Biogas from Italian ryegrass and oil seed radish: Effect of nitrogen application on biomass yield and methane production.

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Effect of nitrogen application on biomass yield and methane production.

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BACKGROUND

Catch crops are grown as supplementary crops after harvest of primary crops to bind nutrients in the soil. Their green biomass constitute a by-product of sustainable crop production that could be used as a biomass source for biogas production.

In order to obtain an economically feasible use of catch crops as feedstock for biogas production, it is necessary to increase the net energy yield per hectare, m^3 CH_4/ha, which was shown to depend mainly on the biomass yield per hectare. The biomass yield per hectare may depend on the time of the seeding, on temperature and rainfall during the growing season, on the amount of available nitrogen (N) in the soil and on the time of harvest.

OBJECTIVE (Catchcrop2biogas)

To investigate the potential of catch crops as a sustainable source of biomass for biogas production.

APPROACH

Effect of N-application (0, 50 and 100 kg N/ha) on biomass yield and specific methane yield of two catch crops:

Italian ryegrass (IR)
(*Lolium multiflorum*)

Oil seed radish (OSR)
(*Raphanus sativus* var. *oleiformis*)

Both of them were sown in two different locations in Denmark, namely Holstebro and Haderslev.

Table 1. Agricultural calendar for both catch crops.

	Holstebro	Haderslev
MARCH	100 kg N/ha	130 kg N/ha
APRIL	11/4 Barley Sowing	4/4 Barley Sowing 8/4 IR Sowing
MAY	9/5 IR Sowing	
JUNE	70 kg N/ha	
JULY	19/7 OSR Sowing	18/7 OSR Sowing
AUGUST	13/8 Barley Harvest 0,50,100 kg N/ha	4/8 Barley Harvest 0,50,100 kg N/ha
SEPTEMBER		
OCTOBER	24/10 IR Harvest 24/10 OSR Harvest	25/10 IR Harvest 25/10 OSR Harvest

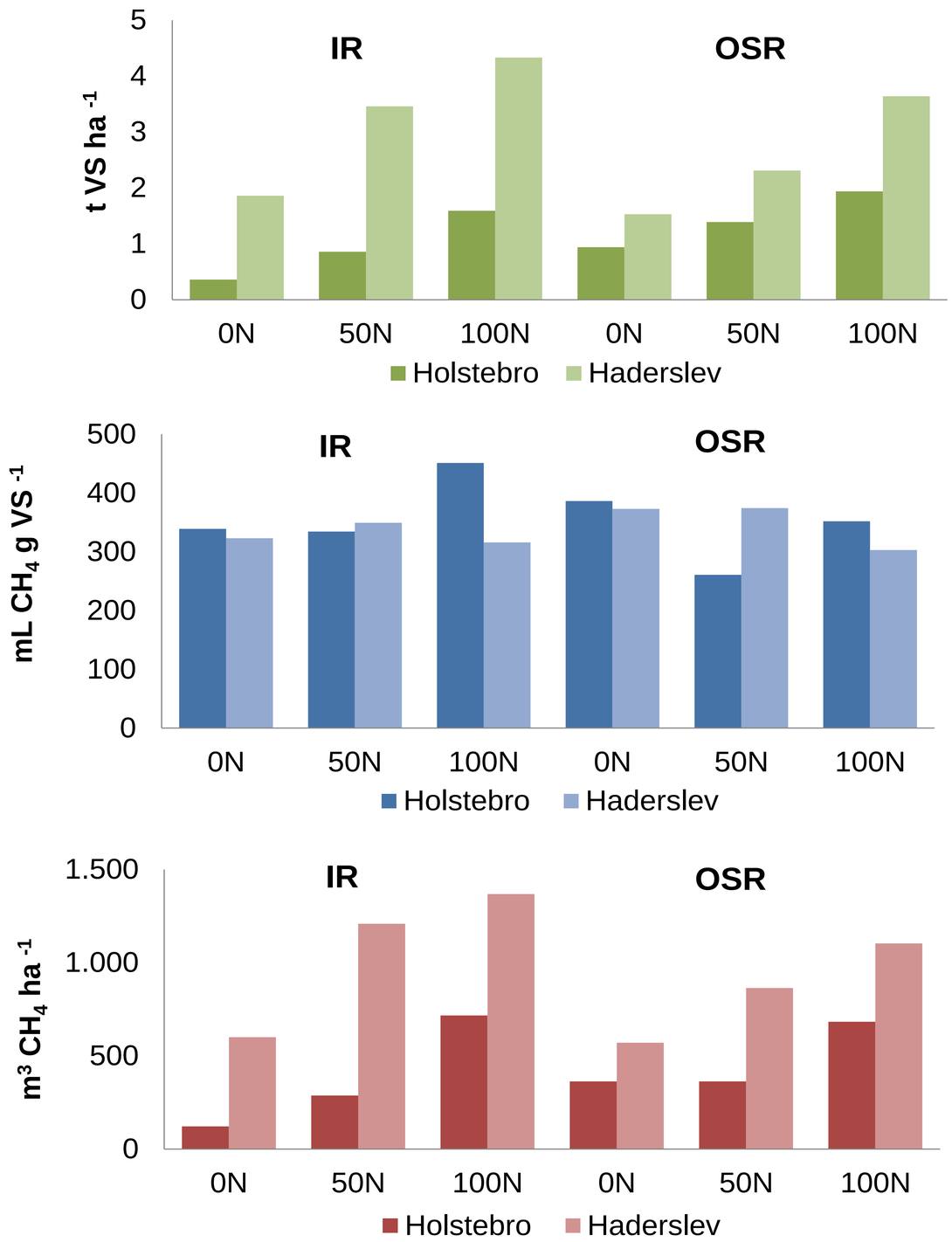

Figure 1. Biomass yield (above), specific methane yield (middle) and net energy yield per hectare (below) for Italian ryegrass (IR) and oil seed radish (OSR) in both locations with nitrogen dosages of 0, 50 and 100 kg N /ha.

RESULTS AND CONCLUSIONS

Biomass yields (t volatile solids (VS)/ha) were increased by up to 77% and 52% for IR and OSR, respectively, when applying 100 kg N/ha. Biomass yield and its response to N fertilization varied largely between locations. This fact could be attributed to the higher precipitation registered in Haderslev (180 mm in August 2011).

In Haderslev, harvest of the biomass recovered N amounts equivalent to or higher than the amount applied whereas the amount of N recovered was below the N dosage applied in Holstebro.

No significant difference in specific methane yield was observed among the different N dosages or between locations.

The threshold for an economically feasible biogas production from catch crops was stated as 700 m^3 CH_4/ha. The net energy yields per hectare obtained in Haderslev were greater than 700 m^3 CH_4/ha for IR and OSR when applying 50 and 100 kg N/ha.

The dry matter (DM) content was generally higher for IR (22.8 ± 2% DM) than for OSR (15.8 ± 3% DM); the low dry matter content for oil seed radish could be problematic for storage due to the risk of percolate run-off.

- ✓ Nitrogen application enhances biomass yield, which determines net energy yield per hectare and therefore, the economic feasibility of the process.
- ✓ Nitrogen application had no effect on the specific methane yield.
- ✓ Rainfall could play a major role on biomass production and, hence, N recovery of catch crops.
- ✓ The higher dry matter content coupled with the lower ash content make Italian ryegrass (IR) more suitable for biogas production than oil seed radish (OSR) since it would be easier to store.

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