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Abstract for oral or poster presentation at VIII ESA Congress:

Suggested session: ESA Section 5 Cropping and Farming Systems

WEED MANAGEMENT IN GRAIN LEGUMES USING AN INTERCROPPING APPROACH

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Introduction

Grain legumes benefit the farming system via symbiotic N_2 fixation and subsequent residue incorporation contributing to soil fertility together with their effect as break-crop in cereal rich rotations. However, grain legumes are weak competitors towards weeds and consequently weeds constitute a major problem. Since the European policies for reducing the negative effects of agricultural plant production on the environment point to reductions in pesticide use (Mortensen *et al.*, 2000), there is a requirement to further develop strategies to reduce weeds. Intercropping involves the simultaneous growing of several plant species in the same field and the cropping strategy is known to involve interspecific interferences increasing the use of plant growth resources in space and time (Ofori and Stern, 1987) improving crop competitive ability towards weeds (Hauggaard-Nielsen *et al.*, 2001). The main objectives of the present study was to determine the effects of grainlegume-cereal intercropping on the weed biomass production as compared to the respective sole crops using successive harvests in a three-year field study.

Materials and methods

The experiments were carried out at the Experimental Farm of The Royal Veterinary and Agricultural University, Denmark (55°40′N, 12°18′E) from 2001-2003. The soil was a sandy loam (USDA) with a pH ($CaCl_2$) of 5.9, 1.4 % total C and 0.08 % total N. Average (25 yr) annual precipitation and air temperature were 600 mm with maximum and minimum daily air temperature of 15 ^{o}C (July) and –0.9 ^{o}C (February). Field pea (*Pisum sativum* cv. Agadir), lupin (*Lupinus angustifolius* cv. Prima.), faba bean (*Vicia faba* cv. Columbo) and barley (*Hordeum vulgare* cv. Otira)L.) was grown as sole crops and grain legume-cereal intercrops using a replacement design. The experimental plots (1.3 m x 10.0 m) were laid out in a complete one-factorial randomised design including four replicates. Crops were managed according to organic farming regulations with no weed management except for false seedbed preparation.

Results

There was no difference in the total number of weed species between the treatments within each year, but the weed infestation level was very different. In 2001 a late sowing followed by rather warm temperatures and fast crop emergence caused general low weed pressure consisting mainly of *Polygonom* spp., *Lolium perenne* L. and *Chenopodium album* L. species. In the second year the weed biomass was dominated by *Trifolium pratense* (red clover) volunteer crops. In the final year 2003 medium weed levels was observed mainly with *Sinapsis arvensis*, *Cerastium faotanum* spp. and *Chamomilla suaveolens* species, but poor nodulation of lupin and low germination ability of faba bean caused high weed biomass levels in these two sole crops. However, a general reduction in weed biomass production comparing grainlegume-cereal intercrops and the respective grain legume sole crops was found and calculated as percentages the reduction ranged between 5-85% (data not

shown). There was no tight relation between neither sole cropped grain legumes (Fig. 1a) nor grain legume-cereal intercropping (Fig. 1b) and weed suppression. One major difference though when comparing the two cropping strategies was a more uniform yield of the intercrops, whereas the sole crop yields differed considerably stimulating a greater range of weed biomass production levels.

Discussion

The general lower weed biomass production at the final harvest in three succeeding years comparing grain legume sole crops and grain legume-cereal intercrops indicate how more diversified annual crop improve its adaptation to variable growth conditions in time and space (Ofori & Stern, 1987). Thus, available growth resources are utilised for crop production and not weed biomass (Hauggaard-Nielsen *et al.*, 2001a). However, there was a lack of tight relation between present weed suppression and crop yield (Fig. 1) indicating a more complex dynamic between crops and weeds than just crop yield and resource use.

Weeds interfere with crop production as the combined intra- and interspecific competitive interactions between a heterogeneous collection of weed phenotypes and an often relative homogenous population of crop phenotypes over a large area. If reducing the use of herbicides in future European cropping systems (Mortensen *et al.*, 2000) the quantity and diversity of the weeds may increase (Rydberg & Milberg, 2000), which is a major problem for farmers growing grain legumes. Utilization of environmental resources for plant growth resources change over time altering the interspecific relation between the crop stand and the weed biomass. The dynamic ability of intercrops to respond to variable growth conditions over time and in space is crucial to be able to empty resource niches and thereby capture local plant growth resources according to intercropped species limiting the ability of weeds to increase biomass production. However, to understand and utilise interspecific competition in an intercrop to manage weeds a more complex description of the dynamic relation between crop yields and weed biomass production is needed.

Conclusion

Grain legume-cereal intercropping seems promising in providing a weed management strategy utilising competition and natural regulation mechanisms while maintaining crop yield.

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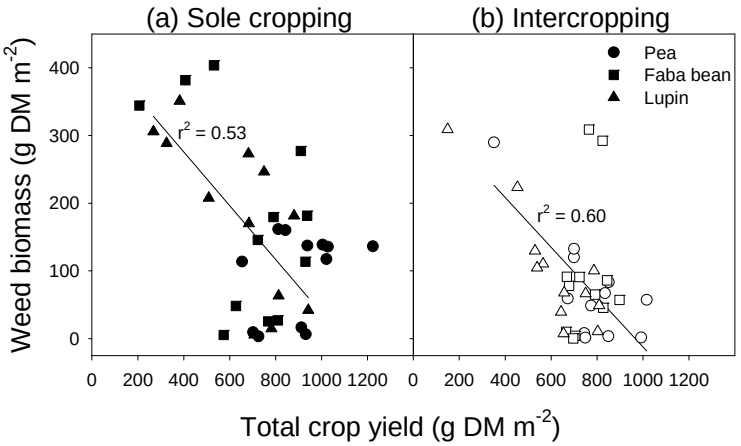

Figure 1. Total crop dry matter (DM) production as a function of weed biomass when pea, lupin and faba bean are sole cropped (a) and intercropped with barley using replacement design (b). Values are specific numbers in the respective years (n=12; 3 years with four replicates).