11th Nitrogen Workshop 9-12 September 2001, Reims, France
Book of abstracts, page 457-458

Theme 3 **Poster**

Pea-barley intercrop N dynamics in farmers' fields

H. Hauggaard-Nielsen[1], M.B. Peoples[2], M.K. Andersen[1], A.H. Nielsen[3] & E.S. Jensen[1]

Introduction

Knowledge about crop performances in farmers' fields provides a link between on-farm practice and research. Thereby scientists may improve their ability to understand and suggest solutions for the problems facing those who have the responsibility of making sound agricultural decisions.

Nitrogen (N) availability is known to be highly heterogeneous in terrestrial plant communities (Stevenson and van Kessel, 1997), a heterogeneity that in natural systems is often associated with variation in the distribution of plant species. In intercropping systems the relative proportion of component crops is influenced by the distribution of growth factors such as N in both time and space (Jensen, 1996). In pea-barley intercrops, an increase in the N supply promotes the growth of barley thereby decreasing the N accumulation of pea and giving rise to changes in the relative proportions of the intercropped components (Jensen, 1996). The pressure of weeds may, however, significantly change the dynamics in intercrops (Hauggaard-Nielsen et al., 2001). Data from farmers' fields may provide direct, spatially explicit information for evaluating the potentials of improving the utilisation of field variability by intercrops.

Materials and methods

An on-farm study was conducted on Djursland (57^{o}N, 11^{o}E), Denmark in August, 2000. Plant samples were collected from three individual farmers fields holding pea-barley intercrops and other three holding pea sole crops. All fields were located within a radius of 30 km on similar sandy-loam soil types. From each field five replicates, of 1 m^2, were harvested along a transect. Allowing for a distance of at least 50 m between individual replicate harvests. Crops were sampled at around peak biomass (mid pod-fill). From each field the sampled plant material was separated into three fractions - pea, barley and weeds. The samples were dried at 70^{o}C to constant weight and the total above-ground dry matter (DM) production determined. Total N concentration and natural abundance of ^{15}N were determined using an automatic N and carbon analyser (ANCA-SL), interfaced with a 20-20 stable isotope mass spectrometer (Europa Scientific, Crewe, UK).

Results

Estimates of symbiotic N_2 fixation (SNF) for the intercropped pea varied from 20-70 kg shoot N ha^{-1} compared to 45-70 kg shoot N ha^{-1} at the three pea sole crop sites (Fig. 1). Although the reliance of pea upon N_2 fixation for growth (%Ndfa) ranged from 51-72%, there was no significant difference between cropping strategies. %Ndfa values were 63 and 67% for intercropped and sole cropped pea, respectively (Fig. 1). The three farmers' fields with pea-barley intercrops displayed considerable differences in the relative proportions of pea and barley. In one field there was a 50:50% pea-barley above-ground DM distribution, in another field barley was the dominant species and in the third field pea was the dominant species (data not shown). The soil N uptake in intercropped pea shoots varied considerably between the three intercrop sites. The intercropped barley was able to increase or decrease shoot yields accordingly thereby giving rise to almost equivalent total intercrop soil N shoot accumulation comparing the three sites (Fig. 2). When including weed shoot soil N uptake that picture was emphasized.

Discussion

Nitrogen fixation plays an important role in supplying a renewable source of N to agricultural cropping systems (Peoples et al., 1995). However, SNF is very sensitive to soil mineral N and high concentrations of soil inorganic N will substantially reduce the inputs of fixed N in cropping systems. Grain legumes and cereals grown as mixed intercrops offer an opportunity to increase the input of SNF into temperate agro-ecosystems, while simultaneously using the available inorganic N sources efficiently, and maintaining yield levels and stability (Hauggaard-Nielsen et al., 2001; Jensen, 1996).

[1] The Royal Veterinary and Agricultural University, Department of Agricultural Sciences, Section of Agroecology, Agrovej 10, DK-2630 Taastrup, Denmark. Phone: +45 3528 3454, fax: +45 3528 2175, Email: hhn@kvl.dk
[2] CSIRO Plant Industry, GPO Box 1600, Canberra, ACT 2601, Australia. Phone: 61(0)2 6246 5244, fax: 61(0)2 6246 5399, Email : mark.peoples@pi.csiro.au
[3] Danish Institute of Agricultural Sciences, Department of Agricultural Systems, reserach Centre Foulum, P.O. Box 50, DK-8830 Tjele, Denmark. Phone: +45 8999 1202, fax: +45 8999 1200, E-mail: AndersH.Nielsen@agrsci.dk

Jensen (1996) found that a significantly greater percentage of N derived from fixation (%Ndfa) in intercropped compared to sole cropped pea. This was not observed in the present study using pea harvested in farmers' fields where the mean %Ndfa values for the intercropped and sole cropped pea were similar (Fig. 1), possibly because the competitive pressure of weeds for soil inorganic N in the pea sole crops was similar to that of barley and weeds in the intercrop. Thus, minimising the potential for complementary use of N sources by pea and barley in the intercrop.

The on-farm levels of fixation tended to be lower than observed in many experimental trials (Peoples et al., 1995). This may indicate that farmer decisions about when to include a legume in the rotation may not be based on measures of soil inorganic N prior to cropping.

The sharing of soil N among all plant species is apparent in the present data (Fig. 2). Comparing fields, the variability in crop yields indicate how differences in topography, soil organic matter, soil structure, etc. influence the synchronisation between N mineralization and plant N uptake. The data are consistent with the notion that the interspecific competitive interactions in intercrops result in better the management of within field variability and thereby improve the management of within field variability. Observations from the present study emphasize the importance of changing focus from cropping strategies based upon assumptions of homogeneity within field units toward the potential in the management of within field variability.

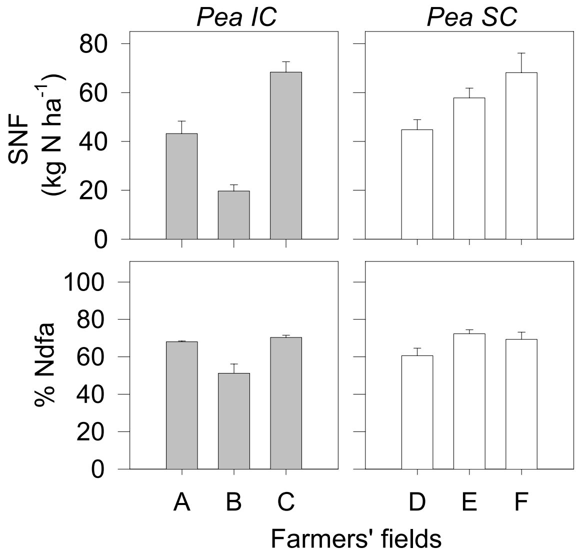

Figure 1. Pea symbiotic nitrogen fixation (SNF) and pea percentage N derived from fixation (%Ndfa) calculated from aboveground N accumulation at harvest in six Danish farmers' fields with pea-barley intercropping (IC)(A-C) and pea sole cropping (SC)(D-F) harvested in August 2000. The values are means (n=5) ± SE.

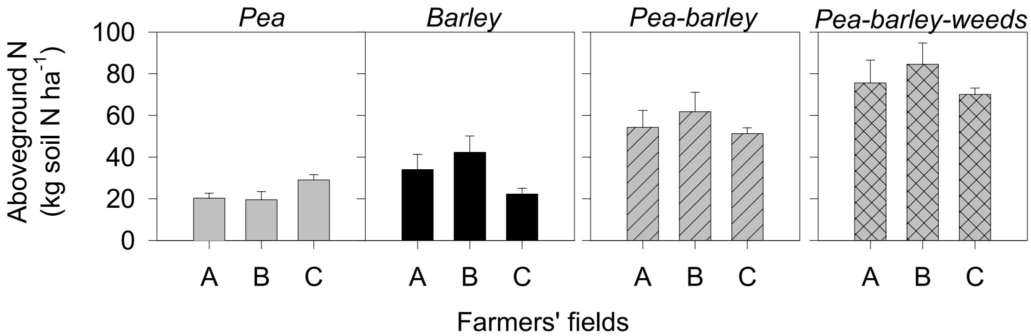

Figure 2. Above-ground dry matter (DM) production of intercropped (IC) pea and barley - weeds included. Further explanations see Fig. 1.

Conclusion

Using data from farmers' fields it was evident that the complete plant community (including weeds) should be included when trying to understand the use of plant growth factors in low-input cropping systems. In the interspecific competition for plant growth resources the weed component should be regarded as a significant component along side the crop species. It is concluded that the present pilot experiment expanded our understanding of the practical applicability of our scientific ideas dealing with pea-barley intercropping.

References

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