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Level and causes of weed control in organic pea cultivation via intercropping under varying ploughing depths

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Introduction

Semi-leafless peas have a weak weed suppressive ability and a reduction of soil tillage depth is often related to an increase in weed infestation in organic farming. The high weed suppressive ability is one important aspect of growing peas in an intercrop with oat. Therefore a pea-oat intercropping is a feasible weed management strategy for pea cultivation in reduced tillage systems. We determined the interaction of pea sole or intercropping and of shallow or deep ploughing on annual weed infestation. Of additional concern were the causes of weed suppression in pea-oat intercrops.

Materials and methods

A field and a divided pot experiment were conducted in Northern Germany (8.8°C, 760 mm, sandy loam). The field experiment was carried out as a split-plot design of four replications with two tillage systems as the whole plot and three cropping systems as the subplot in 2009 and 2010. Deep ploughing (DP) consisted of stubble tillage with a precision cultivator (9 cm depth) followed by mouldboard ploughing (25-27 cm depth), whereas shallow ploughing (SP) was carried out using a skim plough (twice, 4-6 and 10-12 cm depth). The factor cropping system comprised pea sole cropping, oat sole cropping and pea-oat intercropping. Annual weed biomass was determined at the beginning of pea flowering, pod development and at maturity.

The divided pot experiment was carried out under growth chamber conditions to examine the effect of a pea sole crop, an oat sole crop or a pea-oat intercrop on the growth of S. media, the most dominant weed species in the field experiments. The crop and the weed were separated by shoot or/and root barriers. The crop-weed interference treatments were root barrier, shoot barrier, root and shoot barrier or no barrier. The experiment was carried out as a complete randomized block design and was repeated three times. The weed shoot biomass was determined at the end of the experiment.

Data were analysed using Proc GLIMMIX and GLM in SAS 9.2.

Results

Pea sole cropping under SP resulted in a significantly higher annual weed infestation compared to DP (Fig. 1). The weed infestation was significantly lower in oat than in pea sole crops in both tillage systems. In addition, we found lower weed infestation in pea-oat intercrops than in pea sole crops under DP. Shallow ploughing caused a greater weed biomass accumulation in the intercrop than in the pea sole crop under DP at the first and second harvest date in both years, whereas intercropping under SP tended to result in lower values at crop maturity. We detected significant differences between tillage systems in pea-oat intercrops in both years and oat sole crops in 2010. The divided pot experiment showed no significant influence of the cropping system on the weed growth in both treatments with root barrier. The weed shoot dry weight was significantly greater in the pea sole crop than in the intercrop and the oat sole crop in both treatments without root barrier.

Discussion

We have observed significantly higher weed biomass values in SP than in DP except for the oat sole crop in 2009. This can be due to an accumulation of weed seeds in the upper soil levels under shallow ploughing (Colbach et al. 2000). Pea sole cropping resulted in higher weed growth than pea-oat intercropping and oat sole cropping in the field and the divided pot experiment treatments without root barrier. Field experiment data indicate that the weed suppressive ability of pea-oat intercrops enhances towards crop maturity. For this reason the intercrop only compensated for the higher weed growth under SP in comparison to pea sole cropping under DP at crop maturity. Cropping system effects on weed growth were detected in treatments without root separation in the pot experiment. Therefore weed suppression in intercrops is attributable to a below-ground interaction.

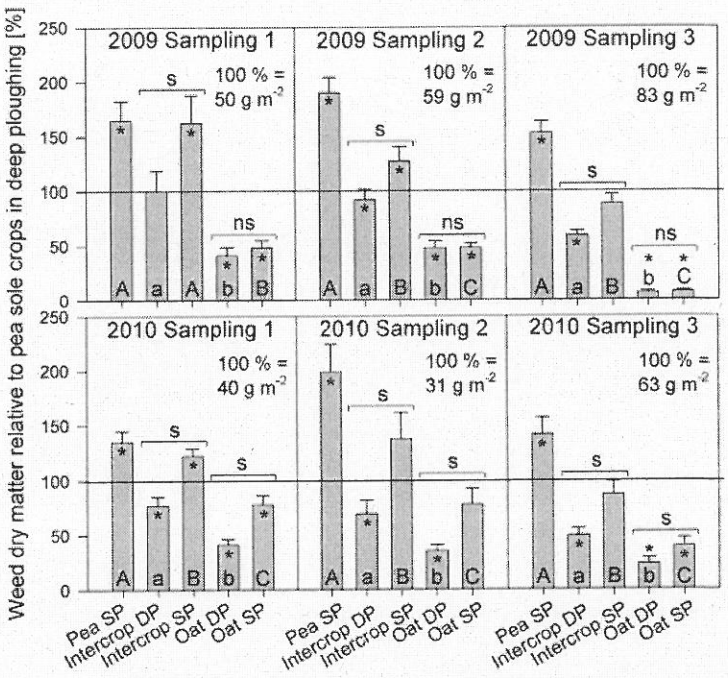

Figure 1: Relative weed biomass in pea and oat sole or intercrops under deep (DP) or shallow (SP) ploughing compared to the reference value pea sole cropping under DP at three sampling dates in 2009 and 2010. Different capital (SP) or lowercase (DP) letters indicate significant differences ($P < 0.05$) between cropping systems within the same tillage system. s/ns = significant/non-significant difference between DP and SP within the same cropping system, * = significantly different from the reference value pea sole cropping under DP.

References

Colbach et al. 2000: Eur. J. Agron. 13, 111-124.

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