

In crop rotation green manures as winter cover crops enhance ecosystem services of farming

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Organic farming systems should be characterized by excellent soil fertility management to keep plant nutrient cycles short and as closed as possible.

Therefore, it is extremely important to establish growing systems that have rotations with appropriate crops and intercrops to ensure fertile and biologically active soils, to enhance biodiversity and to provide high quality crop yields. Locally available organic fertilizers include green manures and animal manure. The influence of green manures as intercrops and these combined with composted cattle manure on soil properties, biodiversity indicators and crop yields was studied in a crop rotation experiment in three organic systems at the Estonian University of Life Sciences.

In a five-field crop rotation experiment, winter wheat, peas, potato and barley undersown with red clover and red clover were grown in succession. System Org 0, as control, follows this rotation. In System Org 1, green manures as winter cover crops are used: after winter wheat - ryegrass, after peas - winter oilseed rape and after potato - winter rye. In System Org 2 green manures plus cattle manure at 40 t/ha was applied. Thus, in both Systems Org1 and 2 all plots had green plant cover in winter.

After the first rotation the following tendencies have been observed.

Under the influence of green manures (Org 1) and when these were combined with cattle manure (Org 2) organic carbon (from 1.26 to 1.43%), potassium (from 13.64 to 14.61 mg/100g) and phosphorus (from 9.88 to 10.25 mg/100g) contents of the soil and its pH level (from 5.86 to 6.10) increased. Also, microbial hydrolytical activity (from 43.1 to 52.7) increased significantly indicating soil life activation and some physical properties (water holding capacity etc.) improved.

Biodiversity indicators – ground beetles and weeds – were also influenced by organic manures. Ground beetles play an important role in pest control and their abundance was significantly higher (1.4 times) in systems with green manures, which apparently act as refuges offering them places to hibernate. The species diversity of weeds was dependent on the green manure crop - the greatest number of different weeds was in ryegrass and also in the following pea crop. The best suppressor of weeds was winter rye (Org 1 and 2).

Yields of barley and winter wheat increased under the influence of green manure and significantly when it was combined with cattle manure (according yield increase in barley 0.73 t/ha and 1.43 t/ha in winter wheat). In all crops, yield quality was dependent on the organic manures used (Org 1 and 2). Depending on the crop there were differences in metabolomics, microbiological parameters and in contents of single chemical components.

Thus, the first rotation is already showing that the use of green manures as intercrops covering the soil during winter brings multiple benefits for ecosystem services. Green manures offer supporting services, such as nutrient cycling and soil formation. They offer a regulating service with promotion of beneficial insects for pest control. They offer provisioning services such as good quality food products.

Acknowledgment

The current crop rotation experiment in different organic farming systems is supported by ERA NET CORE organic II TILMAN-ORG project.