

Influence of different seed rates, sowing techniques and N supply on grain yield and quality parameters in intercropping systems

C. Dahlmann and P. von Fragstein und Niemsdorff
 Faculty of Organic Agricultural Science at the University of Kassel
 Department of Organic Farming & Cropping
 Nordbahnhofstr. 1a, 37213 Witzenhausen, Germany
 (dahlmann@wiz.uni-kassel.de)

Introduction

Intercropping of cereals and grain legumes is a neglected theme in agricultural science and practice, both conventional and organic. In 1998 less than 10,000 ha of organic crops (~ 5% of the organic cultivated arable land in Germany) were cultivated using an intercropping system, but this system can be an alternative to sole crops in order to improve yield and quality parameters. Furthermore, seed rates, techniques and N supply may influence the effect of intercrops on yield and qualities. The objective of this study was to determine the effects of relative frequency of intercrop components and intercrop design on the intercrop performance compared with sole cropping.

Materials and Methods

The experiments were carried out on experimental fields of the university of Kassel at the Hessian State Estate Frankenhausen, Germany (51°25'N, 9°25'E). The soil was a Cumuli Anthrosol. Spring wheat (*triticum aestivum* cv. Vinjett EU) and faba bean (*Vicia faba* cv. Marcel) were sown as:

- **sole crop (SC):** Spring wheat (W) with the half density, 200 seeds/m² (W50) respectively with the full density 400 seeds/m² (W100); and faba bean (F) with 20 (F50) respectively 40 (F100) seeds/ m².
- **intercrops in a replacement series design** [% of plant population in full density of the SC] (F25W75; F50W50; F75W25).
- **intercrop in an additive design** (F100W100).

In 2004 and 2005 mixtures were applied using two row techniques:

- **Row Intercropping (IC)**, {species in alternating single rows}
- **Mixed Intercropping (MC)**, {species sown in the same row}

In 2003 and 2004 variants of the core trial (all SC + ICF50W50; ICF100W100) were supplied with 50 kg N/ha in the form of sugar beet Vinasse (N+) and without fertilizer (N-).

All trials in each year were arranged in a randomized block design with four replicates.

Results and discussion

Concerning grain yields we note that over all experiments most of the intercrop variants increased yield in comparison to the highest yield sole crop (Fig. 1 – Fig. 3). Also the results of the LER's, as an indicator for the resource complementarity, with values from 1,02 up to 1,33, shows the advantage of intercropping. The sowing technique and corresponding plant distribution is not an important factor. Also manuring had no essential influence on the grain yield, but more on the thousand grain weight of sole cropped and intercropped faba bean. These values, in the replacement and also in the additive design, are lower than in not fertilized plots. It is believed that manuring reduced N₂ fixation. Perhaps this N resource is lacking during the filling phases of fertilized faba beans.

Another point concerning N₂ fixation from the atmosphere is the higher fixation rates in intercropped variants (ICF50W50 = 87,80 % Ndfa; ICF100W100 = 92,94 % Ndfa) compared with the faba bean sole crop (F100 = 69,03 % Ndfa) in 2005. It is known that interspecific competition is able to increase N₂ fixation. Results of the present study are identical with research of JENSEN, who also found a significantly higher amount of N₂ fixation in pea intercropped compared to the pea sole crop.

N values in spring wheat grain are higher than in sole cropping in all experiments in intercropping (Fig.1 – Fig. 3). This also confirms results from the other sites of the EU Project. What are possible explanations for this phenomenon? It is supposed that spring wheat uses more N in the first soil layer during the vegetation period, due to the fact that there is no serious competition between wheat and N₂ fixing faba bean. During the filling phases spring wheat can use more N resources in deeper soil layers which are still available.

Conclusions

Intercropping is an interesting system for improving yield and quality, especially the N content in spring wheat grain. The results show that (a) intercropping is able to increase total grain yield compared to sole crops (depending on seed rate), (b) MC-Intercropping (better suited to farming practice) achieved similar results to IC-Intercropping and (c) the 50 kg N/ ha with sugar beet Vinasse has no significant influence on researched parameters of intercropped spring wheat/ faba bean.

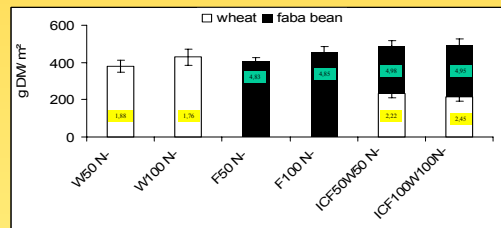


Figure 1. Grain yields (g DM/ m²) core trial without N supply in IC. Mean ± SE values of 2003 - 2005. Figures in columns are N content in % in grain dry matter.

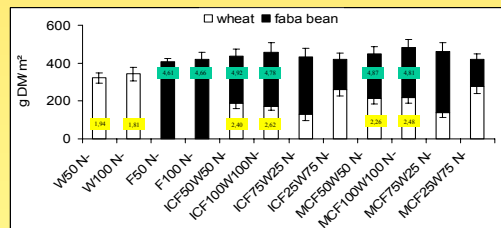


Figure 2. Grain yields (g DM/ m²) of variants with different seed rates and two sowing techniques in IC and MC without N supply (N-). Mean ± SE values of 2004/ 05. Figures in columns are N content in % in grain dry matter.

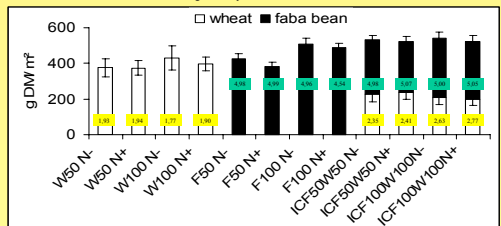


Figure 3. Grain yields of variants with N supply (N+ = 50 kg N/ha, N- = 0 kg N/ ha). Mean ± SE values of 2003/ 04. Figures in columns are N content in % in grain dry matter.