Winter cover crops decrease weediness in organic cropping systems

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**Implications**

By inserting cover crops into organic cropping systems, the number and biomass of weeds decreased. Winter cover crops clearly have a suppressive effect on weeds by providing competition for light, water and space.

**Background and objectives**

In organic farming one of the most important issues is to maintain soil fertility and to reduce the influence of weeds on the main crop yield (Melander et al. 2016). Since infestation with weeds results in competition for nutrients, water and sunlight and thus is the main reason for considerable crop loss, it is important to control weediness (Robaccer et al. 2015). Drilling winter cover crops after the main crop harvest can improve soil characteristics, when incorporated into the soil, and prevent leaching. Growing cover crops provides agroecological services by preventing water and winter erosion, improving chemical, biological and physical soil properties and suppressing weeds by providing competition or by releasing allelopathic chemicals from either living or decomposing plant tissue (Melander et al. 2016). The aim of the study was to investigate the influence of different winter cover crops and their combination with composted cattle manure on weeds in three organic farming systems during the period of 2014–2016.

**Key results and discussion**

During the experimental period it became evident that the introduction of winter cover crops to a five-year crop rotation (Org I system) and in combination with cattle manure (Org II system) depressed weediness in comparison with the control system (without cover crops, system Org 0). In spring before the incorporation of winter cover crops into soil, the weed dry mass was statistically highest in system Org 0 (51.5 g DM m-1), where no winter cover crops were used and the soil was bare. In the systems Org I and Org II the weed dry mass did not differ from each other but it was significantly lower than in system Org 0. These results correlated with the weed density – in Org 0 system the number of weeds was the most abundant and it was much lower in Org I and II systems. Different cover crops depressed weeds differently. Winter rye and a mixture of winter rye and winter turnip rape were better suppressors of weed dry biomass and weed density compared to winter turnip rape. There were no significant differences in weed species composition between cultivation systems. Before the incorporation of the cover crop, the dominant weed species was *Matricaria inodora* in all systems. The weed species also often found were *Viola arvensis* Murr., *Capsella bursa pastoris*, and *Chenopodium album* L. There was a tendency, that the number of weed species was higher in Org 0 and lower in winter rye as cover crop in Org I and II systems.

These results indicate clearly, that autumn sown cover crop establishes a sufficient living plant mulch covering the soil before winter. In early spring the cover crop is able to resume its vegetative state and thus suppresses weediness by competition (Hollander et al. 2007). Also winter rye exhibits allelopathy and thus inhibits weeds by releasing natural toxins.

The use of cover crops reduced the weed pressure during the cover crop cycle. But the effect was not permanently significantly obvious in the subsequent cash crop. In cash crops before harvesting the suppressing effect of winter cover crops was strongly influenced by climatic conditions and significant differences between systems appeared only in 2015.

It can be stated, that winter cover crops have a suppressing effect on weeds. From the cover crops used the winter rye was the best weed suppressor. Beside of supression of weeds, winter cover crops have multiple positive effects on different soil properties (Luik et al. 2014)

**How the experiment was carried out?**

The five-field crop experiment with three different organic systems was started in 2008. The crops grown in succession were as follows: barley (*Hordeum vulgare* L.) undersown with red clover (*Trifolium pratense* L.), red clover, winter wheat (*Triticum aestivum* L.), peas (*Pisum sativum* L.), and potato (*Solanum tuberosum* L.). The control System (Org 0) followed this rotation. Winter cover crops were used as green manure in System Org I: mixture of winter turnip rape and winter rye after winter wheat, winter turnip rape after peas and winter rye after potato. In System Org II winter cover crops were used as green manure and in spring composted cattle manure – 20 t ha-1 for potato, 10 t ha-1 for winter wheat and for barley was applied On average, the dry matter of composted cattle manure contained 138 g C kg−1, 9.7 g N kg−1, 4.6 g P kg−1, 8.6 g K kg−1. The average dry matter content was 44.8 percent. The experiment was established in four replicates, each plot (60 m2) situated in a systematic block design. The field is the property of the Department of Field Crop and Grassland Husbandry of the Estonian University of Life Sciences. The field’s location is near Tartu (58°23´N, 26°44´E). The soil type was sandy loam Stagnic Luvisol according to the World Reference Base classification (FAO 2014). The cover crops were sown right after the harvesting of the main crop and in next spring at the beginning of May they were ploughed into the soil. In cereals, potato and peas mechanical weed harrowing was used to control weeds. All data regarding the five-field crop experiment was collected according to TILMAN-ORG Handbook of Methods (Cooper et al. 2012). Total dry mass and density of weed species were measured in the end of April before the cover crops were ploughed into the soil and three weeks before harvesting the rotational crops. All measurements were carried out in four replications per each plot with a 25 x 25 cm frame. All weed samples were collected and counted by species. Total biomass was weighted using only aboveground biomass after the weed samples were dried (80 °C) to a constant weight.

Statistical analyses were performed by using the Statistica software package (version 11.0). Significant differences between cropping systems, winter cover crops and experimental year were tested by Tukey’s least significant difference test. The statistical significance level was set at p<0.05.

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