied reach of R Panchanoi.

Key words: Tolerable magnitude, Flood, Disaster, Erosion, Disaster management

SIX/O-11

Pattern of Pesticide used in Rice Field of Barak Valley, N.E. India

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Pesticide is a collective term covering all the chemicals used to control or destroy pests. Barak valley, N.E. India, Assam is uniquely endowed with diversity of very rich and extensive paddy field resource, but most of the paddy field are attacked by number of pests throughout the year. For this pesticide have assumed great importance in this agroecosystem.

Therefore the present study was an attempt to investigate the pattern of pesticide used in three districts of Barakvalley, Assam. Pesticides are used in high doses and it is often the dealer who advises farmers on which pesticide to use. In India more than 20% of the pest control practices rely on organo chlorine pesticide.

Farmers in this valley played an important role choosing pesticide and its quality. Findings of this search and survey revealed that although percent frequency and pesticide used by farmers are of different types, but Malathion 50EC an organophosphate pesticide was the most commonly used by 59.52% of farmers. The amount of pesticide sold by dealer was 2943 lt./yr, but the report from the Agriculture Department stated that 2323.8 lt./yr. Recommendation of doses of pesticide to be used by dealer and Agriculture Deptt. were 2 ml./lt. for all type of pesticide while the farmer apply their own doses (0.5ml/lt.).

The farmers rely upon their traditional methods or biological methods followed by (IPM) for high yielding crop production and to sustain their biodiversity of agro ecosystem by conserving both target and non target species, not to create problems of ecological imbalance.

Farmers are also aware that indiscriminate use of pesticide in the rice field not only spoils the diversity, but they run off to the river and pond causing water pollution thereby hampering the biodiversity of aquatic eco system also.

Key words: Pattern, Pesticide, Agro ecosystem, Traditional, Biodiversity, Malathion

SIX/O-12

Impacts of Indoor Pollutants on Occupants: Strategies to Control Indoor Pollution

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In most practical estimates of indoor pollutant exposures, it is common to assume that the pollutant is uniformly and instantaneously mixed in the indoor space because mostly people spend more than 90% of their time indoors so it is important to recognize and control indoor air pollution.

This paper summarizes the releases of indoors toxic agent which are responsible for immediate and long term harm to occupants, some indoor pollutant sources includes: pressed wood products, aerosol sprays, cleaning agents, moth balls, manufacturing gas appliances, cigarettes and wood stoves etc.

The major indoor pollutants are formaldehyde, volatile organic compounds, electromagnetic radiation, biological pollutants, radioactive pollutants etc. People may react differently to air pollutants like immediate effects include headache, nausea, asthma, dizziness, irritation to eyes etc. and long term exposure leads to cancer, heart disease etc. We can control indoor pollution by using various ways like proper ventilation, plantation in our home and by proper maintenance of electronic items etc.

The main objective of this paper is to provide brief and focused overview on indoor pollutants and their harmful effects on human health, which will be very usefull in environmental education, related to indoor environment quality and the strategies for controlling indoor pollution.

Key words: Indoor environment quality, Volatile organic compounds, Formaldehyde, Education, Biological pollutants, Indoor air pollution

SIX/O-13

Impact of Human Activities on Biodiversity of Three Coasts from Raigad District, Maharashtra

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Raigad district of Maharashtra state has number of villages having scenic beauty of hilly region on one side and Arabian Sea on the other. Present study area included sea shores of three such villages from Raigad district having diverse habitat.

Macroalgae and macrofauna of intertidal zone from above said coasts is being recorded since November 2008 till date. Visits are planned taking into consideration the tidal activity (i.e. on full moon day and no moon day). Though baseline data preparation of flora and fauna is the main objective of current study, interference of human activity on the locations grabbed the attention.

Intertidal zone of Barshiv being rocky happens to be a suitable habitat for molluscs, especially gastropods. 31 molluscan species and 17 species of macroalgae were recorded till date. Though the spot is not frequently visited by tourists, it is an attraction for college students as an excursion site. They are exploiting the spot for collection of algae neglecting the damage caused.

Nagaon being sandy coast exhibited 11 bivalve species. The beach has been frequented by weekend picnickers from Mumbai (about 110 km) and Pune (about 200 km). Various water sports, cart rides and paragliding have been started for attracting people ultimately causing damage to the marine life. Village is all set to greet the visitors. This has led the villagers to progress both socially and economically elevating the life style of Natives of Nagaon.

Akshi village is 4 km away from Nagaon having equally beautiful beach exposing 1000 mts of rocky patch during low tide. Being mixed types of shore molluscan species (i.e. 29 Gastropod species and 18 Bivalve species) are observed along with colourful sponges, exotic corals like Gorgonia and Pentapora and Hydroid colonies. Once Aplysia was also sighted. As the village is close to Nagaon, Panchayat members (local administrators) of Akshi are planning to develop the village as tourist spot by providing necessary facilities. This may pose threat to marine life in future.

To create awareness in natives the tourists, following measures are being taken: 1. Beach cleaning program involving college students. 2. Convincing visitors to be careful about waste disposal and avoiding littering. 3. Arranging lecture and slideshows for school children to make them understand damage caused. 4. Discussing with Panchayat members and finding out suitable solution.

Key words: Raigad, Barshiv, Nagaon, Akshi, Macroalgae, Corals

SIX/O-14

Ecological Concerns in Context of Medicinal Plants in India

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Climate change has become increasingly recognized as one of the greatest challenges to humankind and all other life on earth. Worldwide changes in seasonal patterns, weather events, temperature ranges, and other related phenomena have all been reported and attributed to global climate change. Numerous experts in a wide range of scientific disciplines have warned that the negative impacts of climate change will become much more intense and frequent in the future particularly if environmentally destructive human activities continue unabated. Like all living members of the biosphere, Medicinal and Aromatic Plants (MAPs) are not immune to the effects of climate change. Climate change is causing noticeable effects on the life cycles and distributions of the world's vegetation, including wild MAPs. Some MAPs are endemic to geographic regions or ecosystems particularly vulnerable to climate change, which could put them at risk. Concerns regarding the survival and genetic integrity of some MAPs in the face of such challenges are increasingly being discussed within various forums. Some effects of climate change appear to be impacting plants worldwide. For instance, evidence has shown that climate change has been affecting vegetation patterns such as phenology (the timing of life cycle events in plants and animals, especially in relation to climate) and distribution. Some wild plants, including MAPs, have begun to flower earlier and shift their ranges in response to changing temperatures and weather patterns. Shifting phenologies and ranges may seem of little importance at first glance, but they have the potential to cause great challenges to species' survival. They further serve as harbingers of future environmental conditions from climate change.

India is well known as the "Emporium of Medicinal Plants". The Indian sub continent is one of the most distinct bio-geographic regions of the world, with a rich repository of medicinal plant species. According to All India co-ordinated projects on ethno-biology over eight thousand plant species of India have been documented to be in medicinal use in the various indigenous medicinal systems. As a consequence of unregulated use of these plants, their populations are heading towards alarming depletion, coupled with fragmentation of their natural habitats.

India one among 12 mega- biodiverse countries;16 agro climatic zones;2 hotspots: [Western- Ghats and North-East];2.5% of total world's area and 8% of recorded global floral spp.;45000 plant spp.-15000 spp. of medicinal plants (Charak samhita and Susruta samhita);9000 spp. are used in traditional system; Indian System of Medicine & Homeopathy (ISM&H), Min. of Health & Family Welfare, G.O.I. Habitat loss and deforestation combined with

overharvesting due to the surge in popularity of herbal remedies and supplements in recent years has resulted in dwindling populations of important medicinal plants around the world and medicinal plants are at risk. A report states that plant extinctions are occurring at rates hundreds of times higher than natural background rates, and 15,000 species of medicinal plants are now threatened.

The threat to the plants came to the fore in an assessment exercise in different states carried out by the Botanical Survey of India (BSI). The assessments were done for a total of 359 prioritized wild medicinal plant species. Out of this, 335 have been assigned Red List status ranging from critically endangered, endangered, vulnerable to near-threatened. In addition, a total of 15 such species recorded in trade have been found threatened. Some of the rare plants reported to be threatened, have been relocated during the last decade, including *Utleria salicifolia* and *Hydnocarpus Pentandra* in Western Ghats, *Gymnocladus assamicus* and *Begonia tessaricarpa* from Arunachal Pradesh and *Agapetes smithiana* in Sikkim.The assessments have involved conducting Conservation Assessment and Management Prioritisation using (IUCN) Red List Categories.

Medicinal plants are increasingly vanishing, not only because they are highly demanded for primary health care, but also because they cater for several other purposes such as trade, food, timber, firewood and building poles. Land clearing (for agriculture, settlements and other developments) and accidental and deliberate fires also contribute to loss of these species.So it is the need of hour to have a scientific plan and management to cope up the loss incurred by climate change towards the medicinal plants so that they can be protected.Scientific community by their efforts through their interdiciplinary researches may find out appropriate solution so that the loss could be minimised medicinal and aromatic plants (MAPs) may be conserved from threat of climate change.

Key words: MAPs, Endangered, Phenology, Vulnerable, Red list, Indigenous

SIX/O-15

Medical Geology: A Boon to Human Health

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The distinctive advantage of India as the second in the world on the human head counts has lately made it as the super-power in human resources. Even the developed countries like USA and European Union, has recognized this facet of the country and have even become scared about it understanding the great potential that the country can command over the world.

Sustaining over a billion people by way of their food requirements, employment and quality of life are three important domains that need to be addressed as the first step to empower the nation. Another crucial aspect that has an important impact on the above three is the aspect of human health without which a qualitative impact is impossible.

Human health is a coefficient of the quality of food, nourishment, purity on sustainable basis, besides several other related aspects. Vegetable food products are mainly derived from nature i.e. either from fields or rocky terrains whereas the animal products in turn are depended on vegetable products. Therefore the impact of soil/ sediments along with surface and sub-surface water conditions can be considered to command maximum impact on the quality of the food which in turn, would affect the human health.

Geo-environment relates to the geological background that leads to the formation of soil in a particular area, the surface morphology or geomorphology of the region, the nature of surface and ground water conditions and combination of many of these that set the environment in which the biosphere survives. As a human consumer, there is a direct impact of the geo environment on the human health. Therefore the study of the geo-environment which in turn relates to the geology of the area is directly linked to the health of the people including those at the medical level.

Nature and manmade contamination and pollution in any of these geo-environmental conditions may lead a serious impact medically on the population who are living in such areas. May it be fluoride related problem, Arsenic related problem, Chromium, Lead, Mercury, Copper, Cadmium, Calcium Carbide and other toxic element related problem or exposure to radioactive regions such as Monazite beach sand or water related diseases. In long run, it becomes a serious health issue as the impact on large population for a long duration may become a matter of human sufferings and agony.

The medical geology and the studies related to it can effectively provide us a framework in which quality of life especially healthy surroundings and healthy food can be monitored so that the general human health gets improved. Although, in India, medical geology has yet to take-off, its significance on a futuristic basis cannot be undermined and should be effectively utilized to make the nation humanly healthy. In long run this can command to make India not as a super power but as a supreme power on human-resource front.

Key words: Geo-environment, Medical geology, Human health, Soil, Pollution

SIX/O-16

Integrated Path: A Complete Solution for Agriculture

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Today as we are moving towards 21st century, we find out that India becomes a powerful country and in future India would become a supreme power. The customs, traditions, employment, business, techniques and all other small or

large issues are changing and revolutions are getting in. Even today a large portion of Indian revenue comes from agriculture products. To accomplish the demand of increasing population many new techniques have been introduced. In farming with the introduction of first and second five year plans "green revolution" spreads in all over India. Miracles of such revolution attract the farmer to adopt it. Green revolution includes use of new technologies, equipments, hybrid seeds, chemical fertilizers, chemically processed seeds, pesticides and many others.

With the application of such technologies farmers are gaining many benefits such as large profit, quick control over pests and insects, production of non seasonal crops, more fleshy foods and an enhanced growth rate. With the implementation of biotechnological techniques the genetically modified plants, which have more resistance power against diseases and pests are also grown. Therefore it can be said that Indian agriculture is touching new peaks.

But there is a famous English proverb that "*Each coin has two faces.*" With the help of above mentioned technologies the quantity has obtained but quality has decreased. To decrease the pressure of demands of population a large quantity of pesticides, chemical fertilizers and wrong method of farming applied these activities affected the natural properties of food and soil such as the aroma of 'Basmati Rice', taste of 'Himalayan Apples' and 'Nagpur Oranges' and nutritional value of 'wheat' and 'vegetables' have been lost. The fertile land has degraded into unfertile land. Chemical fertilizers and pesticides affected the soil's physical and chemical properties. Human health also affected as they consume foods grown in such lands. Due to the process of Biomagnifications the chemical substance has increased their concentration in human body, and many new diseases are now in front of us.

The present paper discusses the importance of application of natural and eco-friendly methods of farming. The natural properties of land and food would be saved by the use of natural seeds, organic manure, green manure, traditional methods of agriculture. Many efforts are in active phase in such direction. For example: 'Beej Bachao Movement' by farmers in which they use original seeds for agriculture and horticulture. In other example 'natural fertilizers and pesticides technique' is an important eco friendly technology, used by 'Bishnoi Society' in Western India. In such technique the farmers use excreta of birds and animals as fertilizers and pesticides.

Although use of such techniques provides us an eco friendly way of agriculture yet not required quantity. Hence we should adopt 'Integrated path' instead of 'Soft path' as well as 'Hard path'. Hard path indicates the use new technologies to increase quantity without giving attention to environmental problems and quality. Whereas Soft path emphasis only on quality of products following environmental friendly way. Now it is the today's requirement to use integrated path that means to use soft path to increase quality as well as hard path for fulfillment of quantity needs.

Key words: Green revolution, Bio magnification, Green manure, 'Beej Bachao Movement', Bishnoi society, Integrated path

SIX/O-17

Uses of Some Potential Plants Meeting Iron and Zinc Deficiency and their Conservation in Uttar Pradesh

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There are large numbers of peoples seriously suffering from hunger, malnutrition, under nourishment, lack of adequate vitamins and minerals in their diet in many developing and developed countries worldwide. Prenatal death of children and their mothers occurs due to mostly hunger, under nourishment, malnutrition and anemia at a large. There are 923 million under nourishing people increasing and the number of hungry people could increase by further 100 millions would pass the one billion mark in the world by 2009. The state of Uttar Pradesh is nineteenth in highest percent of pregnant women with anemia, fifteenth in percent of married women with anemia and second in percent of children age 5-35 months with anemia

The state of Uttar Pradesh is a very rich floristic and ethnic diversity with traditional culture, and indigenous knowledge on potential plant taxa. The rich diversity of wild plants are the source of food, medicine, fibre, oil, fuels, housing, clothing, contraceptive and other material needs for the humankind. Large numbers of tribal peoples live in close vicinity of the forests practice primitive agriculture, observing traditional practices like fishing, hunting, gathering foods religious ceremonies, tabbos, and belives ethnoherbal therapy. Some potential wild edible plant species like, Aegle marmelos, Allium ceppa, Amaranthus spinosus, A. viridis, Basella alba, Bauhinia vahlii, Boerahavia diffusa, Bombax ceiba, Bridelia squamosa, Buchanania lanzan, Butea monosperma, Cajanus cajan, Carica papaya, Carissa opaca, Centella asiatica, Citrus medica, Curcuma amada, Diplazium esculentum, Emblica officinalis, Ficus recemosus, Flocourtia indica, Ipomoea aquatica, Limonia elephantum, Momordica dioica, Oxalis corniculata, Phyllanthus fraternus, Physalis minima, Portulaca oleracea, Puraria tuberosa, Rumex hastatus, Anthocephalus chinensis, Antidesma ghaesembilla, Solanum nigrum, Shorea robusta, Sterculia urens, Trminalia arjuna etc. are consumed as food and meeting the iron and zinc requirements by the tribal and aboriginal populations. The plant species highlighted in this paper needs further investigation and conservation for standardization and development of value added product and formulations meeting the iron and zinc requirements through the chemists, pharmacologists and clinicians in the healthcare and human welfare.

Key words: Zinc deficiency, Pharmacologists, Adequate vitamins and minerals

SIX/O-18

Livelihood Security and Sustainable Development

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Sustainability is not an option but imperative. Environmental deterioration and economic decline disengages sustainability through poverty, pollution and poor health. The rapid increase in land degradation, increasing floods and droughts, marching deserts and deteriorating conditions of fragile ecosystems, deforestation, loss of biodiversity and environmental pollution have become subjects of serious global concern. Greening programme is both people centered and environmentally sound. It meets the challenges of food accessibility through food for work scheme, fodder for livestock, conserving soil, water and biodiversity, increasing agricultural production, enhancing off-farm employment, livelihood and environmental security by strengthening local resource management systems with the active involvement or people. Natural resources particularly land, water and forests including biodiversity occupy centre stage for the welfare and development of people. National forest policy 1988 also envisages 33% of land area under forest tree cover. The successful implementation of the programme will help the country achieving ecological security, environmental and economical balance and hold the country in pride position amongst developed nations of the world. Greening will ensure sustainable management of land, water, forest and biodiversity integrated development of these natural resources will bring desirable peace and prosperity happiness, livelihood security and sustainable development. Noteworthy efforts made in the country to recognize the contribution of forestry and tree resources to ecological stability and people centered development through qualitative and quantitative improvements are discussed.

Key words: Sustainable development, Greening programme, Tree resources

SIX/O-19

Legislations and Bye Laws to Make Green Cities and Buildings

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This paper briefly discusses the diverse legislations that have been framed to make ecologically sensitive decisions by professional. More closely, the paper will look into Byelaws that have been adopted by cities to make the city and its buildings green. These Bye laws will not only help professionals but also common man to make ecologically sensitive decisions.

Key words: Legislations, Green buildings, Sensitive decisions

SIX/O-20

Study of Macrobenthic Fauna in the Intertidal Zone of Gorai Creek, Mumbai

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Present study deals with the assessment of macrobenthic biodiversity for the period from September 2006 to August 2007 in the intertidal zone of Gorai creek (Location: 19°10' N-19°20' N and 72°46' E-72°55' E) of northwest coast of Mumbai, India. Two Stations of Gorai creek were selected of which Station-1, with exposure to anthropogenic activities was found to have 13 species of macrobenthic fauna. It showed dominance of polychaetes inhabiting in the soft fine sediment while station-2, comparatively less disturbed, showed presence of 29 species throughout the year, witnessing abundance of molluscs in the sandy sediment. The population of macrobenthic fauna at station-1 was 2125 indi./m^2, while it was 1580 indi./m^2 at station-2; having little difference in density structure.

Many biotic and abiotic factors are responsible for variations in benthic population structure, ultimately indicating fishery potential of the aquatic ecosystems. An effort has been made to understand the correlation between biodiversity of macrobenthic fauna and the environmental variables as well as consequences of alteration in these environmental features leading to declining diversity of macrofauna in the aquatic ecosystems.

Key words: Gorai creek, Macrobenthos, Biodiversity, Polychaetes, Mollusks, Environment

SIX/O-21

Impact of War on the Ecology

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War is the highest form of armed conflict. It is an act of high or low intensity violence, involving the use of force, intended to impose one's will on the other. Once it outbreaks, war challenges realistically every institution of the human society and ecosystems in terms of living and non-living elements of the environment. Ecology signifies the present and future of individuals and their societies. Inflicting destruction on the ecosystems means initiating severe damages to the society itself.

There have been a number of wars in which deliberate military operations were launched to cause death, destruction and despise on the enemy's side by assaulting the environment. These wars have undercut or devastated environmental, physical, human and social assets in alarming degrees. Empirical studies bear the testimony that it eventually culminated into the loss of materials and manpower, subsistence and opportunity, as well as erosion of human dignity and human rights. Occupations and survivals are directly affected through diminished access to land, and inadequate availability of natural resources, as a

consequence of exclusion, forced displacement and the destruction of biodiversity. It gives rise to new tensions and conflict over many critical resources, such as water, food or energy. Each deleterious impact of war on the environment accumulates and compounds with all the other injuries, and ultimately the welfare of future generations is endangered. Generally, the impoverished and institutionally weak countries, usually with low GDP and per capita income, have alarmingly high risk of such losses due to war.

Among human activities bringing short- and long-term ecological impact, war is both intensive and far-reaching. Yet ecological studies intertwined with warfare are limited in depth and scattered by discipline. This paper relates to a field of study called "warfare ecology," provides a taxonomy of warfare useful for systematizing the field and proposes research directions and policy implications that emerge from the ecological study of warfare. The paper entails that warfare ecology encompasses the three stages of warfare--preparations, outbreak and operations of war, and postwar activities--and considers bio-physical and socio-economic systems as coupled systems. A number of empirical studies suggest intricate relationships between warfare and ecosystem change. Prospective researches require the development of theory and methodology for studying the short- and long-term effects of warfare on specific ecosystems. Policy implications may prompt for initiating greater integration of ecological science into national defence planning and improved rehabilitation of postwar ecosystem services, leading to increased peace, security and sustainable development.

Key words: Warfare ecology, Ecosystem, Sustainable development

SIX/O-22

Biological Delignification and Chemical Pretreatment of Wheat Straw for Bioethanol Production: A Comparative Study

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Wheat straw is an abundant agricultural residue with low commercial value. An attractive alternative is utilization of wheat straw for bioethanol production. However, the production cost based on the current technology is still too high preventing the commercialization of the process. In present study comparison of biological and chemical treatment on wheat straw were studied. The biological delignification was carried out using white rot fungi, *Pleurotus ostreatus* HP-1 (Gene Bank Accession no. EU420068) and chemical pretreatment by acid and alkali. The result obtained indicates the removal of 13-50% lignin with both biological and chemical pretreatments. The pretreated Wheat straw thus obtained was further saccharified using *Aspergillus ellipticus* and *Aspergillus fumigates*. Maximum saccharification obtained was between 41-44% with an enzyme loading of 6 FPU. The hydrolysate thus obtained was used for bioethanol production using *Saccharomyces cerevisiae* NCIM 3570 strain. The ethanol yield increased by 60% in treated wheat straw as compared to untreated wheat straw. This study shows that biological pretreatment holds potential in utilizing agricultural waste for the production of sugar and biofuels.

Key words: Wheat straw, White rot fungi, Delignification, Pretreatment, Saccharification, Bioethanol

SIX/O-23

Sustainable Biofuel Cell for Green Technology

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Generation of sustainable power using biofuel cells is considered as an elementary problem in their practical applications. This is a report on designing a sustainable enzymatic biofuel cell coupled to the large scale production of the enzyme laccase. Laccase is an oxidoreductase enzyme produced by fungi and bacteria; and can be used at the cathode of a biofuel cell. Laccase can be produced on a large scale by co-culturing the fungi *Trametes versicolor* with *Candida* sp. Enzyme production can be increased 24-fold by addition of aniline. A part of this laccase can be used to refuel the biofuel cell, which uses laccase at cathode. Thus, there is a continuous power generation by the biofuel cell. This power can be used for pumping the feed into the fermentor used for laccase fermentation. Thus, biofuel cell as well as laccase production, a source of continuous power generation. Rest of the laccase enzyme can be used for various industrial and biotechnological applications like detoxification of industrial effluents, as an agent for bioremediation, manufacturing anti-cancer drugs and to produce more biofuel cells.

Key words: Sustainable, Biofuel cell, Laccase fermentation, Industrial application, Bioremediation

SIX/O-24

A Study on Understanding the Perception of Farmer's about Climate Change and their Adaptation Measures in Eastern Dry Zone of Karnataka

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Climate change is one of the biggest challenges facing the world today. The problem of human induced climate change first came into force and drew the attention of the scientists and policy makers when Inter Governmental Panel on Climate Change (IPCC) was established. The effects of global climate change are many folds and there is need to create awareness and its impact on various sectors of economy. Agriculture and Climate are mutually dependent.

There is a need to understand the effect of climate change on agricultural sector both at Global and as well as at regional level especially from the point of view of providing food to vulnerable section of the population. The study was conducted to understand the perception and adaptation measures initiated by farmers' in response to climate change. Two important climate change parameters viz., rainfall and temperature during time interval before and after 2000 were considered for the study. The data was collected from 120 respondents in three districts of the Eastern Dry Zone (Zone-5) of Karnataka and analysed with the help of suitable statistical tests. The findings indicated that, more per cent of farmers had high followed by medium and low perception level about climate change before 2000. With regard to climate change after 2000, majority of them had medium followed by low and high level of perception. With respect to adaptation measures in crops like Ragi, Paddy and Mulberry after 2000, majority of the farmers' initiated short duration varieties, changed in planting dates, increased fertilizer dosage, irrigation etc, and also they constructed farm ponds and initiated many soil and water conservation practices, but very less number of farmers' initiated above practices before 2000.

Key words: Adaptation, Agriculture, Climate, Perception, Rainfall, Temperature

SIX/O-25

Alkali Pretreatment and Enzymetic Hydrolysis of Kans Grass to Fermantable Sugars for Bioethanol Production

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In view of rising prices of crude oil due to increasing fuel demands, the need for alternative sources of bio-energy is expected to increase sharply in the coming years. Among potential alternative bio-energy resources, lignocellulose have been identified as one of the important source of bioethanol. Lignocelluloses biomass as agricultural, industrial and forest residuals or waste account for the majority of the total biomass present in the world. Two approaches have been developed in parallel for conversion of lignocelluloses to ethanol "acid based" and "enzyme based". The enzyme based technology is advantageous over chemical treatment due to higher conversion efficiency, absence of substrate loss due to chemical modification and the use of more moderate and non-corrosive conditions like low temperatures, neutral pH values and use of biodegradable and non toxic reagents.

Bioconversion of lignocellulosic material to ethanol consists of four major unit operations: pretreatment, hydrolysis, fermentation and product separation/distillation. Kans grass, a lignocellulosic biomass, non-competing with agricultural land and do not require extra concern for its cultivation was used as lignocellulosic raw material in this study. The full characterization of biomass including lignin, holocellulose, ash content as well as moisture content was estimated. Alkali pretreatment was optimized at 121°C with different concentration of NaOH (0.5, 1, 1.5 and 2% w/v) by loading 5% biomass for different residence time duration (30, 60, 90 and 120 minuets). The liquid fraction was estimated for percentage of lignin solubilization and maximum xylose sugars released and was estimated to be 28% and 2.2g/l with 78% solid residue recovery. The solid residues was further used for hydrolysis with the crude mixture of (20 FPA Units/g) enzyme produced by *Trichoderma reesei* (obtained from NCIM) and 7g/l of maximum reducing sugars was obtained when Kans grass was pretreated with 0.5% w/v NaOH at 121°C for 120 minutes. The total reducing sugars form was estimated to be 164mg/g dry weight. Further step of fermentation to obtain ethanol was carried out by hexose and pentose fermantating yeasts *S. cerevceae* and *P. stipitis* respectively.

Key words: Alkali pretreatment, Kans grass, *T. reesei*, Cellulase, Saccharification

SIX/O-26

Role of Mass-Media in Generating Environmental Literacy among Masses: An Analytical Study

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The interrelationship and coexistence of man and nature is so deep and intricate that one is almost indispensible for the survival of other. Both are inter-woven in such a manner that without each other they cannot survive. Nature has provided all which man has earned from it but in return he has ruthlessly exploited the nature. The pace and nature of environmental change in recent years have brought about a series of environmental problems of global magnitude. This has resulted in concern which has dramatically increased among the public over the last few decades. It has been found that people of developed countries are more sensitive in their behavior towards nature. Issues like global warming, depletion of ozone layer, dwindling forests and energy resources, loss of bio-diversity etc. which are going to affect the mankind as a whole are global in nature and for that we have to think and plan with global outlook. Public awareness about environment is at a stage of infancy. Whatever knowledge people have acquired, has been accumulated from informal sources or that which has been studied in schools. The time is ripe where the mass has to be educated in this field. Today media is hovering over us at its fullest. Media, both print as well as electronic has proven its capability of greater coverage than any other source of spreading awareness regarding environment. Radio and television technology offer great potential for the communication as it is easily accessible, cheap and effective. According to NRS, 2006 there are average of 95 million people who listen FM radio per week, 230 million averages per week viewership of television and 200 million approx. newspaper readers. It is quite clear that media is so prevalent that they can create a very powerful impact on masses. Many educationists and eminent persons have suggested that media

could be used as an effective tool to spread environmental literacy among people. In this study the researchers have tried to find out the accessibility of mass-media among people in rural and urban areas as well as to analyze the role media plays in generating environmental literacy among masses.

Key words: Environmental literacy, Masses, Media, Accessibility

SIX/O-27

Theory, Practices and Perspectives in Environmental Education in India

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Environmental awareness deserves to be propagated at all levels. Students constantly need to be made to understand that environmental conservation can be achieved if we all share a single thought, the thought of creating a better world to live in, the thought to give a better deal to everyone, human or otherwise, to the present as well as to the future generation who all have to share God's great gifts of clean environment and with abundant natural resources on our planet earth. They should be taught that environmental protection encompasses not only pollution but also sustainable development and conservation of natural resources and the ecosystem. The focus of mine revolves around examining the extent to which awareness about the environment has percolated into the students' consciousness, and making a frank appraisal of enforcement measures adopted so far in protecting the environment.

Today, the need of environmental awareness and enforcement is more demanding and urgent than ever before. Planners, educationists, guardians and students are fully aware of the consequences but are in no position to do much about it. Till date, they have become accustomed to the traditional passing on of knowledge which they possess to these students. But the question arises is that are they imparting the actual facts of what exactly is going on in around them and the measures that needs to be taken to sort out the big question in hand, i.e., to how to protect our environment and its resourcesfi Are the present methods in practice preparing the younger generation to evolve into actual protectors of the environment with an in depth understanding of the constantly changing situationsfi

Integrated with several of the existing methodologies in practice, the use of simulations will assess the likely performance of individuals in similar environments, which particularly, but not exclusively, could be an assessment tool. Though simulated environments can never be identical to reality; results show the growth of better levels of preparedness and understanding of environmental education as a subject in students. Students' commitment and dedication towards first understanding the problem in hand and towards the cause of protection, preservation and conservation of environment increased. Once fed with ample amount of information, they can be made to increase environmental awareness or even teach them how to help remedying environmental problems. This paper analyses the relevant aspects in detail.

Key words: Environmental education, Environmental awareness, Sustainable development, Consciousness, Assessment

SIX/O-28

Unified Approach to the Teaching of Environmental Sciences

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A unified approach to the teaching of the Environmental Science is a guiding principle in the field of Environmental Education. The content of this principle is reflected in the materials of the Tbilisi Conference. In unified approach the emphasis is on Environmental Education which is centered on practical problems and of interdisciplinary character. Environmental Education should not be just one more subject to add to existing programme intended for all learners, rather it should play the role of a catalyst, in the renovated process of modern instruction.

This paper deals with the way through which unified approach to the teaching of Environmental Sciences, adopted in schools. The curricula programme designed for the school children should be such that the students perceive the environment as a whole.

- The unified approach comprises three linked components:
- Education about the environment (Knowledge)
- Education for the environment (value, attitudes, positive action)
- Education in or through the environment (a resource)

The paper deals with the suggestion about the inclusion of these components in various school disciplines and related activities. The paper also deals with the challenges which need to be faced by the teachers, curriculum planners for such unified approach. The unified approach to the teaching of Environmental Sciences should be a means for promoting the recognition by peoples of certain units of the educational process and make it possible for them to develop the knowledge, skills and attitudes for preserving our environment.

Key words: Unified approach, Interdisciplinary, Curriculum programme, Environmental sciences

SIX/O-29

What Makes Ordinary Looking Plants as Weeds

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Weeds are plants with efficient reproductive system,

better adaptability and greater survivability. All these features enable them to overshadow the native flora and to tide over the unfavorable environmental conditions. *Commelina benghalensis* L and *C. caroliniana* Walter are two rainy season weeds growing prolifically in tropical and sub-tropical regions of India. The two are interesting in that both are andromonoecious, the former being highly polymorphic and the latter monomorphic in their foliar and floral features. *C. benghalensis* bears male, bisexual chasmogamous and bisexual cleistogamous flowers on as many branch systems whereas *C. caroliniana* bears male and bisexual chasmogamous flowers only. In addition to these, structural and functional variations also occur in the bisexual chamogamous flowers of both the species. Together these influence the breeding system to a great extent. Coupled with efficient reproductive output in terms of high fruit and seed sets, greater seed germination, seedling survival and seedling establishment; floral diversity puts the two taxa at advantage above the rest. Besides this, both the taxa are able to contribute genetically diverse seed to the next generation ensuring immediate fitness and long term evolutionary flexibility. The presentation will tend to highlight these aspects.

Key words: Weeds, Breeding system, *Commelina benghalensis, C. caroliniana*, Native, Polymorphic, Monomorphic.

SIX/O-30

Comparative Studies of Antibacterial and Antifungal Activity of Different Parts of *Withania somnifera* Against Multi-Drug Resistant Pathogens

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There is a continuous and urgent need to discover new antimicrobial compounds with diverse chemical structures and novel mechanisms of action as there is an alarming increase in the incidence of new and re-emerging infectious diseases. Another big concern is the development of resistance against antibiotics in current clinical use. Some plants have shown the ability to over come resistance in some organisms and this has led to researchers to investigate their mechanisms of action and isolating active compound. Selected plant, *Withania somnifera* (Aswagandha) is extensively used in traditional Indian and Ayurvedic medicines, in fever, painful swelling (Inflammation), Opthalmitis, as abotifacient, adaptogen, antibiotic, aphrodisiac, deobstruent, diuretic, nacrotic, sedative and tonic. The present study deals with antibacterial and antifungal activity of acetone and petroleum ether extracts of different parts of *W. somnifera,* which were screened against *Pseudomonas aeruginosa* and *Candida albicans*. Results reveal that crude extract was found to be maximum in ripen fruits (11.73%) in acetone extract and 9.47% in petroleum ether extract. Maximum antibacterial activity against *Pseudomonas aeruginosa* was shown by leaf extract in petroleum ether (IZ=20mm) followed by root extract in acetone (IZ=14 mm) and maximum antifungal activity against *Candida albicans* was shown by leaf extract in acetone (IZ=10mm) followed by stem extract in petroleum ether (IZ=8mm). The comparative study has proved that petroleum ether extract of leaf has higher antibacterial activity then acetone extracts whereas acetone extract of leaf has higher antifungal activity than petroleum ether extracts.

Key words: *Withania somnifera*, antimicrobial activity, *Candida albicans, Pseudomonas aeruginosa*

SIX/O-31

Effect of Seed Mass and Light Intensities on Seedling Success on *Mesua ferrea* Linn.

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Seeds contain all the required materials for the development of a new plant provided they receive favourable environmental conditions for germination. Light is one of the abiotic factors that affect not only the rate of germination but also the pattern of growth and development. However, in addition to other environmental factors, the weight of the seed itself is an important determinant of the viability of seeds as well as its response to the existing external environment. The present study was undertaken to analyze the combined effect of varied light intensities and difference in seed weight upon the germination, survival and growth of seeds of *Mesua ferrea* Linn. Results thus obtained showed that the rate of seed germination is related inversely to the intensity of incoming solar radiation and related directly to the seed weight. In addition to this behaviour of seedlings in terms of resistance to sunlight, at different light intensities and for different seed weight growth rates as well as pattern of development establish differently. Seeds germination and development in shady area were found to be more favourable than the open site and the lightest seeds weight were found to be the least viable.

Key words: *Mesua ferrea* Linn., Seed weight, Light intensity, Germination, Growth, Development

SIX/O-32

Bioenergy and some Future Prospects

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Bioenergy is one of the renewable energy sources that can readily replace fossil fuels, while helping to reduce green house emission and promoting sustainable rural development. Agriculture and forestry residue represent a potential low cost and low carbon source for bioenergy. Biomass covers more than ten percent of the world primary

energy demand (about 50 EJ year_1) and biomass resource are by for not fully used. 86% of this energy is in the form of fossil fuels (coal, petroleum, natural gas) resulting in over 8.5 Gt Cyr-1 of carbon dioxide (CO2) emissions. Because bioenergy is carbon neutral (i.e. net carbon emissions from bioenergy are negligible) using biomass to produce electricity can displace CO2 emission from combusting fossil fuels in power generation. As global supplies of fossil resource tighten and concerns about climate change mount, interest is growing in biomass energy as a means to replace some part of the energy portfolio currently occupied by fossil fuels. The response to the energy and climate challenges will require a dramatic restructuring of global energy portfolio with bioenergy likely to play an increasing role.

Considering the global magnitude of agriculture and forestry production, residue biomass is potentially a large and under-utilized resource. Utilization of a residue biomass is an economic decision, influenced by competing crop and energy prices as fill as the price of carbon. Given the potential for bio energy from residue biomass, further research is needed as to how the most sustainably harvest this resource, and how to most efficiently convert it to energy. Inter-annual variability on local residue production will need to be buffered by appropriate storage and transport systems, coupled with national and international biomass markets. The ability to use residue from different source interchangeable at the end-use, wood also help buffer local variation in supply, although this is likely easier to achieve for combustion and gasification technologies than for biologically-based technologies such as cellulosic ethanol conversion.

There is dramatic expression of bioenergy production particularly bio fuels for the transportation sector, motivated by a efforts to increase domestic energy supplies, boost rural, agriculture economics and to reduce green house gas emissions by replacing fossil fuel. The ability of bio energy systems to (I) give security of supply (II) economically compete with fossil fuels (III) ensure assist and meeting of individuals 'minimum energy needs (IV) contribute to revenue and reduction in fuel imports of bio fuel producing countries (V) create export potential (VI) create local and national employment (VII) create income and wealth (VIII) diversify rural economies and business risk are some of key economic sustainability factors. It is essential to incorporate feed stock production, energy conservation and policies. Thus, efficient development of bioenergy lies in the optimization of its entire value chain. In this sense, policies that encourage the vertical integration of the industry and internalize or alleviate the externalities (e.g. environmental externalities) associated with the production and consumption of bioenergy would be more efficient.

Key words: Bioenergy, Biofuels, Renewable energy, Residue biomass

SIX/P-1

Potential of Azolla as a Biofertilizer on the Production of Wheat (Triticum aestivum) crop

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An experiment was conducted to know the response of *Azolla* as a biofertilizer for wheat (*Triticum aestivum*) crop. The application of *Azolla* may be very much beneficial to conserve the environment for developing renewable, sustainable resources and to provide a natural source of nitrogen. Besides the environmental suitability, the use of *Azolla* may enhance the economic status of many of the poor farmers by increasing yield while minimizing the cost. The present study deals with the use of *Azolla* either solitary or in combination with two levels of chemical fertilizers i.e. 60 and 80 Kg N ha^{-1}. It was observed that solitary application gave better product as compared to treatment combinations.

Key words: *Azolla*, Biofertilizer, Chemical fertilizer, Sustainable resources, *Triticum aestivum*

SIX/P-2

Smart Farming: The New Age Agriculture

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Agriculture is the most important part of wide biological industry, several significant measures and technologies have been used to support the sustained growth of agriculture that can cater to ever rising demands of the population in terms of food, clothes and medicine. These include improvement in the plant varieties by conventional breeding methods, followed by the use of genetic engineering tools in recent times, which is time consuming, expensive and at times lack the wide acceptability because of several legal, ethical and health related reasons and also not being environment friendly. On the other hand there are practices like improvement in conventional methods of agriculture that include optimized, slow and delayed release fertilizers with the use of organic matrix or more recently with the use of the expanding horizon of the nanomaterials. The ability to design materials at the atomic or molecular level is likely to have profound impact on the new age agriculture, through the development of coatings, barriers, release devices and novel packaging materials. These are being produced through the use of composite structures (nano assemblies) formed from successive molecular layers of different polymers and this approach may be adapted for controlled or slow release of fertilizer only upon the need or over the extended period of time. This review deals with the comparative use of conventional and organic matrix based fertilizers with an advanced idea of incorporating nanomaterials in agriculture for still efficient and more prolific availability of fertilizers and to have least adverse effect on environment as well as on the consumers. Further,

due to the recent developments in the prospects of scaling down of the electronic transistors to the molecular size, it brings forward an idea of incorporating nano devices into the future agricultural machinery to collect and transmit vital real time data like growth rates and physiological activities that can provide clues on performance, productivity and exposure to environment, chemical and biological hazards.

Key words: Agriculture, Nanomaterials, Fertilizers, Transistors, Environment

SIX/P-3

Conservation Dynamics of Certain Fishes in the Barind Tract (Northern Part in Bangladesh)

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Conservation dynamics of the indigenous two catfish, two snake heads and one climbing parch in the Barind tract is discussed in the paper. The ecological adaptations, the environmental aspects and their interactions in favour of their journey to the continuity are kept in focus.

Key words: Conservation, Indigenous, Ecological adaptations

SIX/P-4

Toxics Tour in Home

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"We don't just get sick but are being made sick. The age old question, 'Why mefi' and 'Why nowfi, do have answers". Yes!

In fact most of us expect our home is the safest place for us environmentally speaking. We don't need to go into open world which is polluted. Approximate 60% of all chemical pollution is within house. Many of us use toxic chemicals in daily life, sometimes aware of it, sometimes not.

Toxins were found in many household utility closet cleaning products, in the kitchen like anticling sheets, disinfectants, in living rooms like moth repellants, soft vinyl toys, baby bottles, even furnishings, in bath various cosmetics etc. These hidden pollutants in our home can cause tremendous symptoms and have serious consequences of health and behavior.

Toxic chemicals in homes can be eliminated by making thoughtful choices after educating oneself about where the hazards are in common consumer products. One shelf of simple and relatively safe ingredients can be used to perform most home cleaning chores. There is a need that we know how can we make our indoor atmosphere. Besides, man made sources in our homes like television, mobile, CFL etc. also emit electromagnetic radiations and cause various health problems.

Mother Nature is a wonderful women. Living green and flowering indoor plants are not only decorative but may provide a valuable tool for removing toxic chemicals from indoor air in home.

Key words: Pollutants, Chemicals, Consumer products, EMR, Plants

SIX/P-5

Studies on Algal Pollution of Amaravati Dam of Dhule District, Maharashtra (India)

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Certain forms of algae may be toxic are may ecologically modify the physical and chemical environment sufficiently to retard or ever prevent growth. The oxygen production and utilization of nutrients substances by algae may greatly modify the colour, odour or test of the water.

In present investigation different stations of Amravati Dam of Dhule district of Maharashtra (India) was selected for collection of water and algal sample at the interval of one month from November 2006 to October 2007. The quantitative and qualitative study of three groups of algae viz. cyandrophycal, chlorophycae and Bacillariophycea was made for one year palmers's pollution indices were calculated for assessing the organic pollutions with relation to algae hold good for assessing the water quality of Amaravati Dam. At all the station of dam 20 pollution tolerant genera were recorded. By using Palmer's index for rating of water samples as high or low organically polluted at the station of dam was examined. The total score of Amrawati Dam Station (ADS) II and ADS III stations were 20 and 28 respectively which indicates high organic pollutants in dam. In ADS I station the score is less than 20 which indicates the rate of organic pollution low as compare with ADS II and ADS III. In present study algal communities were used as indicator of organic pollutants.

Key words: Algae, Pollution, Indicators, Dam

SIX/P-6

Past and Present Occurrence of the Genus *Dipterocarpus* Gaertn. in the Sub-Himalayan Zone of Nepal and its Palaeoclimatic and Phytogeographical Significance

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The Churia group is delimited on the south by the Main Frontal Thrust (MFT) and on the north by Main Boundary Thrust (MBT). It consists of basically of fluvial deposits of Neogene age (23 million years to 1.6 million years old). This extends all along the Himalaya forming the southern most hill range with width of 8-50 km (Fig1). The general dip of the beds of the Churia formation has north wards trend with varying angles and the overall strike is east west. The study area of Arjun khola falls in the Dang Section of western Nepal. Almost a complete and uninterrupted sequence of Churia group is well exposed all along the road from Arjun Khola to Ghorai ranging in age from Middle

Miocene – Middle Pleistocene. The Arjun khola sequences mostly consist of molasses sediments of the Lower and Middle Churia formation. The whole sequence is divided into14 profiles on the basis of their lithological characters. There are more than 30 fossiliferous beds of mainly shales. Siltstones and few fine grained sandstones yielding a variety of well preserved leaf, fruit and flower impressions.

Investigation on the plant megafossils collected from Churia group (10-12 Ma) of western Nepal reveals the presence of fossil wood, leaf and fruit impressions of a phytogeographically important genus, *Dipterocarpus* Gaertn. of the family Dipterocarpaceae. They have been identified with *Dipterocarpus indicus* Bedd. *Dipterocarpus alatus* Roxb.and *Dipterocarpus bourdillonii* Br. The analysis of present day distribution of the comparable forms of fossil remains indicates that all the extant species of the genus *Dipterocarpus* Gaertn. do not grow in the sub-himalayan zone of India and Nepal, they are presently distributed in the evergreen forests of South-east Asian region (Mayanmar, Malaya, Java and Borneo etc) where there are more atmospheric precipitation. This suggests that after rise of Himalaya, drier condition was prevailed due to which such moist loving species could not survive there. Based on the present and past distribution of the comparable extant species of *Dipterocarpus* the phytogeography as well as route of migration of this genus has been discussed.

Key words: MFT, Lithological characters, Evergreen forest, Atmospheric precipitation

SIX/P-7

Extraction of Cactus (*Opuntia ficus indica*) Mucilage using Different Solvents

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The cactus *Opuntia* (subfamily Opuntioideae, family Cactaceae) is well known as cactus pear plant or nopal. Due to their efficient water use, this plant exists in arid and semi-arid regions of the world. It can be easily grown from the cuttings or from the seeds. With thick water –retaining stem, lack of leaves and extensive root system, the cactus is well adapted to dry environment conditions and it can be raised with minimal care and attention. *Opuntia* genus is widely known for its mucilage production. Mucilage, a complex carbohydrate with a great capacity to absorb water, is considered a potential source of industrial hydrocolloid. The mucilage content found in the cactus cladodes is influenced not only by the management of the crop but is also dependent on the temperature, irrigation and the rainfall. Cactus mucilage, from the pads of the *Opuntia ficus-indica*, is known to remove contamination from drinking water and also used as cattle feed in some desert areas.

Traditionally the mucilage is extracted by boiling of cactus pads in water, but to improve the quality and quantity of mucilage, optimization of conditions is needed. Secondly if the mucilage is to be obtained in relatively pure form and is to be stored for long time, an appropriate precipitation step should be incorporated. The present paper deals with comparative performance of different extraction methods. The extraction and precipitation of the mucilage from *Opuntia* plants have been studied under different conditions. The conditions for extraction were optimized by changing the pad/water ratios (1:20, 1:10, 1:5), extraction temperature, (45±2 and 20±2 °C) and extraction time (6, 12 and 24 h). For the precipitation of the mucilage two types of alcohol (ethanol and isopropyl alcohol), acetone and two water/alcohol ratios (1:2 and 1:5) were used. Maximum precipitation was obtained with acetone and minimum with water/alcohol 1:5 ratio. The average mucilage yield after drying was 1.7% based on fresh weight and 4.8% based on dry weight. The data related to mucilage yield under different condition with solvent will be presented.

Based on this work appropriate technology for extraction and precipitation of mucilage can be proposed.

Key words: Cactus, Prickly pear, Mucilage, Precipitation

SIX/P-8

Asia Brown Haze

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A radio carbon study of aerosol particles has pointed biomass burning as a major source of the giant brown haze that periodically hovers over large portions of South Asia.

This atmospheric brown cloud shows up in the winter and has been attributed to both fossil-fuel and biomass burning. This causes pollution related health problems in the region and likely impacts climate-related problem such as glacier melting. The carbon isotope ratios of aerosol particles from western India and the Indian ocean is found that the particles had higher concentrations of ^{14}C, which is associated with recent plant life fossil fuels, by contrast, have much lower concentrations of the isotope. The contributions of carbonaceous aerosol particles from biomass burning, such as agriculture and home-scal wood and cow dung fires, need to be reduced to shrink the cloud.

Tungsten causes physiological stress to flora or fauna. We eat plants but we do not know, which plant contains which metal in its tissue polytungstates may play a role in plant toxicity by elisrupting the production of energy transporting adenosine triphosphate and signaling pathways.

Sunflower roots contains twice the amount of tungsten but leaves and stem accumulate less. Mercury is poisonous which is absorbs by plants and goes to food chain, and it is toxic. Plant burning causes much of South Asia's brown haze, as seen in Pune, India.

Key words: Aerosols, Biomass burning, Brown haze, Fossil fuel

SIX/P-9

Utilization of Potato Extract for the Production of *Spirulina platensis*

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Attempts were made to culture *Spirulina platensis* in potato extract to achieve biomass production for potential application using different concentrations with supplementation of prescribed medium i.e. CFTRI (1983). *Spirulina platensis* was grown in potato extract in different concentration from 10 to 50% in triplicate at 1600 L light intensity and 31°C temperature under 10/14 light-dark period. Harvesting was done after 28 days of inoculation and growth was measured in terms of dried biomass. The culture results showed that *Spirulina platensis* grows successfully in 10% potato extract and yields maximal biomass over CFTRI medium and other concentrations.

Key words: *Spirulina platensis*, Potato extract, CFTRI medium, Biomass production, Light intensity

SIX/P-10

Insecticides: Its Role in Increasing Environmental Toxicology

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Any toxic substance used to kill animals or plants that damage crops or ornamental plants or that are hazardous to the health of domestic animals or humans. All pesticides act by interfering with the target species normal metabolism. They are often classified by the type of organism they are intended to control. Some inadvertently affect other organisms in the environment, either directly by their toxic effects or via elimination of the target organism. Pesticides or chemicals are meant to control harmful pest. However unbalanced, unscientific, unprotected and extensive use of pesticides has created more problems than resolving them such as adverse effects on the non-target organism like pollination, parasitoids, predators and wild animals, this also adversely affected the ecological balance and caused environmental pollution. Pesticides and other persistent organic pollutants (POP's) harms human health and the environment; human everywhere carries a (POP's) body burden that contributes to disease and health problem. Pesticides are non-biodegradable and its residue gets accumulated through the food chain in higher level of organism that is bio-magnification. The findings of higher chemical residue levels in water, sediment tissue result in skewed sex ratio, reduced biodiversity, gonadal malformation in sharp tooth catfish, histological impacts on spermatogenesis in catfish and striped mouse are matters of serious concern. This adversely affected the ecological balance and caused environmental pollution.

Key words: Ornamental plants, Humans, Target organism, Pesticides, Pollination

SIX/P-11

n-Alkanes and Associated Hydrocarbons in the Intra-Volcanic Bole Horizons from the Mandla Lobe of the Eastern Deccan Volcanic Province: Palaeoenvironmental Inferences

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Organic compounds extracted from the bole sediments were analyzed by GC-MS, show presence of n-alkanes (C_{16} to C_{29}), pristane and phytane. We have reported that n-alkanes concentrations in bole sediments ranging from 13.47 to 16.41 ppm. Carbon preference index (CPI) value (5.6) indicates its derivation from cuticular waxes of higher plants. Pristane (Pr) and phytane (Ph) concentrations varies from 0.19 to 1.66 ppm. In case of bole associated organic matter, values for Pr/Ph ratio is < 1, indicative of anoxic conditions. The negative excursion of δCe values associated with the bole clays is also supportive of this finding. It is concluded that the boles from the lower succession of the eastern Deccan volcano-sedimentary succession were formed under reducing environment. Such condition possibly preceded Lameta sedimentation, evidenced by the presence of smectite-rich clays in the Lameta sediments, derived from the weathering of the Deccan basalt. It implying that early activities of Deccan volcanism is associated with the highly anoxic conditions prevailed either during or just prior to the Maastrichtian Lameta sedimentation.

Key words: GC-MS, Eastern Deccan volcanic province, Organic compounds, Carbon preference index, Pr/Ph ratio

SIX/P-12

Role of Mushrooms as Environmental Managers

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Mushrooms are one of the best environmental managers. They are required with good tools particularly in the form of enzymes. These enzymes manages the waste material in such way that it is converted into a useful substance whether in the form of food, fuel or fertilizer and many more things like reduction in environmental pollution by sequesting heavy metal, carbon etc. Considering the immense importance of the mushrooms present study has been undertaking. Oyster mushrooms have been cultivated on different waste and spent mushroom compost was used as fertilizer, which enhance the fertility of the soil. From the present study we have concluded that mushrooms help us to develop eco-friendly atmosphere.

Key words: Compost, Ecofriendly, Mushroom, Managers

SIX/P-13

Variable Rates of Primary and Secondary Metabolites during Different Seasons and Physiological Stages in Medicinal Plants of Ahmednagar Tehsil

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In the present investigation attempts have been made to investigate the rate of plant metabolism during different seasons (rainy/winter/summer) and physiological stages (seedling, vegetative/flowering/maturity). Variable amount of metabolites have been found in the species with change in season and physiological stages. Investigations provided an idea of time of harvest of individual drug with optimum concentration of active principles like alkaloids, polyphenols, organic acids etc. Medicinal plants worked out include *Asparagus*, *Carissa*, *Convolvulus*, *Datura*, *Malva*, *Oxalis*, *Riccinus*, *Sida*, *Tribulus* and *Withania.*

Key words: *Asparagus*, *Carissa*, *Convolvulus*, *Datura*, *Malva*, *Oxalis*, *Riccinus*, *Sida*, *Tribulus, Withania* leaf pigments, Proline, Protein, Alkaloids, Phenols, Growth, Growth stages

SIX/P-14

Performance of Chilli Genotypes for Capsaicin, Oleoresin, Extractable Colour and Colour Value Content during Two Seasons

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Twenty-one selected chilli (*Capsicum annuum* L) genotypes of diverse origin were evaluated for quality parameters such as capsaicin, oleoresin, extractable colour and colour value from the fruits harvested in two seasons i.e. 2002-2003 and 2004-2005, for the identification of the genotypes having less capsaicin and high colour content. Significant difference ($p<0.05$) was recorded between the genotypes and within the genotypes during both the season for the above parameters. The average capsaicin content during two seasons ranged from 0.29 to 1.74% and the average oleoresin varied from 10.30 to 17.10%. The average extractable colour (the standard measurement of colour in the spice industry) ranged from 126.08 to 325.52 ASTA and the average colour value ranged from 50845 to 128380 c.u. Multivariate Cluster analysis based on Ward's method showed that the genotypes were mainly divided at the first node into 2 clusters with 12 and 9 genotypes which were further sub divided into two groups.

Key words: Chilli, Capsaicin, ASTA, Colour value

SIX/P-15

Phthalate Migration from Plastic Package to Edible Oil

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Packaging has become an indispensible element in the food manufacturing process and different type of additives, such as antioxidant, plasticizers, stabilizers, anti-blocking agent etc are widely used to improve the performance of polymeric packaging material. Plasticizers or Phthalic acid diesters (phthalates, PAEs) are key additives in many plastic, phthalates are a group of diesters of pthalic acid (dialkyl or alkyl aryl esters of 1, 2–benzendicarboxylic acid, increasing their flexibility only through weak secondary molecular interactions with polymer chains. Being not covalently bound to the polymer matrix, their migration from plasticized products to contact materials can occur through extraction (leaching) or evaporation processes. Worldwide production of PAEs and their widespread application in different products of everyday use has resulted in their massive presence in all parts of the environment and, consequently, in food. In this present study an attempt has been made to check the presence of phthalates in edible oil packaged in plastic packaging. Sample was prepared by phase equilibrium method and then analyzed by Gas chromatography- mass spectroscopy (GC-MS). For phthalate esters, the most intense peak in the electron impact (EI) ionization mass spectrum was at *m/z* 149 due to the rapid formation and stability of the ion. The presence of phthalate compound was noticeable through the spectrum, which clearly shows that compound was migrated from plastic packaging into the oil. In the recent year researches, it is clearly evident that phthalates possess estrogenic and carcinogenic properties and consumers are exposed through ingestion, inhalation, and dermal exposure during their whole lifetime, including intrauterine development.

Key words: Packaging, Plasticizers, Phthalate, Migration, GC-MS

SIX/P-16

Preparation of Herbal Drinks by Incorporating Wheatgrass Extract

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Wheat is consumed in large quantities in various forms like breads, bagels, donuts, pizza, cookies and deserts that are often highly processed, lifeless or even enzyme-less. However, the actual benefits of wheat are hidden in the wheatgrass which is the young grass of about 10 to 14 days after sprouting from the seed of wheat plant '*Triticum aestivum*'. The objectives of the study were to use wheatgrass

extract in the preparation of different juices, to assess the organoleptic quality of the developed juices and to calculate the nutritive value of the prepared juices after incorporating wheatgrass extract. Four herbal drinks were prepared, namely Carrot wheatgrass juice, lemon wheatgrass juice, pineapple wheatgrass juice and mixed wheatgrass juice with one control (T_0) and three treatments for each product i.e. T_1, T_2 and T_3 at 15percent, 30%, and 45% of wheatgrass extract respectively. The organoleptic analysis of these products was done using the Nine- point hedonic Scale, their nutritive value were calculated with the use of and the data were analyzed statistically using analysis of variance technique and critical difference. The results revealed that the Sensory scores of carrot wheatgrass juice showed that the overall acceptability was highest in T_2 (8.51) with 30 percent of wheatgrass extract. In lemon wheatgrass juice the sensory score of T_1 (8.1) with 15 percent of wheatgrass extract was best regarding the overall acceptability. Sensory scores of pineapple wheatgrass juice revealed that T_2 (8.3) with 30 percent of wheatgrass extract was liked very much and Mixed wheatgrass juice at (7.72) (with 15 percent of wheatgrass extract) level T_1 was found to score maximum. Among the four wheatgrass juices the lemon wheatgrass juice was best both organoleptically and nutritionally. Since lemon juice does not contain vitamin E, vitamin B_{12} and beta carotene but wheatgrass extract contains good among the vitamin E, vitamin B_{12} and beta carotene. Other nutrients such as energy, protein, carbohydrate, vitamin C, calcium, phosphorus, iron, magnesium and potassium of lemon juice were also enhanced after adding wheatgrass extract.

Key words: Wheatgrass extract, Herbal juices, Organoleptic analysis, Nine point hedonic scale

SIX/P-17

Use of IKONOS Satellite Images to Identify Slum Areas for Sustainable Human Settlements in Lucknow City, India

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The phenomenon of squatter settlements has to be seen as a stage in the process of urbanization in a developing country like India and not so much as a consequence of the growth of cities. The movement of large number of rural migrants to the urban areas has far reaching social implications in transforming the nature and character of urbanization in India. Slums in cities have been found to be invariably inhabited by the poorest of the poor, those at the bottom of social hierarchy and also engaged in the dirtiest occupations irrespective of the level of development of the society. Slums in India inhabited largely by the urban poor were earlier labeled as areas of despair signifying pessimism among those dwelling in them. The problem of urban poverty and consequently slums in India has most often ascribed to the persistent rural to urban migration due to various reasons such as health, education, employment, cultural, technological, commercial or industrial services and thus act as focal points development opportunities, economic, industrial etc. Lucknow is the capital of northern state of Uttar Pradesh. Today, Lucknow has more than 780 slums, overflowing sewage pipes and streets choked by gridlock. Its population of 2.7 million, nearly triple the number in the 1980s, is adding as many as 150,000 new residents a year. Lucknow has attracted hundreds of thousands of migrants from rural areas, swelling the city's population. As much as 70% of residents don't have sewage service, leaving much of the waste to flow directly into the Gomti River. Slums in Lucknow mainly located in Azad Nagar, Hasanganj, Ganeshganj, Wazeerganj, Daulatganj, Yahiyaganj, Saadatganj, Chowk, Alambagh and Hazaratganj etc and these are increase day by day.This research highlights the potential of IKONOS satellite images to identify the temporary structures of slum areas of Lucknow, India. IKONOS satellite images show the houses with plastic roof covers make known dark grey tone in merged, which helps to extract information about the people living in slums and below the poverty line. The Identification of these areas through the use of IKONOS satellite images can be quantified using classification technique successfully. Combination of shadow pixels with temporary structures poses limitation and need further research. IKONOS satellite images provide important information and structure of slum areas that helps to improve the quality of human being in slum area with resources and housing condition, education, health facility, water supply, electricity, sanitation, employment etc. for sustainable human settlements in Lucknow, India.

Key words: Slum areas, Sustainable human settlement, IKONOS satellite images

SIX/P-18

Process Standardization of *Lassi* by Incorporation of Whey and Stevia Powder

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The present study was carried out with the objectives to prepare Lassi by incorporation of whey and *Stevia* powder, to assess the sensory acceptability of developed product and to find the nutrient content and shelf life. Fifteen experimental treatments were prepared with varying proportion of whey and curd in 5 different ratio's viz.70:30, 60:40, 50:50, 40:60 and 30:70 and three variations of *Stevia* powder (viz., 0.13 percent, 0.15 percent and 0.17 percent) in each combination ratio of whey and curd. Each treatment was replicated three times. Sensory evaluation of all the three products was carried out using a 9 point Hedonic scale. The data obtained during the study were analyzed statistically using analysis of variance and critical difference techniques. On the basis of findings, it was concluded that T_{14} (70 percent curd, 30 percent whey and 0.15 percent *Stevia* powder) was found to be best in case of flavor and taste, consistency and overall acceptability whereas treatment T_{13} (70 percent curd,

30 percent whey and 0.13 percent *Stevia* powder) proved to be the best in terms of color and appearance. In all the combination of 70 percent curd, 30 percent whey and 0.15 percent *Stevia* powder proved to be the most acceptable combination. All the experimental treatments were also analyzed chemically using AOAC (1980) procedures. Nutrient analysis indicated that highest protein, ash, total solids, and total energy content was found in experimental treatment T_{14} while highest carbohydrate and fat percentage was found in treatments T_1 and T_{13} respectively. The shelf life of the best treatments T_{13} and T_{14} was checked by microbial analysis through yeast and mold count and presumptive coliform test for 7 days. The results revealed less than 100 cfu/gm (standard value) yeast and mold count and negative coliform test when compared with the standards given by PFA, 1955. Hence the product was acceptable till 7 days of refrigerated storage. Hence, it can be concluded that whey and *Stevia* powder can be successfully incorporated up to 30 percent and 0.15 percent in the prepared products.

Key words: *Stevia* powder, Sensory analysis, Hedonic scale, Coliform test

SIX/P-19

Analysis of Nutritional and Anti Nutritional Content of Underutilized *Digera arvensis and Celosia argentea* Leaves

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Aqueous leaf extracts of underutilized green leafy vegetable *Digera arvensis* and *Celosia argentea* were analyzed for nutritional and antinutritional composition. The proximate composition as well as mineral element analyzed. The Proximate composition, ascorbic acid, and β-carotene content of *Digera arvensis* and *Celosia argentea* on fresh weight basis included mainly moisture (79.98% and 84.39 %), Protein (4.36 and 1.45 g/100g), fibre (6.29 and 0.68 g/100g), carbohydrate (1.07 and 9.06 g/100g), energy (39 and 53 Kcal), ascorbic acid (40 and 60.6 mg/100g), β-carotene (816 and 2166 µg/100g) respectively. The mineral contents of the leaves were found to be Fe (22.38 and 26.48 mg/100g) and Ca (404 and 170.6 mg/100g) for *D. arvensis* and *C. argentea* respectively. Antinutritional contents of *D.arvensis* and *C. argentea* were obtained oxalate (165.14 and 23.4 mg/100g) and phytate (104.5 and 112.5 mg/100g) respectively. The results suggests that the plants leaves if consumed in sufficient amount could contribute greatly toward meeting human nutritional requirement for normal body growth and adequate protection against disease arising from malnutrition.

Key words: Underutilized green leafy vegetable, *Digera arvensis*, *Celosia argentea*, β-carotene, Antinutritional factors

SIX/P-20

Bioconversion of Xylose to Xylitol, a Natural Sweetener from Agricultural Residues

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Every year large amounts of wastes biomass are accumulated in nature, causing serious environmental pollution problems. Burning one ton of these waste would produce 1.7 tones of CO, NO, methyl chloride and other poisoning gases. The wastes output have been increased to a point where natural reclamation pathways are rendered in adequate. So it is necessary to find new technologies for economical use of these renewable products in order to decrease the costs of pollution control. In recent years, attention has been focused on the biotechnological process for production of several useful feed stocks and food products from agro-forest residues and agricultural residues such as rice straw, eucalyptus, and sugar cane bagasse. Rice straw is an agricultural residue containing xylose, which represents up to 90% of the total sugar present in the hemicellulosic fraction of this residue and can be converted to different products. One of these products, xylitol, is widely used in food and pharmaceutical industries. Xylitol production by fermentation may be an attractive alternative to the traditional process employing chemical synthesis. Xylitol is sugar's mirror image. While sugar wreaks havoc on the body, xylitol heals and repairs. It also builds immunity, protects against chronic degenerative diseases and has anti-aging benefits.

Xylitol being a five-carbon sugar has an antimicrobial effect preventing the growth of bacteria. Another significant property of xylitol is the prevention of dental cavity, thus making it the best nutritive sugar substitute with respect to caries prevention. Xylitol is easily metabolized (independently of insulin) in human body and produces the same amount of energy (4 cal/gm) signifying its application in all diabetic foods. Xylitol also has skin smoothing properties. By the 1960s, xylitol was being used in Germany, Switzerland, the Soviet Union, and Japan as a preferred sweetener in diabetic diets and as an energy source for infusion therapy in patients with impaired glucose tolerance and insulin resistance. Despite this wide range of applications, the use of xylitol as sweetener is limited. Comparatively high production cost (about 10 times that of sucrose) seem responsible for its limited market share as sweetener. Xylitol can be obtained by various technologies, including the extraction from some fruits and vegetables, but this procedure is not economical owing to its small concentrations. Chemical reduction of xylose process is relatively expensive because of the extensive purification and the separation steps required.

Biotechnological conversion of xylose solutions is a selective and promising process for xylitol production. Bioconversion can be carried out with microorganisms or purified enzymes from these microorganisms. The most studied xylitol producers are yeasts. The hemicelluloses

fraction of agricultural and hardwood lignocellulosic material contains xylose as the major sugar component. These cheap and abundant natural resources, on hydrolysis with acid, yield xylose-rich hydrolysates that can be recovered in good yields

The aim of the present research is to obtain xylose from a cheap material by bioconversion of its xylose to xylitol realizing two main objects: first to reduce the price of this economically important product used in pharmaceutical, chemical, and food industries due to its dietetic and anticarcinogenic characteristics. Traditionally, xylitol has been produced almost exclusively by chemical process, which involves an expensive step of purification of xylose and quitesevere operational conditions. In recent years, attention has been focused on the biotechnological process, because it does not require initial xylose purification and is conducted under moderate temperature and atmospheric pressure. Secondly, to eliminate air pollution as a result of burning rice straw waste.

Key words: Pollution, Anti microbial, Xylitol, Xylose, Biotechnological process

SIX/P-21

Better Option for Drug Therapy in Treating Mycotic Infections in Humans

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Posaconazole, a broad spectrum antibiotic, well known for its unbearable side effects, which are attributed to its synthetic nature and can be reduced by increasing its bioavailability. In the present investigation, inclusion of some plants i.e. *Eucalyptus citriodora, Zingiber officinale* and *Psidium guajava* with Posaconazole has been tested for their efficacies against two species of human pathogenic fungi viz., *Trichophyton mentagrophytes* and *Microsporum gypseum.* Among the selected plant-drug combination, inclusion of *Zingiber officinale* with Posaconazole proved cent percent inhibition at both concentrations against *M. gypseum.*

Key words: Bioavailability, Posaconazole, Plant-drug combination, Human pathogenic fungi

SIX/P-22

Inhibitory Effects due to Combination Drug Thearpy against Dry Mycelial Growth of Experimental Organisms

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Terbinafine, a broad spectrum antibiotic, well known for its unbearable side effects, which are attributed to its synthetic nature and can be reduced by increasing its bioavailability. In the present investigation, inclusion of some plants i.e. *Eucalyptus citriodora, Zingiber officinale* and *Ocimum sanctum* with Terbinafine has been tested for their efficacies against two species of human pathogenic fungi viz., *Trichophyton mentagrophytes* and *Microsporum gypseum.* Among the selected plant-drug combination, inclusion of *Zingiber officinale* with Terbinafine proved cent percent inhibition at both concentration against *T. mentagrophytes*.

Key words: Bioavailability, Terbinafine, Plant-drug combination, Human pathogenic fungi

SIX/P-23

Food Security through Quality Protein Maize

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The nutritional well being and health of all people are vital prerequisites for the development of the society. Malnutrition is a widespread problem, particularly in developing countries with low per capita income and with large population living below poverty line. Malnutrition is the insufficient, excessive or imbalanced consumption of nutrients. There were 923 million malnourished people in the world in 2007, an increase of 80 million since 1990, despite the fact that the world already produces enough food to feed everyone - 6 billion people - and could feed the double - 12 billion people.

In India, there are around 217 million under nourished children of which maximum are children below 5 years of age. This leads to stunted growth, weakened resistance to infection and impaired intellectual development. One of the major reasons for this is the lack of sufficient quality protein in the diet of people, especially children and women of child bearing age. Majority of the nutrients are provided through staple cereals we consume such as rice and wheat. Maize is one such cereal consumed globally. In India it is consumed as 'roti' or 'bhutta'. Quality Protein Maize (QPM) is enriched maize with high lysine and tryptophan which was deficient in normal maize.

The present study is conducted to emphasize the use of QPM. QPM can be consumed in several ways. It can be prepared in different ways for different types of people according to the need. These products have high nutritional value, better acceptability and low cost when compared to wheat products.

Several standardized and value added products such as mathri, ladoo, health mix etc of wheat and quality protein maize was prepared and evaluated for acceptability and nutritional value. It was found that the QPM products were more acceptable as compared to wheat products. The acceptability score of QPM namakpara was the highest (9-on 10 point scale) where as that of wheat was 8.5. The lowest acceptability was of QPM burfi (7) and wheat burfi (6). On evaluating the nutritive content it was found that the protein content of QPM health mix was the highest (14.62g/100gm) where as that of wheat health mix was 10.12 g/100 gm. The fat content of QPM mathri was 13.35g/100gm as compared to 15.68g/100gm in the same product of wheat. On comparing the other components of proximate analysis it was found that QPM has better nutritive value as compared to

wheat. Thus QPM products provide better health status and nutritional security, better taste and acceptability. Their cost is low and provides more nutrition.

Key words: Quality protein maize, Lysine, Tryptophan, Malnutrition, Value added products

SIX/P-24

Interaction Effect of Plant Density and Irrigation Level on Growth and Yield Contributing Characters of Chilli cv. HC-4

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The experiment was conducted with six plant density viz. D_1 (36 plants), D_2 (72 plants), D_3 (30 plants), D_4 (60 Plants), D_5 (24 Plants) and D_6 (48 plants) per plot and four irrigation levels viz. ID/CPE ratio of I_1 (0.5), I_2 (0.75), I_3 (1.0) and I_4 (1.25) at CCSHAU, Hisar. Maximum plant height at final harvest was with lowest plant density i.e, D_5 along with I_3. Maximum numbers of branches, dry weight of leaves, root length and root biomass per plant were recorded under the lowest plant density ie D_5 in combination with I_3 level of irrigation. Maximum number of fruit cluster, weight of fresh red ripe fruit and biomass per plant were recorded with I_3 during 1st year and I_2 during 2nd year with the lowest plant density ie D_5 during both the years. Maximum fruit yield was harvested from D_4 during 1st year and D_2 during 2nd year with irrigation level of I_2.

Key words: Plant density, Irrigation level, ID/CPE ratio

SIX/P-25

Urban Ecology: A Case Study of Tuljapur City

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Cities and towns are the focal points for the growth of human civilization. However, it is the process which is responsible for many of today's ills. Tuljapur is a famous pilgrim centre and derives its importance and popularity due to the location of this holy point at Tuljabhavani. Tuljapur town which was recently a small town has grown rapidly in the recent decades due to the establishment of various educational institution by the government and private sector. Simultaneously both the pilgrim activities as well as the educational industrial, commercial establishments have taken the lead for the development of the town and its environments.

The present study deals with the urban morphology and ecological setup of Tuljapur city, located in Balaghat range, dist. Osmanabad (M.S.). The present study is relied upon both data to discern and describes the demography, urban land use, land values, urban spread, spatial and structural pattern of society in Tuljapur City.

Key words: Civilization, Holy point, Pilgrim activity, Demography

SIX/P-26

Comparison of Environmental Health and Status of Staff Health in South Pars Phases 9 and 10 Projects with Sirri Island NGL Project

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The environment as a process includes all the different aspects of life and affect on it. It has a special status and feature, which is based on the growth and evolution of human societies and depend on reasonable exploitation of natural resources water, soil and air in the limit of sustainable development.

Otherwise, the unidirectional attitude as a result of inadmissible and greedily exploitation of natural resources, while creating irreparable danger to life, will be faced by the future generations with regretful hazards.

The purpose of this environmental health study is to ensure: whether health status of workers working in south projects of Iran is in satisfactory conditions or notfi; whether the basic health needs of humans and the World Health Organization statements are available or notfi; Is there any measure to control infectious and noninfectious diseases among workersfi; whether other health questions are answeredfi

Key words: Environmental health, Unidirectional attitude, World Health Organization

SIX/P-27

Reactive Oxygen Species and Antioxidant Phytochemicals of Nutraceutical Importance

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About 5% or more of the inhaled O_2 is converted to reactive oxygen species (ROS) and are continuously produced in biological system by the action of mitochondrial electron transport system. Environmental factors such as UV light, ozone, tobacco smoke, ionizing radiation, herbicides and pesticides also contribute in the production of ROS. Thus cells under aerobic condition are always threatened with the lethal effects of ROS, which however are efficiently taken care of by the highly powerful antioxidant systems of the cell. Oxidative stress, a result of imbalance between the antioxidant defense system and the formation of ROS, may damage life-important membrane lipids, proteins, DNA and carbohydrates. The damage may cause several chronic diseases like cancer, metabolic dysfunction of almost all the vital organs, coronary heart disease, diabetes and neuro-degeneration.

The synthetic antioxidants like hydroxyanisole (BHA), butylated hydroxytoluene (BHT), propyl gallate (PG) and tert-butyl hydroquinone (TBHQ) are most frequently used as preservatives. The replacement of synthetic antioxidants by natural ones may have benefits due to health implications. Epidemiological and animal studies suggest that the regular consumption of fruits, vegetables and whole grains, reduces the risk of chronic diseases associated with oxidative damage. Carotenoids, tocopherols, ascorbates, lipoic acids and polyphenols are strong natural antioxidants with free radical scavenging activity generally found in plants and foods. Endogenous antioxidant enzymes like super oxide dismutase (SOD), catalase, glutathione peroxidase, glutathione reductase, minerals like Se, Mn, Cu, Zn, vitamins A, C and E, carotenoids, limonoids and polyphenols exert synergistic actions in scavenging free radicals. The natural antioxidants are gaining importance, due to their health benefits for humans, decreasing the risk of cardiovascular and degenerative diseases by reduction of oxidative stress and protection against ROS. The sources, antioxidant potential and application of some phytochemicals as nutraceuticals, functional food and biopharmaceuticals will be presented.

Key words: Reactive oxygen species, Oxidative stress, Antioxidants, Carotenoids, Tocopherols, Polyphenols

SIX/P-28

Persistent Organic Pollutants (POPs): Status in India

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Scientific studies have revealed that the present and future generations of human beings and wildlife would be exposed to the toxic effects of various industrial chemicals, pesticides and unintentional by-products. Some of these substances are persistent and toxic and may bioaccumulates and biomagnify in human and animal tissue leading to serious health concern. Thus persistent organic pollutants (POPs) are an issue of regional, national and global concern. Our objective in this paper is to provide a brief focused overview on current status of POPs in India, highlight the harmful effect that they may have on environment and wildlife, and their possible alternatives.

Key words: POPs, Biomagnifications, Persistence, LRAT

SIX/P-29

Study on the Mural Plants Available on the Historical Monuments of Sivasagar District and their Management

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Sivasagar district is located in the East of Assam and in the North East direction of India according to world geography. The district lies between $94^0$8' and $95^0$4' East longitude and $26^0$7' and $27^0$2' North latitude having altitude 105 m-130 m above sea level. The district is bounded by Brahmputra river, Lakhimpur and Dibrugarh district on the North; Arunanachal Pradesh on the East; Arunanchal Pradesh and Nagaland on the South; Jorhat district on the West.

Sivasagar district is the heart of Assam in concern of its glorious history of mighty Ahom dynasty and culture. The district is famous as an ideal heritage spot for tourism of the existence of a large number of historical and ancient monuments viz. temples, palaces, pavilions, explosive-storage huts, stone bridges, forts, roads, ponds, channels, drains, maidams (Ahom pyramids) etc. constructed in the medieval period, during the ruling age of Ahoms in between 1228 A.D. and 1826 A.D. by applying rare, mysterious and sustainable indigenous engineering technology of that era. These archeological monuments are still sporadically scattered and unawareness all over the district bearing the significance of our six hundred year old divers' culture.

During the survey recorded 45 Mural plants available on the monuments in various historic sites of the district *viz.* temples, palaces, pavilions, explosive-storage huts, stone-bridges and maidams etc.

Key words: Mural plants, Historical monuments, Archeological monuments

SIX/P-30

Comparison of Movement Behaviors of *Caenorhabdities elegans* in Response to the Treatments in Different Toxic Chemicals at Low Concentrations

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This study describes a new approach for assessing toxic response behaviors of *Caenorhabdities elegans* by automatic recognition of line movement through image processing system. At low concentrations (1.0ppm) of benzene, toluene and formaldehyde the individual specimens of *C. elegans* were continuously observed in Laboratory conditions. Variables such as speed, acceleration and meander were calculated according to body segments. A comparison of toxic response among three chemicals were found to be similar however, *C. elegans* has shown more toxic response behavior to toluene and followed by benzene and formaldehyde.

Key words: Image processing, *C. elegans,* Toxic chemicals

SIX/P-31

Photosynthesis in Jatropha fruit

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Seed oil of *Jatropha curcas* is a promising and commercially viable alternative to diesel oil. Therefore numerous attempts are being made for its oil improvement. The photosynthesis has been implicated in the physiology of developing oil seeds however, the details of dark and light reactions in seed photosynthesis are not known.

Measurements showed that the photosynthesis rate of *Jatropha* fruit is relatively much lower than respiration rate therefore photosynthesis was calculated as difference between net respiration rates in light and dark. The net high rates of respiration indicated that the seed development is indeed an energy demanding stage and the demands are being fulfilled at least partially via fruit photosynthesis. Apparently the imitation kinetics of photosynthesis may be different from that of leaf as the stomatal limitation of photosynthesis does not exist. Further CO_2 concentration has no effect on the photochemistry as the parameters like electron transport rate; quantum yield etc remained constant at range of CO_2 concentrations. Unlike CO_2 effects light saturation kinetics in fruit is similar to that of leaf. High intrinsic efficiencies of activity by photosystem II, measured as Fv/Fm, in dark-adapted green fruit (range 0.77–0.82) which decreased with fruit ripening. Photosynthesis and electron transport of the green fruit saturates at 400 mol m^{-2} s^{-1}, while quantum yield showed characteristic decline with excess light which is dissipated as heat. The images of chlorophyll fluorescence of individual fruit at different stage of ripening reveal that photosynthesis is highly active in green tissue and decreased with fruit ripening. The data of chlorophyll content showed that the proportion of light-harvesting chlorophyll to active centre chlorophyll was also lower as indicated by higher ratios of chlorophyll a/b.

Together, these results demonstrate that the seed development in *Jatropha* fruit is energy intensive process met by respiration and potentially powering re-fixation of CO_2 via photosynthesis.

Key words: Chlorophyll fluorescence; Fruit photosynthesis; *Jatropha curcas*; Photosystem II

SIX/P-32

Prospects and Retrospect of *Jatropha curcas* Plantations on Sodic Lands in Uttar Pradesh

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Jatropha curcas has been widely propagated as a promising plant species for biofuel production in different parts of India. Its growth and yield performance on sodic lands of U P have been observed for the last three years at Banthra Research Station of NBRI, Lucknow. The rooted cuttings of *Jatropha curcas* were established at four sites with significant variation in pH and other soil fertility parameters. Similar cultural treatments were applied at all the sites are under trial. Growth variations in the population were assorted as low, medium and high which were recorded annually. Relative growth rate (RGR) was relatively high in medium growth for plant height and diameter whereas, number of branch and canopy diameter increased significantly in high growth plants. These different growth forms (variability) were observed because of inherent heterogeneity in fertility levels and stress of sodic soil as well as plants vigor. Plants initiated the seed yielding from 3rd year, but the yields could not be obtained as expected. Growth and yield were discussed with various pH levels and other soil fertility parameters. The growth characters like plant height, number of branches, collar and canopy diameter showed the significant variation as per soil sodicity stress. The RGR in plant height, number of branch, stem and canopy diameter decreased significantly in third year as compared to second year growth observations. It appears that sodicity stress retarded the growth characteristics, when plant roots could not get proper nourishment during their most active development phase in third year. The growth of plants reacted not only with soil pH but other fertility/stress parameters were also equally important to large variability. Organic carbon, available N, K and bulk density of the soil played the vital role in general but the electrical conductivity and available phosphorus at various sites dominantly regulated the plant growth characters. The seed yield was disappointing to recommend it for large scale plantations on such lands. However, it can be confirmed from the multilocational trials on sodic lands in different agroclimatic zones of Indogangetic plains, where sodic soils are sporadically distributed throughout the region.

Key words: *Jatropha curcas,* RGR, Sodic

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Characterization of Algal Oil for Biofuel Production

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Development of clean fuels to combat climate change and protect against oil price shocks is an urgent challenge facing our society. Resources of fossil fuel are limited and our current demand does not allow the use of fossil fuel at the same level and for the same price in the future.

Nature has developed photosynthesis, a very efficient light harvesting and conversion system which offers a natural and highly efficient method to produce emission-neutral biofuels. However, using higher plants for such purposes leads to several problems which are difficult to overcome and includes competition with food producing plants, utilization of arable land and fresh water. But the use of microalgae offer

an alternative approach, it can be cultivated in saline ponds and wastewaters while consuming large amount of carbon dioxide. These tiny biological factories can perform photosynthesis very efficiently and double their biomass in a short span of time, i.e. in a few hours. As part of the photosynthesis process algal biomass can produce lipids and can generate up to 15 times more oil per acre than any other crops used for biofuels, such as corn, jatropha, soybean and switch grass.

The present work includes extraction of oil, physico-chemical testing and comparative analysis of algal oils with other biodiesel producing crops. Fresh water algal biomass is collected and identified from various localities of Uttarakhand. Oil extraction from algal biomass was done by soxhlet method using petroleum ether as a solvent at 40-60 ^{0}C. Fatty acid profiling of extracted algal oil was done by Gas Chromatography.

Physico-chemical analysis and comparative study with other vegetable oil, on the basis of pH, density, refractive index, non sap percentage and specific gravity are performed to confirm the suitability of algal oil for biofuel production. The fatty acid analysis of algal oil shows the presence of monounsaturated fatty acids (Palmitoleic and Oleic acids) and saturated fatty acids (Hexadecanoic acid and Octadecanoic acid) in higher percentage. Presence of these fatty acids proves to be the best in terms of oxidative stability and cold weather behavior of algal oil along with other physico-chemical properties for large scale biofuel Production.

Key words: Microalgae, Algal oil, Biofuel, Physico-chemical properties, Fatty acids

SIX/P-34

Physico-Chemical Characterization of Algal Oil: A Potential Biofuel

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Continuous increase in demand of energy and depletion in the fossil fuel sources force the researchers to search the alternative of fossil fuels for energy production. Biofuels are the best energy sources because they are renewable (biomass can be repeatedly grown) and reduce the CO_2 level in the atmosphere. Higher photosynthetic efficiency, higher biomass production of algae and low emission profile of algal biofuel makes algae as a promising biofuel source. The main advantages of algal biofuel such as, they are non-toxic, highly biodegradable and contain no sulphur. Some species of algae are ideally suited to biodiesel production due to their high oil content nearly 40%.

Natural algal biomass samples collected from Lucknow and surrounding localities. The samples were identified under microscope, preserved and biomass was dried in oven. From dried algal biomass the oil was extracted and total lipid content in sample is estimated as percent (w/w). Physico-chemical properties like density, specific gravity, pH and percent non-saponifiable fat were estimated. Fatty acid composition of oil was studied by the gas chromatographic (GC) analysis. The physicochemical properties of algal oil were compared with *Jatropha curcas* and *Pongamia pinnata*, which are used as biodiesel. Thus the above said properties are suitable to use algal oil as biodiesel.

Gas chromatographic analysis shows higher percentage of methyl palmitate, methyl stearate (methyl esters of saturated fatty acids), methyl oleate (methyl ester of monounsaturated fatty acid) and methyl linoleate (methyl ester of diunsaturated fatty acid). There are few properties that a biodiesel must meet are given by American society for testing and materials (ASTM). These specifications are cetane number, kinetic viscosity, oxidative stability and cold flow properties.

Ignition quality of a fuel is improved with increase in cetane number which can be enhanced by increase in chain length of a fatty acid Thus methyl palmitate and methyl stearate have ignition property. Heat of combustion and melting points increases with increase in number of carbon atoms and decreases with an increase in unsaturation. Cold flow properties of a fuel such as cloud point, pour point and cold filter plugging point are determined by the amount of higher melting saturated esters or other higher melting minor components regardless of the nature of the unsaturated esters. Oxidative stability is more of saturated fatty esters. Thus we conclude that the fatty acid composition of algal oil is suitable for using it as biofuel.

Key words: Algae, Biofuel, Fatty ester, Physico-chemical property, Gas chromatography

SIX/P-35

Effect of Nitrogen on Lipid Accumulation in Green Algae

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An increased demand for fossil fuel independence has intensified the search for renewable fuels which are biodegradable, renewable and nontoxic in nature. Algal biofuel which is derived from lipids after transesterification can be used to replace the need of conventional fuel in the industries as well as automobile sector. In India nearly about 120 million tonnes of petroleum is consumed every year which emits large amount of green house gases to the atmosphere. A part of this huge amount can be replaced by the use of algae which can grow anywhere (in brackish land or in waste water) without much of nutrient supply and with very short doubling time.

It has been reported that in algae the biomass productivity and lipid cell content can be enhanced under stress conditions especially nutrient limitation. Therefore it is important to explore ideal cultural conditions which can give more biomass and lipid content. Nitrogen being one of the important growth media nutrients shows variable effects on the growth of algae when added in different concentrations.

So the aim of this work is to study the effect of nitrogen concentration on cell growth and lipid accumulation in green alga *Chlorella* which may help to lower the cost of commercial production of biofuel.

Natural samples were collected from the state of Himachal Pradesh. Auxenic culture of *Chlorella* was grown in the media containing 0, 2, 4, 8 and 12 mM of urea. Biomass was determined by measuring the density of samples at 600 nm. It was observed that the biomass of *Chlorella* increased significantly when urea concentration increased from 2 to 8 mM, but decreased at the concentration of 12 mM. Biomass productivity reached the highest value of 3.0 g/l at 8 mM. After drying, the biomass was subjected to Soxhlet extraction for lipid content measurement and it was found that the highest lipid productivity of 0.39 g/g occurred in the medium containing 4 mM urea. Finally the results suggested that the combined maximum growth of biomass and lipid content occurs at 4 mM among the tested condition.

Key words: *Chlorella*, Biofuel, Nitrogen depletion, Biomass

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Changes in Seed Oil Content of *Jatropha curcas* Influenced by Varying Soil Conditions and Plant Age

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Jatropha curcas is a multipurpose, drought resistant plant and also a promising alternative for biodiesel production. The objective of this study was to observe the changes in seed oil content of three to five year old *J. curcas* plants growing under three different soil conditions. Seeds were collected from 3 to 5 year old *J. curcas* plants growing on different sites such as: fertilized soil, highly alkaline soil and normal garden soil. Total seven accessions (IC-468908, IC-468909, IC-468910, IC-471344, IC-471353, IC-471349 and IC-471346) were selected for the study. The oil content was analyzed with the help of Nuclear Magnetic Resonance (NMR- 7.5 MHz) technique and Soxhlet extraction method. Out of the seven accessions studied, the oil content decreased with age in all the accessions except in IC-471344 that showed an increase in oil content in 4^{th} and 5^{th} year in comparison to 3^{rd} year. If we compare the percentage of oil content in three different soil conditions, it was found that in fertilized soil oil content was higher in three accessions (IC-468909, IC-468910, IC-471346), in normal soil oil content was high in three accessions (IC-471344, IC-468908, IC-471349) and in highly alkaline soil, oil content was high only in one accession (IC-471353). According to the study we revealed that oil content decreases as the age of the plant increases and the higher oil content is obtained when the plant is grown in fertilized and normal soil conditions but can also yield higher oil content in low nutrient rich soil condition i.e. alkaline soil.

Key words: Soxhlet, Alkaline, Jatropha, Oil content, Accessions

SIX/P-37

Genetic Diversity for Seed and Oil Yield and its Contributing Traits in *Jatropha curcas* L.

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Genetic diversity was studied in 24 accessions of *Jatropha curcas* L. for seed yield plant^{-1} and oil content and its contributing traits viz. plant height, number of branches plant^{-1}, inflorescence plant^{-1}, male: female flower ratio, pollen grain fertility %, fruit set %, fruit length, fruit width, fruit weight, seeds fruit^{-1}, seed weight fruit^{-1}. Based on Hierarchical cluster analysis and D^2 statistics, 24 accessions were grouped into 14 clusters indicated the presence of wide range of genetic diversity among these accessions. The maximum number of 3 accessions (BRS-12/05-UpA2, BRS-12/05-UpA3 and BRS-03/06-WbB) were included in cluster XI followed by 2 accessions in clusters II, IV, VI, VII, VIII, X, XII and XIII. Clusters I, III, V, IX, XIV included only 1 accession in each case. As the accessions procured from different locations were grouped in same cluster (XI). These accessions were phenotypically somewhat similar but have distinct origin. Thus, divergence depended more on morphological attribute than geographic origin of the accessions, indicated no definite relationship between geographic and genetic diversity and geographic diversity can't be used as an index of genetic diversity. Intra cluster values ranged from 0.00 to 12.220 and cluster XIII is most diverse group. The inter cluster values ranged from 7.868 to 70.340. Maximum divergence was noticed between clusters XIV and VI (70.340) followed by clusters XI and VI (67.312) and clusters XIII and VI (66.750). Clustering pattern revealed that diverse accessions can be used for the improvement of yield and oil productivity, through hybridization programme to generate wide range of transgressive segregants in populations. BRS-06/05- GuB3, BRS-09/05- GuB4, BRS-06/05-OrG and BRS-11/05-NaM being genetically diverse from rest of the accessions can be involved in hybridization programme with all clusters. Substantial amount of genetic diversity in *J. curcas* for oil and seed yield and its contributing traits offers better scope for breeding to improve seed and oil yield plant^{-1}, which will ultimately enhance biodiesel productivity.

Key words: Clustering, Diversity, Jatropha curcas, Oil content, Seed yield

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Maconellicoccus hirsutus (Green) Infestation on *Jatropha curcas* L. Saplings and its Possible Management through Herbal Pesticides

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Rapid depletion of fossil fuels, increasing concern over global climate change and ever-increasing demand for energy has led to resurgence in development of alternative eco-friendly energy sources. In these scenarios biodiesel is established as an important alternative of the same. The recognition of *Jatropha curcas* L. (JCL) seed oil as a source of high quality biodiesel has led to surge in cultivation of JCL worldwide. The limited knowledge of agronomic practices, diseases and insect pest management are major constrains in successful cultivation of JCL as a biofuel crop. Recently, infestation of *Maconellicoccus hirsutus* (Green) also known as the pink, grape or hibiscus mealy bug, on JCL saplings has emerged as a serious problem at Biomass farm site Banthra of National Botanical Research Institute, Lucknow. Many herbal pesticides were evaluated to control *M hirsutus* on JCL saplings. The simplest possible method for extraction of herbal pesticide was used in order to make it useful for farmers. Leaves of suspected plants were collected from natural vegetation and the extracts were sprayed on affected saplings with hand sprayer. On the basis of present study herbal pesticides obtained from *Lantana camara* L. and *Clerodendrum infortunatum* L. were found most suitable for management of Maconellicoccus hirsutus (Green) infestation on JCL saplings.

Key words: Biodiesel, Jatropha curcas, Saplings

SIX/P-39

Potential Contribution of Bioenergy for Rural Development and to the World's Future Energy Demand

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Climate change, together with an increasing demand for energy, volatile oil prices and energy poverty have led to a search for alternative sources of energy that would be economically efficient, socially equitable and environmentally sound. Biofuels have attracted growing attention of policy, industry and research. One option that has raised enormous public and private interest is biofuels. Farmers seek additional income and biofuels may have the potential to promote rural development and access to energy in poorer countries. As a 'readily available' alternative, biofuels offer to continue business as usual in the transport sector. Encouraged by research indicating that biofuels could provide substantial energy while mitigating climate change, governments have supported production aimed at increasing biofuel use in many countries. Industry has invested significantly in production and technology development. Biomass is a versatile raw material that can be used for production of heat, power, transport fuels and bioproducts.

When produced and used on a sustainable basis, it is a carbon-neutral carrier and can make a large contribution to reducing greenhouse gas emissions. Currently, biomass-driven combined heat and power, co-firing, and combustion plants provide reliable, efficient, and clean power and heat. Production and use of biofuels are growing at a very rapid pace. Sugar cane-based ethanol is already a competitive biofuel in tropical regions. In the medium term, ethanol and high-quality synthetic fuels from woody biomass are expected to be competitive at crude oil prices above US$45 per barrel. Feedstocks for bioenergy plants can include residues from agriculture, forestry and the wood processing industry as well as biomass produced from degraded and marginal lands. Biomass for energy may also be produced on good quality agricultural and pasture lands without jeopardizing the world's food and feed supply if agricultural land use efficiency is increased, especially in developing regions. Revenues from biomass and biomass-derived products could provide a key lever for rural development and enhanced agricultural production. The paper places biofuel industry as instrument par-excellence for effective rural development. The potentials of rural areas that support the development of biofuel industry in India as well as the challenges to its development were equally discussed.

Key words: Biofuels, Rural transformation, Biofuel industry, Development

SIX/P-40

Workable Strategies for Environmental Education in Higher Education Institutions in India

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Workable Strategies for effective environmental education in higher education institutions in India must constantly evolve keeping in mind the local situations while working for the improved environment of the global village. Effective strategies must continuously challenge individuals and institutions to examine and rethink their methods based on their efficiency and long term output.

Though humans differ in their knowledge of science or of a particular discipline, their methods or techniques, interests and even in details they seek to communicate must be carefully assessed.

To avoid conflicts in outcome; environmental planners, science communicators, science writers, journalists, scientists, physicians and individuals must together work with the public, aware for the need to understand one another. The problems with the current methods is the fallacy that something can be taught by mere telling and that education is the transmission of already formulated facts and concepts from books to notes or research papers.

In this paper we have presented innovative techniques that will complement the already existent methods of environmental education in India. The strategies proposed are both innovative and practical, challenging yet simple and effective-focusing on current successful methods and on student interaction and stimulation of the thinking process

thereby fostering an analytical mind geared to problem solving, decision making and yet flexible and practical involving 'learning by doing' at several stages.

The strategies perhaps, finally go beyond individuals and institutions but across boundaries to integrate all persons involved in environmental education in the global village at large.

The Strategies proposed in this paper for environmental education in higher education institutions envisages the combined efforts of scientific editors, field workers, publishers, librarians, information specialists, scientists, authors, researchers, and students. These individuals, whether independent or belonging to governmental or non-governmental institutions, scientific or non-scientific, would play a crucial role in achieving higher levels of environmental awareness through education.

Key words: Strategies, Higher education, Environmental education, Science communicators

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Environmental Awareness among the Urban Population of Lucknow City: A Perspective

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A survey was conducted in several areas of Lucknow city to judge the level of environmental awareness of the population. The questions asked in the survey were so designed as to collect data on judicious usage of civic amenities, understanding of various environmental issues, etc. Among the various groups the students were found to be most aware about recent environmental issues. In general, the identification of self with one's environment and an attitude to personally contribute towards it's improvement was found to be lacking among urban population and the people living below the poverty line were not even aware that many of their activities resulted in deterioration of the environment. Thus in the city of Lucknow, there is an urgent need for sensitization of the people towards active participation in resolving the environmental problems. The sensitization may be achieved by seminars, lectures by experts so that people may develop an in-depth understanding of various environmental issues and assume responsibility towards sustainable development of the environment.

Key words: Environmental awareness, Sensitization, Environmental issues, Environmental problems

SIX/P-42

Knowledge, Attitude and Practices of Undergraduate Girls Regarding the Use of Medicinal Plants

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Medicinal plants have been known for millennia and are highly esteemed all over the world as a high source of therapeutic agents for the prevention of disease and ailments. Some of them have been included in the different pharmacopies. Nature has bestowed our country with an enormous wealth of medicinal plants. Therefore, India has often been referred as an medicinal garden of the world.

In this context this paper presents the facts about the knowledge, attitude and practices of undergraduate girls regarding use of medicinal plants in day to day life. A survey was done on 50 undergraduate girls in BHU campus and data was analysed. Some girls have idea that these plants only have medicinal properties, but it has been also used as vegetables, fruits, cosmetics and other beneficial purposes.

Key words: Knowledge, Attitude, Practice, Undergraduate girls, Medicinal plants

SIX/P-43

Efficacy of some Plant Extracts against Mustard Aphid, *Lipaphis erysimi* and its Parasitoid, *Diaeretiella rapae*

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Experimental studies were conducted in the laboratory (GBPUA&T, Pantnagar, Uttarakhand, India) to evaluate the comparative aphicidal activity of seventeen indigenous plant extracts against the mustard aphid, *Lipaphis erysimi.* Fresh leaves were dipped into the desired solution (0.5%, 1.0% and 1.5%) of each extract and dried under the ceiling fan in a petri plate. Twenty healthy aphids were released into each petri plate containing the treated leaves.

Aphid mortality was assessed at 24, 48 and 72 h after application. Among them, 1.5% extracts of *Murraya koenigi + Mentha spicata* was found to be most effective recording 80.00% mortality after 72 hrs of treatment followed by remaining plant extracts. On the basis of relative mean mortality of all the extracts, the order of toxicity of plant extract at 1.5% concentration after 72 hrs of treatment was: *Murraya koenigi +Mentha spicata > Murraya koenigi + Sapindus mukorossi > Vitex negundo + Sapindus mukorossi > Mentha spicata > Acorus calamus*) > *Melia azedarach > Bambusa arundinacea > Vitex negundo > Murraya koenigii > Ageratum conyzoides > Sapindus mukorossi > Vitex negundo + Mentha spicata > Adhatoda vasica > Murraya koenigii+ Vitex negundo > Vitex negundo+ Murraya koenigii > Datura innoxia > Parthenium hysterophorous* with their relative toxicity value being 80.00%, 75.00%, 73.33%, 71.67%, 68.33%, 65.00%, 60.00%,55.00%, 53.33%, 50.00%, 48.33%, 45.00%, 40.00%, 36.67%,30.00%, 28.33% and 26.67% respectively.

The selectivity of ten plant extracts at different concentrations (0.5%, 1.0% and 1.5%) were evaluated against the braconid parasitoid of mustard aphid, *Diaeretiella rapae* in laboratory. Among them 0.5% concentration of *Murraya koenigii + Mentha spicata* proved

to be least toxic which caused 85% emergence of the parasitoid after 9 days of treatment followed by *Acorus calamus*, *Bambusa arundinacea*, *Mentha spicata*, *Vitex negundo*, *Sapindus mukorossi*, *Vitex negundo*+ *Sapindus mukorossi*, *Murraya koenigii* and *Murraya koenigii* +*Sapindus mukorossi* with 83.33, 81.67, 78.33, 75.00, 71.67, 70.00, 65.00% and 63.33% per cent emergence respectively. *Melia azedarach* proved to be most toxic which exhibited only 61.67% emergence of parasitoid. At highest concentration i.e. at 1.5% concentration, maximum emergence of 78.33%, exhibited by *M. koenigii*+ *M.spicata*. It was followed by *Acorus calamus*, *Bambusa arundinacea*, *Mentha spicata*, *Vitex negundo*, *Sapindus mukorossi*, *Vitex negundo*+ *Sapindus mukorossi*, *Murraya koenigii*, *Murraya koenigii*+ *Sapindus mukorossi* and *Melia azedarach* which caused 75.00, 73.33, 68.33, 65.00, 61.67, 58.33, 55.00, 53.33 and 40.00 per cent emergence of the parasitoid respectively.

Key words: *Lipaphis erysimi*, Plant extract, *Diaeretiella rapae*, *Acorus calamus, Vitex negundo*

SIX/P-44

In vitro Antifungal Activity of some Medicinally Important Lichen Thalli Extracts

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The lichens comprised of unique secondary metabolites not known in other group of plants. More than 50% of lichen compounds known, exhibit antibiotic activity. The lichens are well known as folk medicine from the ancient period and their use still persist in different modern medicines. The lichen metabolites exhibit activity against both plant and human pathogens. So far few investigations regarding antifungal properties of lichen metabolites are known. In the present study an attempt has been made to test some common foliose lichens against plant pathogenic fungi.

The antifungal activity of acetone, methanol and chloroform extracts of the lichens; *Heterodermia diademata* (Taylor) D. Awasthii, *Ramalina conduplicans* Vain., *Usnea ghattensis* G. Awasthii has been investigated. Out of the eight plant pathogenic fungi maximum activity was recorded from methanol extract of *Ramalina conduplicans* against *Aspergillus flavus* showing inhibitory zone of 6 mm diameter, whereas minimum activity was detected from chloroform extract of *Heterodermia diademata* against *Alternaria alternata* with 1 mm zone of inhibition. Ketokonazole was used as positive control while respective solvents were used as negative controls. It was determined that lichen substances in the extracts show antifungal activity and were characterized as atranorin and triterpens in extracts of *Heterodermia diademata*, usnic acid, skekikaic acid and salazinic acid in extracts of *Ramalina conduplicans* and galbinic acid, norstictic acid and stictic acid in *Usnea ghtattensis.*

Key words: Lichen, Crude extract, Antifungal activity, Lichenic acids

SIX/P-45

Simultaneous Production of Amylase and Xylanase by a Thermophilic Actinomycetes *Streptomyces thermocoprophilus* MSC702 Utilizing Agro-residue

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Agro-residues such as sugarcane bagasse (SB), wheat bran (WB), rice bran (RB), corn cob (CC), and wheat straw (WS) are the most cheap and abundantly available natural carbon sources. The present study was aimed for the production of amylase and xylanase using agro-residues as a sole carbon source. We have reported production of extracellular amylase and xylanase by thermophilic actinomycete *Streptomyces thermocoprophilus* MSC702 isolated from mushroom compost. Enzyme production was determined using 1% (w/v) of different agro-residues in production medium containing K_2HPO_4 (0.1% w/v), $(NH_4)_2SO_4$ (0.1% w/v), NaCl (0.1% w/v), $MgSO_4$ (0.1% w/v) at pH 7.0 after incubation of 48h at 50°C. The amylase activity (373.89 IU ml^{-1}) and xylanase activity (30.15 IU ml^{-1}) was maximum in rice bran. The decreasing order of amylase and xylanase activity in different type of agro-residues was found as RB > CC > WB > WS > SB and RB > WB > WS > SB > CC respectively. Combined effect of different agro-residues was examined in different ratios. Enzyme yield of amylase and xylanase was ~1.5 and ~2.0 fold higher with WB: RB in 2:1 ratio.

Key words: Agro-residues, Thermophilic actinomycetes, *Streptomyces thermocoprophilus,* Amylase, Xylanase, Rice bran

SIX/P-46

Evaluation of Insect Repellent Properties of an Exotic Weed Hyptis suaveolens

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Hyptis suaveolens is a member of family Lamiaceae, commonly known as bushmint. The plant is a native of South America and was first recorded in the Northern Territory (NT) by the explorer Leichhardt in about 1845. It grows widely as uncontrolled weed in the planes of northeast India and can be considered as 2nd exotic weed after *Parthenium*. It favors disturbed areas such as roadsides and overgrazed areas open and barren land. *Hyptis suaveolens* grows on most soil types, except those which become waterlogged. Locally at Lucknow the plant has occupied most of the open lands, road sides of highways and sides of railway tracks. *Hyptis* is unpalatable to most types of livestock. It is a very hardy and fast growing plant and noticed to suppress the growth of other weeds including many important naturally growing plants of medicinal importance. Observations of last 4-5 years, particularly made in trans Gomti area of Lucknow suggested the specific suppression of the wild *Calotropis*, Dhatura,

Cassia tora, *Solanum nigrum* etc. due to the uncontrolled spreading of *Hyptis suaveolens*. The aromatic oils in *Hyptis* make it unpalatable to stock. Though many of the phytochemicals have been identified from the plant like alkaloids, flavonols, flavones, flavonones, terpenoids, tannins, aldehydes and ketones, but application of this plant is still unrecognized. In order to exploit its application we prepared the 10% aqueous extract of the mature leaves of the plant. The filtered leaf extract was tested for insect repellent efficacy using housefly and sugar syrup model. The results were encouraging and suggested the significant fly repellent action. In another experiment a floor area wiped with aqueous extract and some food stuff was kept to attract ants. In comparison to normal water wipe the extract wipe restrained the aggregation of ants significantly. Thus the aqueous extract of *Hyptis suaveolens* exhibited promise for the development of cheap and economical insect repellent, floor wipe etc. and can be exploited at domestic as well as commercial level. Further detailed experiments are in progress.

Key words: Hyptis suaveolens, Exotic weed, Aqueous extract, Hyptis oil, Insect repellent

SIX/P-47

Evaluation of Antibacterial Activity of *Holoptelea integrifolia* L. Growing in Agra District

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The purpose of the present study was to investigate the antibacterial activity of aqueous extract of the fruits of *H. integrifolia* L. The activity was analysed against *E. coli* by disc diffusion method. The maximum activity was recorded at 200 mg/ml and minimum activity was observed at 50 mg/ml. However, the moderate activity was observed at 100 mg/ml. The obtained results provide a support for the use of this plant in traditional medicine and suggest its further advance investigation.

Key words: Antibacterial, *Holoptelea integrifolia, E. coli*, Traditional medicine

SIX/P-48

Use of Botanical Pesticides for the Control of Three Leaf Spot Fungi of Mango

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Botanical pesticide can be recommended as an ecochemical and sustainable strategy in the management of plant diseases. Because of their biodegradable nature, systemicity after application, capacity to alter the behavior of target pests and favorable safety profile, it is expected that plant-based pesticides play a significant role in achieving evergreen revolution. Leaf extract from six plants was tested against three pathogens. The causal fungi causing leaf spot of mango were *Fusarium moniliforme* var. subglutinans, *Gloeosporium mangiferae* and *Lasiodiplodia theobromae*.

Of the six plants tried maximum inhibition of mycelial growth was observed in leaf extracts of *Calatropis procera* (Aakado) followed by *Withania somnifera* (Ashwagandha) and *Strychnos nux vomica* at 10% (v/v) concentration. The leaf extract of *Catharanthus roseus*, *Tylophora indica* and *Rauvolfia tetraphylla* were not effective.

Key words: Botanical pesticides, *Calotrpis procera, Withania somnifera, Strychnos nux vomica, Catharanthus roseus* and *Tylophora indica*

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Allelopathic Potential of *Parthenium* Extract to Promote Germination Parameters of Cowpea Seeds and to Reduce Water Absorption

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The fresh plant part extracts of *Parthenium* were used to observe the effect on cowpea seeds, which showed significant increase in seed germination and different seedling growth parameters under lower concentrations, viz. germinability (% seed germination), emergence index, relative seed germination, relative root elongation, seedling growth and vigour index. Cent percent germination was observed on 7th day with the concentrations of 20%, on 3rd day with 40% and 60% root extract. The same was also observed with 20% of stem extract on 5th day and 100% germination was observed with only 10% and 20% leaf extract on 9th day.

Only 80% germination was observed with flower extract on 12th day. This stimulatory effect was recorded on other germination and seedling growth parameters of cowpea in order of *Parthenium* parts extracts was root and shoot >leaf and flower. Moreover very little water was added under 20 to 100% concentrations as compared to control and other concentrations.

Key words: Cowpea, *Parthenium allelopathy*, Germination parameters

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Ecofriendly Approach for Controlling Chilli (*Capsicum annuum* L.) Fruit Rot Pathogen [*Colletotrichum capsici* (Syd) B & B] by using Certain Plant Extract

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Indiscriminate use of chemical fertilizers and synthetic pesticides in agricultural fields by the farmers are polluting the environment including air, soil surface and ground water which has led to the deleterious effect on human health and biosphere. The use of bio-pesticides against plant diseases is not only economical but also an eco-friendly management. An experiment was carried out to study the effect of bio-pesticides using certain plant extract

(*Cassia tora*, *Datura metel*, *Leucas indica*, *Lantana camera*, *Ocimum basilicum*, *Solanum nigrum) as well as fungicides Carbendazim and captan to control chilli (Capsicum annuum L.) fruit rot pathogen, i.e., Colletotrichum capsici (Syd) Butler & Bisby.* The maximum inhibition of spore germination of *C. capsici* was observed (75.0%) at the 1.0% concentration of the leaf extract of *D. metel* and followed by *O. basilicum* (70.2%), *L. indica* (66.4%), *L. camera* (60.6%), *S. nigrum* (55.6%), and *C. tora* (38.0%). The minimum inhibition of spore germination of *C. capsici* was observed in the leaf extract of *C. tora* (16.4%) at 0.25% concentration. The fungicide carbendazim has found the maximum inhibitory effect on the spore germination of *C. capsici* (77.0%) and followed by captan (68.5%) at 1% concentration. In field condition the leaf extract of *D. metel* has been found most effective even at 1.0% and has led to the increase yield of 0.75 q/h. and followed by *O. basilicum* (0.66q/h), *L. indica* (0.49 q/h), *L. camara* (0.38q/h), *S. nigrum* (0.36q/h), and *C. tora* (0.35q/h) over control at 0.1% concentrations. The fungicide carbendazim has been found more effective for controlling the chilli fruit rot disease which has led to the increase yield of 0.90 q/h at 1.0% concentration and followed by captan (0.67q/h).

Key words: Chilli, *Colletotrichum capsici*, Leaf extract, Control

SIX/P-51

Organic Farming: A Viable Alternative for Sustainable Agriculture (A Case Study of Himachal Pradesh)

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The economy of the hill state of Himachal Pradesh is primarily agrarian. It provides livelihood support to about 70 per cent of the population. More than 86 per cent of the land holdings comprise of marginal and small holdings. The process of diversification during the past two decades towards the high value cash crops like vegetables, spices, fruits and floriculture has, however, raised the income and employment levels of farming community remarkably. But, it is well established fact that in the intensively cultivated areas, the chemical fertilizers and pesticides have been excessively used rendering the soils lifeless and infertile. Hence, there is a need to evolve or search an alternative system that overcomes the ills of present system along with a guarantee to produce safe, intoxic, unpolluted food economically with sufficient production to meet the requirements of increasing population. Organic farming is being strongly advocated as an effective alternative world over. The sustainability and economic viability of organic farming is much more relevant in context of resource poor marginal and small farmers of Himachal. With this background the present study was felt imperative before advocating organic farming. Kullu district of Himachal Pradesh was purposively selected. The specific objectives for the study were: 1) To have an insight into the awareness and knowledge of farmers about organic farming. 2) To know about the traditional practices in use for pest control. 3) To enlist the crops (commercial as well as traditional) with no/less use of inorganic inputs, that can be easily promoted for organic production.

The responses of the farmers about awareness and knowledge of organic farming were examined on an awareness scale (a three point descriptive rating). The highest scores were obtained for the queries like 'Is it a sustainable agriculture'. Is it a substitute for chemical farming' and 'Are chemical fertilizers allowed in organic farming'. This indicates that the farmers were sure about the sustainability of the system and knew that the chemical fertilizers will have to be substituted by organic fertilizers.

On the other hand the farmers' knowledge regarding organic formulations for plant protection, conversion period, agencies for certification and standards for certification, was quite low. Among traditional practices, the use of ash was quite common (60% farmers) in vegetable crops and early stage of cereal crops to keep the insect-pests at a bay. Salt was mixed in stored chilly powder (25% farmers) whereas lacing of stored pulses with mustard oil (30 % farmers) was practiced to protect the attack of insects like dhora. Cultural practices viz., deep summer ploughing, trimming of bunds, destruction of crop residues and use of resistant varieties were also practiced by 50% of farmers to check the pest attack. Among cereals maize, wheat; among pulses mash, rajmash, soybean; among spices chilly, coriander, garlic; among vegetables bitter gourd, cucumber and squashes were suggested to be the crops with comparatively less agrochemical use. Timely availability of inputs, technical know-how, assured market, premium prices and easy certification were some of the important preconditions, the farmers wanted to ensure before venturing into organic farming.

Key words: Organic farming, Sustainable agriculture, Conversion period, Agrochemicals, Certification

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Effect of Organic Manures and Biofertilizers on Growth and Yield of Tomato

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Tomato (*Lycopersicon esculentum* Mill) is one of the most important vegetable crop grown through out the world. Globalization of world trade has created stronger market competition for Indian agriculture, where apart from increased production; the quality improvement of product is a major requirement. In view of these concerns, the alternate agriculture system has been adopted globally. Hence, field experiment was conducted on organic farming on tomato cv. Hisar lalima. The crop was sown on 15th Feb. 2008 in sandy loam soil. Control, neem cake, caster cake (@ 1 t/ha each) were taken as main plot treatments, while organic manures (FYM 2 t/ha, vermin-compost 2 t/ha and bio-fertilizers (Phosphate solublising bacteria @ 30 g/Kg seed) were taken as sub plot treatments and applied through soil application. All other recommended packages and practices were

followed. Objectives were to compare the effect of different treatments on growth and yield of tomato.

Highly significant differences were observed in respect of growth as measured by plant height, leaf area and leaf area index. Treatment i.e., vermin-compost had recorded the maximum plant height i.e. 72.84 cm at 110 days after transplanting, leaf area was found to be maximum at 80 days after transplanting (1.18m²) in vermin-compost post. Under Neem cake treatment recorded lowest area (0.76m²). In regard no of branches treatment FYM had the maximum number of primary branches per plant (5.46) which was followed by treatment vermin-compost which had 5.19 no. of branches. Significantly high marketable yield (28.90 t/ha), yield per plant (1.09 Kg) and no. of fruits per plant (18.72) were recorded in vermin-compost treatment followed by FYM, which recorded 26.84 t/ha marketable yield.

Key words: Biofertilizers, *Lycopersicon esculentum,* Vermin compost

SIX/P-53

New industrial applications of starch and galactomannans

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Starch is the only plant polysaccharide that is susceptible to breakdown by human digestive enzymes, and as such it constitutes an important food resource for populations all over the world. Resistant and slowly digestible starches are emerging as highly important components of the diet. Starch co-polymers and the new starch based materials are increasingly requested by consumers due to their environmental friendliness. In the non-food area alternative binders can contribute to solve environmental problems like air pollution due to the potential replacement of problematic binders like bitumen and pitch. A variety of new uses for starch has been shown for the food and non-food sector. Recently besides new products for convenience food, functional foods attracting, increasing attention and offering possibilities for calorie reduction, stimulation of digestion and in general prevention of diseases.

Galactomannans play an important role as ameliorating agents in processe3s where water has to be thickened, or where hydrophobic materials needs to be coated, depressed or suspended. Galactomannans presents a very surprising and interesting example of how nature achieves variations in water-solubility of polysaccharides by the degree of substitution of a relatively insoluble polymanan backbone. Some new findings about the galactomannan from *Cassia obtusifolia* are discussed here. These new polysaccharides are easily available and distinguished from others by their specific ability to form gels with polymers bearing carboxyl or sulfoxyl groups.

Key Words: Polysaccharides, galactomannan, Co-polymers, degree of substitution, bitumen, *Cassia angustifolia*, carboxyl

SIX/P-54

Environmental friendly sustainable gum sources from family leguminosae

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Although many gums and resins have been in commerce for several hundred years, the emergence of certain synthetic substitutes from the last few decades have been responsible to some extent for the decline of the importance of the natural products. However, many of the synthetic substances have been found to be toxic to human beings and this has reversed the trend to natural product usage. Now for the next millennium, if the trend the greater emphasis on utilization of natural plant products continues in Western countries then the best source of these products would be the tropical countries like India should play a vital role in this regard. Tribes and tribal areas are the main source of gums and resinous products. There exists a large confusion in literature while describing resins. Several resinous materials have been described as true gums. These resins and gums in the form of natural, biosynthetic or modified polysaccharides are consumed in tremendous quantities.

Commercial gums are water soluble or water dispersible hydrocolloids. Their aqueous dispersion usually possesses suspending and stabilization properties. An industrialist giving thought to the manufacture or use of a new source of gum in his products will give serious consideration to the numerous factors that affect his taking a sound position. These important factors and remarkable properties of the gums from very useful family of bio-wealth will be converted in to economic wealth discussed in this paper.

Key words: Polysaccharides, hydrocolloids, biosynthetic, emulsifiers, resins, exudates, thickeners, bio-wealth

Late Abstracts

L-1

Environmental Protection: Effectiveness of Indian Laws to Control Pollution

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Indian environmental laws need to be reviewed in context with the new challenges and made more effective. India is a developing country, but development at the cost of human and environmental health is unwarranted for. Prevention and control of pollution along with stringent action against polluters is necessary. The Parliament of India has legislated various acts for meeting the International obligations in the direction of protection of Environment. The Laws have to be enforced by the State Pollution Control Boards, Central Pollution Control Board and Ministry of Environment and Forests. There are three principal Acts to be enforced by the regulators. Those are The Water (prevention and control of pollution) Act, of 1974, The Air (prevention and control of pollution) Act, 1981 and The Environment (protection) Act, 1986. The Ministry of Environment and Forests issues certain guidelines pertaining to the Environment (Protection) Act, 1986 which have to be followed by Central Pollution Control Board and State Pollution Control Boards. The main thrust, which should have been on the legal defined meaning of ENVIRONMENT as provided in The Environment (Protection) Act, 1986 by the officials of the regulators, is lacking in the working of the officials. It has been found by many researches including the committees set up by the Government/Parliament/Planning Commission of India that the working of the regulators is not satisfactory. Public participation is restricted to the working of NGO's. These organizations are doing whatever deem fit to them and in that direction which they find suitable. A little effort is being done on seeing whether the laws, rules and provisions are being followed by the officials of the regulators in letter and spirit or not. The major work is being done on researches on various parameters of the Environment but a little attention is being given on enforcement of the Environment Laws. It has become necessary to educate the general public on the legal definition of Environment so that they can understand the factors responsible for damaging the Environment.

Key words: Environmental awareness, Environmental Legislation, Pollution

L-2

Silicon Induced Resistance: An Eco-friendly Method to Control Powdery Mildew of Roses caused by

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To study the ability of silicon to control rose powdery mildew caused by *Podosphaera pannosa and investigate the mechanisms by which it reduces disease in rose genotypes varying in susceptibility to the disease.*

Root application of silicon was investigated in four genotypes of miniature potted roses representing different genetic backgrounds and susceptibility to disease. Plants were watered with a nutrient solution containing either 100 ppm Si supplied as K_2SiO_3 (Si+) or no Si (Si-) before inoculation. Si-application increased leaf Si-content two to four fold compared to control plants. Confocal microscopy showed that Si-accumulation was larger in Si+ than in Si- plants and that deposition mainly occurred in the apoplast, particularly in epidermal cell walls. Si-application delayed the onset of disease symptoms by one to two days and disease severity was reduced by up to 49%. The largest reduction was found in the two most resistant genotypes, which also had the highest increase in Si-uptake. The Si-induced disease protection was accompanied by increased formation of papillae and fluorescent epidermal cells (FEC) as well as accumulation of callose and H_2O_2, especially at the sites of penetration and in FEC, which are believed to represent the hypersensitive response. Activity of total peroxidase was generally increased by Si-application and the activity rose as infection progressed. Catalase activity had an early increase, especially in plants receiving no Si, after which time the activity decreased. Gene expression showed two genes being differentially up-regulated and here Si-application enhanced the transcript levels, especially in inoculated plants. Elevated transcript levels of ***hsr203J*** indicate that FEC represent the hypersensitive response. In addition, Si treatment to cv. smart increases the concentration of phenolic acids and flavonoids in response to *P. pannosa* infection and that key enzymes in the phenyl-proponoid pathway, namely PAL, CAD and CHS were simultaneously up regulated in Si+ inoculated plants. Si-treatment reduced powdery mildew development or infection by inducing host defence responses. Silicon can be used as an alternative eco-friendly disease control measure and has a strong potential in integrated pest/pathogen management.

Key words: Induced resistance, Miniature potted roses, Powdery mildew, Silicon, *Podosphaera pannosa*

L-3

Biopiracy of Traditional Knowledge

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Biological diversity or biodiversity includes variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of

ecosystems. Traditional knowledge associated with such biological resources is of immense value and has the potential of being translated into commercial benefits by providing leads for development of useful products and processes. There exists tremendous potential in biological resources and traditional knowledge associated with it. Most of the World's Biodiversity rich countries are developing countries located in the tropics. These countries are rich in biodiversity and traditional knowledge but they are not able to get benefits by trading in such bioresources and the associated traditional knowledge.

The giant Multinational companies of the developed countries are utilizing the precious bioresources and the traditional knowledge of the south without the prior informed consent (PIC) of the legitimate holders of such resources. So no benefits are shared with biodiversity rich countries from the commercial utilization of such resources of high value .Such unethical practices of multinational companies are known as biopiracy. The grant of patents on non-patentable knowledge (related to traditional medicines), which is either based on the existing traditional knowledge of the developing world, or a minor variation thereof, has been causing a great concern to the developing world. Some examples of bio-piracy of traditional knowledge are turmeric, neem, Basmati, rosy periwinkle, etc.

Key words: Traditional knowledge, Biological resources, Prior informed consent, Multinational companies

L-4

Phyto-Assisted Bioremediation of Heavy Metal Contaminated Soil

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Phyto-assisted bioremediation or rhizoremediation is an emerging technology to treat pollutant particularly under *in-situ* conditions. It harnesses the potential capabilities of plants and microorganisms. It stabilize the heavy metal in the soil through microbial activity that is enhanced by the presence of the rhizosphere. Microorganisms (yeast, fungi, and bacteria) consume and transform heavy metals to non-toxic forms. Plants and microbes synthesize chemical macromolecules such as siderophores, biosurfactants and peptides, which aids in cleaning of metal contamination. The process involves complexation, chelation or biosorption of metals with the macromolecules. They also release nanoparticles, which alter the structure of metals, thereby reducing their toxicity. Similarly natural substances released by the plant roots such as sugars, alcohols, and acids contain organic carbon that act as nutrient sources for soil microorganisms, and the additional nutrients stimulate their activity. This process reduces the mobility of the heavy metals and prevents migration to the groundwater.

At NEERI, different approaches to bioremediation of metal contamination such as phytostabilization, rhizoremediation and the molecules mediated bioremediation have been developed. Integrated Biotechnological Approach (IBA) has been applied on the heavy metal contaminated site in the various parts of the country. In this technology, different combination of organic waste, microorganisms and their secondary metabolites were used on metal contaminated site with suitable plants species. This techniques has been successfully demonstrated to re-establish a vegetative cover at different metal mine sites such as Zinc, Copper, Manganese, Iron etc. Besides this, restoration of biodiversity on coal mine spoil dumps and fly ash ponds achieved following the above approach. Bacterial strains with multi-metal resistance have been isolated from heavy metal contaminated soils, which grow and tolerate high concentration of metal and are capable of production of biomolecules. Molecules such as Biosurfactants and Siderophores have been tested for their efficacy in removing the metals from metal contaminated soils and sludges. Encouraging results have indicated that these molecules can be a potential washing agents to remove metals through complexation and chelation. Thus, phyto-assisted bioremediation of heavy metal contaminated environments is an ecologically sound and safe method for restoration and bioremediation which combine the advantages of microbe-plant symbiosis within the plant rhizosphere into an effective cleanup technology.

Key words: Phyto-assisted bioremediation, Metal contaminated, Chelation

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