Development of weeds in organic crop rotation experiments

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Introduction

Weeds are a major problem in organic farming. Preventive as well as curative measures must be utilised to manage the weeds and avoid proliferation. Besides direct weed control measures, many different aspects of planning and management in the cropping system affect the proliferation of weeds. However, it has rarely been investigated how the whole system affects weed populations.

Materials and methods

A crop rotation experiment was designed to evaluate the possibilities for increasing production of cereals and pulses in arable organic farming without risking yield penalties, leaching of nutrients and increasing weed problems. The experiment was carried out at three locations in Denmark: Jyndevad with a coarse sandy soil, Foulum with a loamy sand and Flakkebjerg with a sandy loam. It had two replicates for eight years (1997-2004) and included three factors: occurrence of nitrogen-fixing crops in a four-year crop rotation (rotation 1 (R1): 1½ year grass-clover + 1 year pulses, rotation 2 (R2): 1 year grass-clover + 1 year pulses, rotation 4 (R4): 1 year pulses), manure application with (+M) or without (-M) animal manure) and use of catch crops with (+CC) or without (-CC) undersown catch crops or bi-cropped clover). All crops in the rotation were present every year. Preventive as well as curative measures for weed management were used where possible in each system, e.g. mechanical weed control was not used after sowing of catch crops, and post-harvest stubble cultivations were only carried out in systems without catch crops. Annual and perennial weeds were monitored over 7 years. The experiments are described in Olesen et al. (2000), yields from the first 4 years are described in Olesen et al. (2002) and the weed development during the first rotation is described in Rasmussen et al. 1999a, b and Rasmussen et al. 2000.

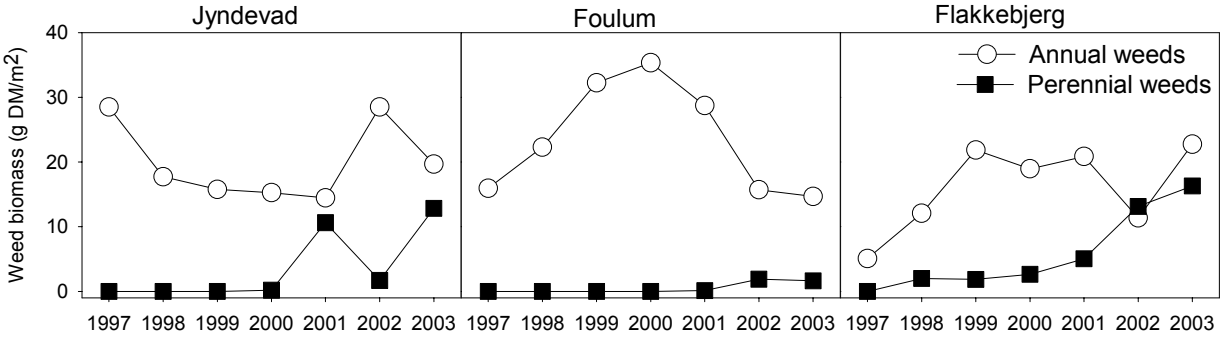

Figure 1. Development of annual and perennial weed biomass, mean of all treatments and crops at the three locations.

Results and discussion

The general development of weeds, annual as well as perennial, during the experiment, differed between locations (Fig. 1). At Foulum the annual weed biomass was higher in the years 1999-2001 than the other years. There were two reasons for this: i) the winter cereals harvested in 2000 and 2001 were sown early the previous autumn, resulting in higher weed pressure, and ii) gradually increasing weed pressure in the spring crops was countered by

increased mechanical weed control from 2001 onwards. At Jyndevad and Flakkebjerg the amount of perennial weed biomass increased towards the end of the experiment in spite of efforts to counter this development.

Weed biomass as well as the proportion of weed biomass to total biomass was greatest in the +M treatment at Foulum and Flakkebjerg, while no effect on biomass and a reduced proportion of weeds in total biomass was seen at Jyndevad. This indicated that the crops benefited more than the weeds from the addition of manure on this sandy soil.

Weed biomass was greater in the winter cereals than in the spring-sown crops. Especially at Foulum there was more weed biomass in the –CC treatments, where weed control was less intensive, than in the +CC treatments. This difference between the catch crop treatments was also seen in some spring cereals at all three locations, but not in the pulse crops, and not in spring barley with undersown ley where no or the same weed control measures were carried out in all treatments.

In R2, which included grass-clover, there was significantly less thistle (*Cirsium arvense* L.) biomass than in R4 without grass-clover at Flakkebjerg, where *C. arvense* was prolific. This was most obvious in winter wheat that followed the grass-clover; no difference was found between the crop three years after grass-clover and the crops in R4 (Fig. 2a). Surprisingly, there were no significant differences between the amount of *C. arvense* in the –CC and +CC treatments, in spite of the fact that stubble cultivations were only carried out in the –CC treatment (Fig. 2b). Control of *Elytrigia repens* (L) Desv. ex Nevski at Jyndevad was carried out by repeated stubble cultivations, but this lead to increased nutrient leaching and decreased fertility in the system.

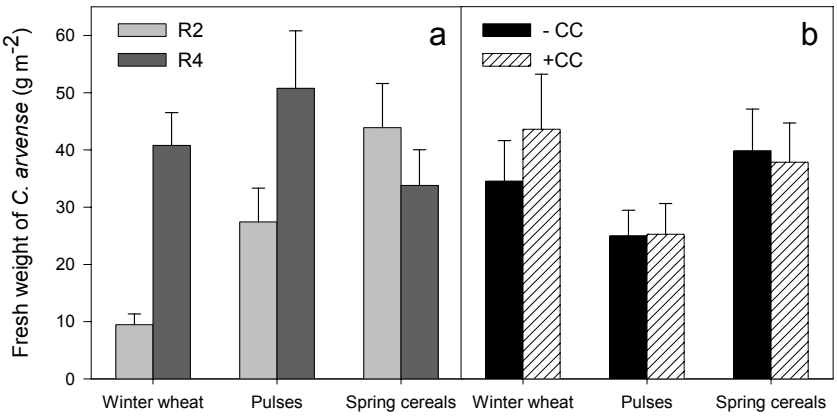

Figure 2. Fresh weight of *Cirsium arvense* in various crops in a. rotation 2 (R2) and 4 (R4). b with (+CC) or without (-CC) catch crops.

References

Olesen, J.E. et al., 2000. Acta Agriculturae Scandinavica, Sect. B, Soil and Plant Science, 50, 13-21.

Olesen, J.E. et al., 2002. Journal of Agricultural Science, Cambridge, 139, 361-370.

Rasmussen, I.A. et al., 1999a. In: Proceedings of the 11th EWRS (European Weed Research Society) Symposium 1999, Basel, p. 98.

Rasmussen, I.A. et al., 1999b. In: Designing and testing crop rotations for Organic farming – Proceedings from an international workshop, Eds. J.E. Olesen, R. Eltun, M.J. Gooding, E.S. Jensen & U. Köpke, DARCOF-report no. 1, Danish Research Centre for Organic Farming, pp. 321-330.

Rasmussen, I.A. et al., 2000. In: Proceedings 13th IFOAM Scientific Conference, 28-31 August 2000, Eds. T. Alföldi, W. Lockeretz & U. Niggli, Basel, p. 182.