Finding new cover crops for Estonian conditions

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**Implications**

Cover crops are essential in fallow periods of cropping systems to protect the soil from erosion and loss of plant nutrients through leaching and runoff (especially in winter). Experiments with potential cover crop species were carried out to evaluate their suitability to the local climate. The biomass production of tested cover crops in the two year experiment depended on the length of the growing seasons.

**Background and objectives**

In the last decades, organic farming has received great attention due to environmental and health-related concerns. Using cover crops in crop rotations is a promising option for sustainable agricultural production in both organic and conventional farming systems. Selection of cover crops depends mainly on the suitability for the local climate. In northern climate, the growth period of winter cover crops remains short, therefore the selection of species is limited.

In Estonia, interest in using cover crops for autumn and winter periods has grown in the recent years. Typical cover crops are white mustard (*Sinapis alba* L.), winter rye (*Secale cereale* L.), winter oilseed-rape (*Brassica napus* L. *ssp. oleifera* var. *biennis*) and winter oil turnip rape (*Brassica rapa* L. var. *oleifera*). Experiments with new cover crop species were carried out to find varieties that are capable of producing large biomass and binding great amounts of nutrients in the northern climatic conditions. More options for winter-hardy cover crops, especially cold tolerant legumes are also needed.

The potential new cover crops for autumn and winter include a brassica species tillage radish (*Raphanus sativus* L.) and leguminous crops berseem clover (*Trifolium alexandrinum* L.) and hairy vetch (*Vicia villosa* Roth).

**Results and discussion**

The weather conditions in 2015 caused a late harvest of cash crop and the cover crops tillage radish and berseem clover were drilled at the end of August. The growth period of the cover crops remained short – only 42 days, with an effective temperature sum (ETS, >+5 °C) of 323 degrees. Biggest biomass was produced by tillage radish - about 950 kg dry matter (DM) ha-1 and it bound 25 kg of nitrogen (N) ha-1. Tillage radish does not survive the winter in our climate, but when established early it produces quite large taproot and therefore is capable of scavenging the nutrients from deeper soil layers. Nutrients absorbed by the taproot are readily available to the following crop because the taproot decomposes quickly, releasing the nutrients almost immediately. We recommend the tillage radish for no-till farming systems because it leaves root channels, so the soil dries and warms up faster in spring.

The biomass DM yield of berseem clover was only 100 kg ha-1. Berseem clover is also winter-killed in Estonia. In autumn it needs earlier establishment before cooler temperatures slow the growth.

The number of growing days for the cover crops tillage radish, berseem clover and hairy vetch was 68 in 2016, with an ETS of 534 degrees. Earlier sowing and more favourable weather conditions resulted in considerably higher biomass yields compared with 2015. The total biomass DM yields varied from 2500 kg ha-1 for tillage radish to 1400 kg ha-1 for hairy vetch and berseem clover. N accumulation by cover crops depends on the total amount of biomass produced and the percentage of N in the plant tissue. Several researchers found non-leguminous cover crops to be very effective in taking up mineral N from the soil during autumn-winter time (Kramberger et al. 2010; Thorup-Kristensen, 2001). Tillage radish bound 70 kg N ha-1. The legumes that are able to bind nitrogen from air as well, bound about 30 and 50 kg N ha-1. Hairy vetch bound more N than berseem clover because of greater N concentration in biomass.

Hairy vetch may be a promising cover crop option for Estonia, because it has potential for surviving the winter and therefore gives an opportunity to scavenge more N. The results of Power and Zachariassen (1993) show that hairy vetch had higher N uptake than other legumes at low temperatures. When accounting for the seed cost, legumes are recommended for seeding in mixture with other species.

Additional research with these new species is needed to evaluate the biomass production and nutrient binding capacity in Estonian conditions.

**How work was carried out?**

A field experiment at Estonian Crop Research Institute (58°44'59.41'' N, 26°24'54.02'') was conducted in 2015 and 2016. The cover crop species in the first year were tillage radish and berseem clover, in the second year hairy vetch was included. The soil type in the experimental area was Cambic Phaeozem (Loamic) soil (IUSS 2015). The sowing dates of cover crops were August 25 in 2015 and August 3 in 2016. Cover crop aboveground biomass samples were collected from four randomly placed squares of 0.25 m2 in each plot in both years during the last week of October. Plant samples were oven dried at 65 °C for 72 h and weighed. N concentrations of the biomass were determined in Soil Science and Agrochemistry laboratory at Estonian University of Life Sciences.

**Acknowledgements**

The research was supported by Estonian Ministry of Rural Affairs project Varieties suitable for organic cultivation.

**References**

[IUSS] Working Group WRB. 2015. World reference base for soil resources 2014, update 2015 international soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports No. 106. FAO, Rome.

Kramberger B, Gselmana A, Janzekovic M., Kaligaric M & Brackoa B 2010. Effects of cover crops on soil mineral nitrogen and on the yield and nitrogen content of maize. Eur. J. Agron. 31: 103–109.

Power JF, Zachariassen JA 1993. Relative nitrogen utilization by legume cover crop species at three soil temperatures. Agron. J. 85: 134-140.

Thorup-Kristensen K 2001. Are differences in root growth of nitrogen catch crops important for their ability to reduce soil nitrate-N content, and how can this be measured? Plant and Soil 230: 185–195.