Competitive ability of grain legume barley intercrops towards volunteer crops and weeds

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Conclusion

The greatest grain yields were achieved by pea and lupin sole cropping. However, the intercrops ability to respond to local conditions through different species responds to actual growth factors is important to secure competitive ability towards volunteer crops and/or weeds.

Objectives

The aim of the present study were to determine 1) the effects of pea-barley and lupin-barley intercropping on volunteer red clover biomass production as compared to the respective sole crops and 2) the effect of crop nitrogen use according to red clover biomass production.

Introduction

Improved competition with weeds has been emphasised as one of the benefits of intercrops (Liebman & Davis, 2000). Crop species like red clover (*Trifolium pratense*), cereal rye (*Secale cereale* L.), potato (*Solanum tuberosum* L.), rape seed (*Brassica napus* L.) among others can volunteer in planted crops presenting the organic farmer with many of the same problems associated with traditional weed management. Establishing an intercrop vigorous enough to suppress weeds has been shown as an efficient management tool (Hauggaard-Nielsen et al., 2001). Intercropping and the following increased interspecific competition as compared to sole cropping is assumed to result in a more dynamic crop response to a variety of growth conditions including temporal and spatial heterogeneity in growth of volunteer crops (and weeds) throughout a growing season.

Materials and methods

The experiments were carried out in 2003 on a sandy loam soil in Denmark (55º40'N, 12º18'E) . The field was known for its regrowth of volunteer red clover grown for seed in 2001. The site was managed with no use of herbicides and with mechanical weeding two times during emergence. Field pea (*Pisum sativum* cv. Agadir) and narrow-leafed lupin (*Lupinus angustifolius* cv. Prima) were grown as sole crops (SC) and in a dual 50%+50% mixed intercrop (IC) with spring barley (*Hordeum vulgare* cv. Otira)

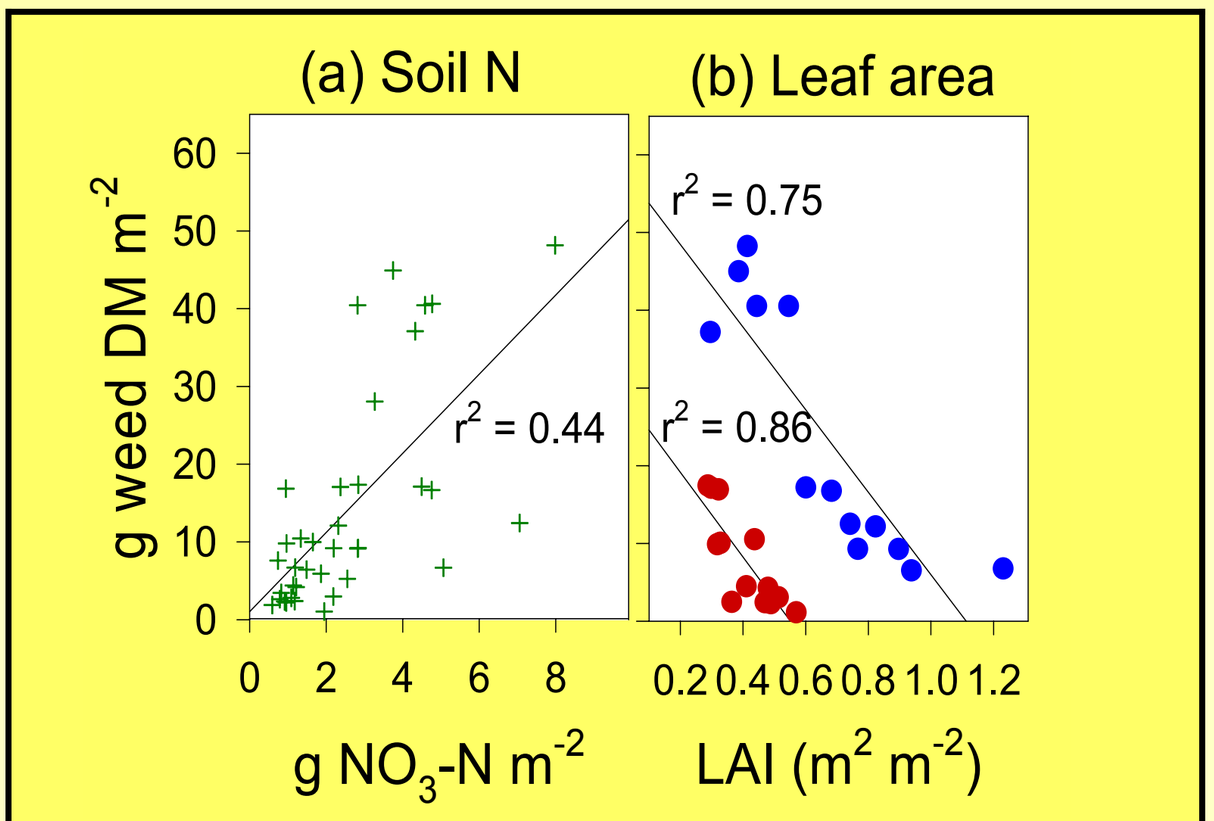

Figure 1. Total weed dry matter accumulation (DM) (including volunteer red clover crop) 36 days after emergence in relation to soil mineral N (a) and total crop leaf area index (LAI) measured 22 days after emergence. Blue circles= 5 g urea-N m^{-2}; red circles = without N application.

Results and discussion

In contrast to barley grain dry matter (DM) yield, pea SC without N application was significantly higher than with N application and even higher than all other SC and combined IC yields (Table 1). Independent of N application pea-barley and lupin-barley ICs produced combined grain N yields significantly higher than barley SC. Total amount of N_2-fixation in pea IC and lupin IC was significantly lower than the amount when grown as SCs (data not shown). Pea IC without N application fixed a greater amount of N than when N was applied, but with no N application effect in lupin IC.

Early responses to improved competitive ability towards weeds may be determined by a greater uptake of soil mineral N (Hauggaard-Nielsen et al. 2001). Only a tendency of such relationship could be found in the present study (Fig.1a). A negative linear correlation between LAI 22 days after emergence (DAE) and weed DM 36 DAE was found for each level of N application indicating effects of early crop canopy size (Fig. 1b). Furthermore, the greatest final red clover growth was found in plots with the lowest leaf area (data not shown).

At later growth stages red clover enlarged biomass production and competition for light and access to atmospheric N_2 through fixation became more important than competition for a very limited amount of soil mineral N.

Utilization of environmental resources for plant growth (light, water and nutrients) change dynamically over time causing temporal variations. When intercropping the crops are able to empty resource niches and thereby capture local plant growth resources to a higher extent than when sole cropped which seems to be important traits for the ability to reduce volunteer crop and weed biomass production.

Table 1. Average grain dry matter (DM) production (g m^{-2}) and nitrogen (N) fixation in pea and lupin SC and IC (g shoot N m^{-2}) estimated by the ^{15}N natural abundance method in sole crops (SC) and combined intercrops (IC) of pea, lupin and barley.

Species	Yield parameter	Fertilisation	
		0 g N m^{-2}	5 g N m^{-2}
Pea SC	Grain DM	678^{A}	514^{A}
Lupin SC		431^{AB}	429^{AB}
BarleySC		138^{E}	335^{CD}
Pea-barley IC		361^{BCD}	350^{BCD}
Lupin-barley IC		293^{D}	394^{BC}
Pea SC	N_2-fixation	22.6^{A}	13.2^{C}
Lupin SC		10.3^{D}	4.5^{E}
Pea IC		18.5^{B}	17.1^{B}
Lupin IC		4.8^{E}	6.9^{E}

Values followed by the same letter are not significantly different (P<0.05)

References

Hauggaard-Nielsen et al. (2001). Field Crop. Res. 70:101-109; Liebman & Davis (2000). Weed Res. 40:27-47.

Acknowledgements

This work was partly funded by the Danish Research Centre for Organic Farming.

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