Weed control in organic crop rotation experiments for grain production

Ilse A. Rasmussen[1], Margrethe Askegaard[2] and Jørgen E. Olesen[2]

[1]Department of Crop Protection, DIAS Flakkebjerg, DK-4200 Slagelse, DK
[2]Department of Crop Physiology and Soil Science, DIAS Foulum, P.O. Box 50, DK-8830 Tjele, DK
E-mail: IlseA.Rasmussen@agrsci.dk

Keywords: *weed control, crop rotation, field experiment, catch crops, manure, cereals,* Cirsium arvense

Introduction

The common organic farming system in Denmark is based on dairy farms, where fodder crops including grass-clover dominate the crop rotations. Stockless arable farming in Danish organic farming is expected to increase, with a subsequent increase in the fraction of cereals and pulses in the crop rotations. Less diversified crop rotations are expected to reduce prevention against weeds, weed control will probably become more difficult, and the crops are likely to become more dependent on import of nutrients. Undersown catch crops make mechanical weed control in the cover crop difficult. The effects of different crop rotation elements on yield, nutrient leaching, weed infestation and soil nutrient availability are investigated in a long-term experiment carried out in Denmark since 1997 (Olesen *et al*., 2000). The development in the weed flora in the systems was monitored.

Materials and methods

Four different four-year crop rotations were compared at four different soil types. All crops in all rotations were represented each year. There were two replicates. Three factors were included in the experiment in a factorial design: a) Fraction of grass-clover and pulses in the rotation (crop rotation), b) Catch crop (without or with a catch crop of ryegrass or bi-cropped clover) and c) Manure (without or with animal manure applied as slurry). Weeds in cereals and pulses without undersown catch crops were controlled by weed harrowing with spring tine weeders. If the weed infestation was large, the wheat was sown at larger row distance and hoed mechanically. Large perennial weed plants (i.e. *Cirsium arvense* and *Artemisia vulgaris*) were removed by hand weeding. *Elymus repens* was controlled if present by repeated stubble cultivation after harvest in treatments without catch crops. The sugar beets were kept weed-free by a combination of pre-emergence flaming, mechanical and manual hoeing and hand weeding large weeds (Rasmussen *et al*., 1999).

Results and discussion

During the first two years of the experiment, there were no differences in weed flora (species, numbers and biomass) within sites pertaining to crop rotation, but a tendency towards lower weed infestation in cereals without catch crops. There was generally a larger weed biomass in the winter wheat compared with the other crops. There were more weeds in the fertilised plots, as shown regarding winter wheat in Table 1. The crop biomass was also largest in the fertilised treatments. *C. arvense* occurred at one location in some plots of all cereal crops in 1998. After harvest it appeared in significantly more plots when no catch crop was sown ($p<0.05$).

Table 1. Biomass of weeds (g m^{-2}) in winter wheat without or with manure. Significant difference between levels of manure within each location and year: * $p<0.05$, ** $p<0.01$.

	Location Foulum		Location Flakkebjerg	
year	no manure	manure	no manure	manure
1997	21	29	4*	11*
1998	17**	45**	9	19

Conclusions

At this early stage of the experiment, it is not possible to draw conclusions about the effect of the crop rotations on the weed flora. Manure application seems to enhance the number and biomass of weeds as well as the crop biomass. The catch crops seem to help reduce the occurrence of *C. arvense* in the cereals. However, the undersown catch crops also reduce the possibilities of mechanical control of annual weeds in the cereals, resulting in a tendency for more weeds in treatments with catch crops.

References

Olesen, J.E., Askegaard, M.A. and Rasmussen, I.A. (2000). Design of an organic farming crop rotation experiment serving multiple purposes. Acta Agriculturae Scandinavica, Section B. Soil and Plant Science. (In press).
Rasmussen, I.A., Askegaard, M.A. and Olesen, J.E. (1999). Plant protection in organic crop rotation experiments for grain production. In: J.E. Olesen, R. Eltun, M.J. Gooding, E.S. Jensen and U. Köpke (Editors), Designing and testing crop rotations for organic farming. DARCOF Report no. 1, 321-330.