

GREEN MANURES IN VEGETABLE CULTIVATION

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Studied the feasibility of intermediate crops in the summer faba bean, vetch, hairy, lacy phacelia, rye, oats, sunflower, amaranth red as green manure for vegetable crops. Revealed their impact on the productivity of vegetables in the first and second year after planting.

Key words: *green manure, organic fertilizer, intercropping, biomass, productivity.*

Unlike in Ukraine, in Poland most soils are low in humus as its content does not exceed 2%. Due to intensification of agricultural production, the amount of organic matter introduced to the soil is much lower, which results in a negative humus balance and progressing degradation of agricultural land. Farmyard manure is the major source of organic matter in agricultural production. As vegetable growers find it more and more difficult to obtain the farmyard manure quantities necessary for successful production, they switch to other organic matter sources to replenish the deficit of farmyard manure. Cultivation of plants for incorporation is one of the oldest ways of increasing soil fertility (MacRae, Mehuys, 1985). It is also connected with implementation of the agri-environment programme which defines cultivation of catch crops as the major activity to improve the soil humus balance, maintain ploughed land under plant cover, limit erosion processes, protect waters against agricultural pollution and increase biodiversity by means of introducing more plant species into rotations. Summer (stubble) catch crops are the most popular kind of green manures in Poland. They can precede all cultivated plants which are sown/planted early in the season and positively respond to organic manuring: potatoes, maize, early maturing brassicas, onion, cucurbits and celeriac. The area under catch crops in Poland was about 425 th ha per year over the years 2005-2011.

Methods

Studies on summer catch crops used as green manures in vegetable cultivation have been carried out by the Department of Horticulture, the Siedlce University of Natural Sciences and Humanities, since 1979. Many species of crop plants have been examined including: faba bean, hairy vetch, serradella, lacy phacelia, rye, oat, sunflower and red amaranth.

The objective of the work was, among others, to determine the value of the catch crop plants cultivated from manuring purposes and their influence on yields of

selected species of vegetables cultivated in the first and second year after incorporation of the green manures (ploughing under of either the whole plants or their post-harvest residues).

Results and discussion

The quantity of organic matter supplied by summer catch crop residues depends on the species, fertilization level and soil as well as climatic conditions. It is usually from 9.7 to 41.2% of the whole biomass (Malicki 1997, Rosa 2005, Franczuk 2006). The results of this study indicate that from 7 to 40 tonnes of fresh matter per 1 ha is introduced into the soil depending on the catch crop species and kind. Of the summer catch crop tested, lacy phacelia, sunflower and faba bean produced the greatest biomass yields, 40.9, 40.4 and 39.4 t·ha⁻¹, respectively (fig. 1).

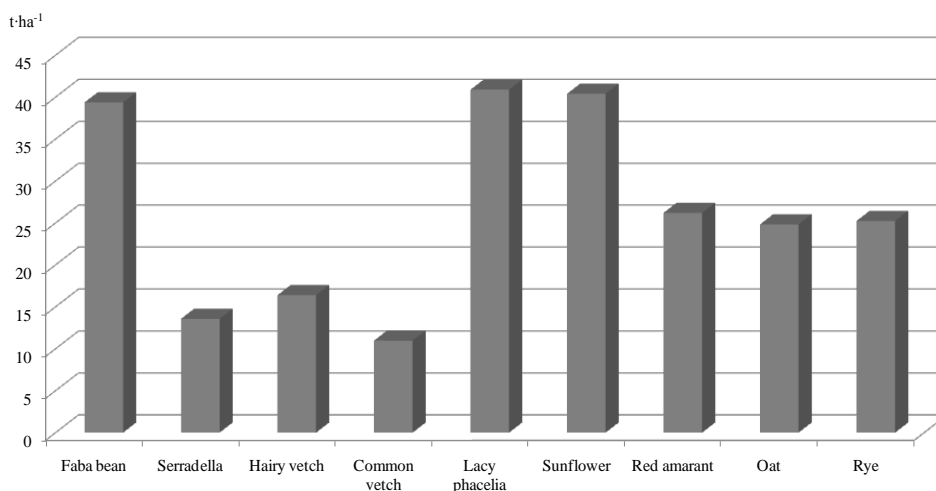


Fig. 1. Yield of fresh matter of the plants cultivated as summer catch crop in the studies from 1986-2006

In this study, there was also determined the amount of nitrogen supplied to the soil with the legumes (fig. 2).

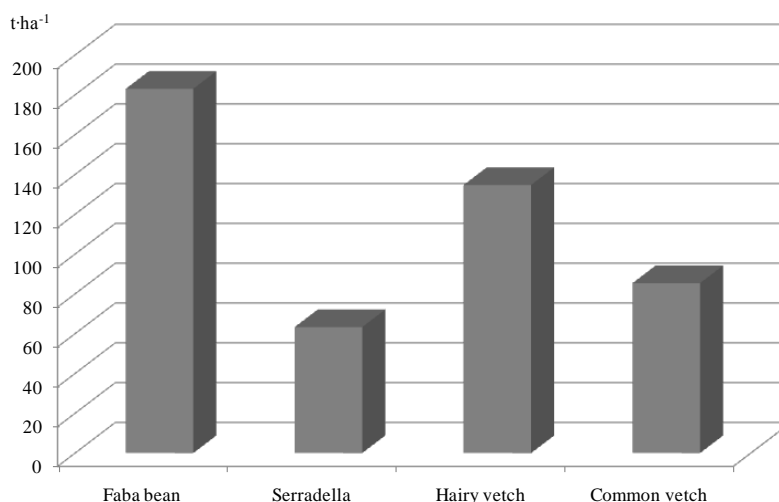


Fig. 2. The amount of nitrogen supplied to the soil with the legumes in the studies from 1986-2006

The following amounts were supplied by the fresh matter of faba bean, serradella, and hairy vetch: 181, 63.5, and 155.5 kg N·ha⁻¹, respectively. The remaining species did not supply nutrients but, by taking them up from the soil, prevented the nutrients from being leached from the topsoil. Moreover, they took up macro-elements which, after catch crop incorporation, remained in the topsoil and after the organic matter mineralisation, were released for the subsequent crop plants. Of the plants cultivated as summer catch crops, sunflower, lacy phacelia, red amaranth and faba bean accumulated most P, K, Ca and Mg in their biomass (fig. 3). The biomass of rye and oat accumulated about half the amount of the minerals compared with sunflower, lacy phacelia and red amaranth. The lowest quantities – less than 100 kg·ha⁻¹ P, K, Ca and Mg – were accumulated by hairy vetch and serradella.

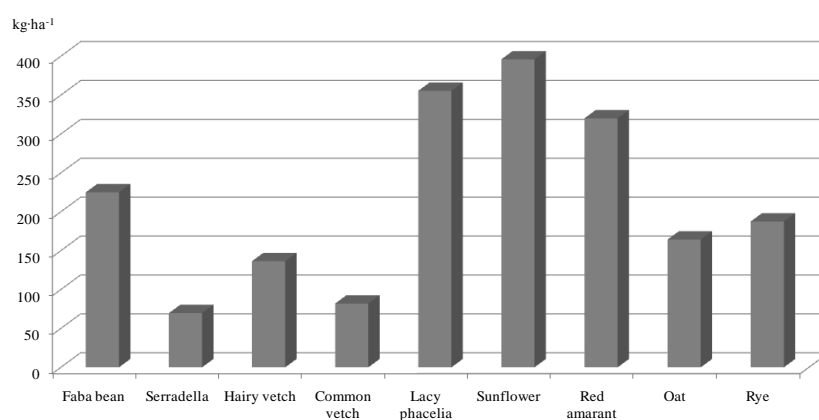


Fig. 3. The amount of macro-elements in the summer catch crops biomass in the studies from 1986-2006

The value of individual summer catch crops as manures can be determined by comparing the quantity of the organic matter they supply to the soil to farmyard manure. Assuming that 1.0 t of farmyard manure contains approximately 0.26 t dry organic matter, the dry matter of individual summer catch crops corresponded to the following farmyard manure quantities: faba bean 25.5, serradella 9.5, hairy vetch 13.5, common vetch 9.6, lacy phacelia 26.7, sunflower 28.5, red amaranth 20.4, oat 18.8, and rye 24.0 t·ha⁻¹ (fig. 4).

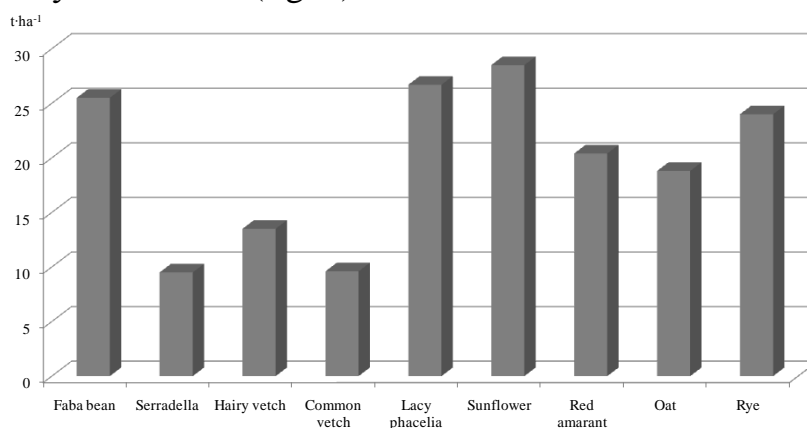


Fig. 4. Yield of organic matter of summer catch crops corresponded to the following farmyard manure quantities

Crop plant fresh matter can be used as fodder whereas the post-harvest residues may be incorporated. The manuring effect of residues is not as pronounced as the whole biomass but it favourably influences soil properties and, as a result, yield of the subsequent crop plants (Franczuk et al. 1999, Kotecki, Broda 1995, Jabłońska-Ceglarek et al. 2006). The quantity of organic matter supplied with residues ranges from 9.7 to 41.2% the whole biomass (Franczuk 2006).

Studies on the value of summer catch crop residues used as manures were conducted in 1986-1988. Analyses were performed of the fresh matter yields of faba bean, hairy vetch, lacy phacelia and rye post-harvest residues (fig. 5).

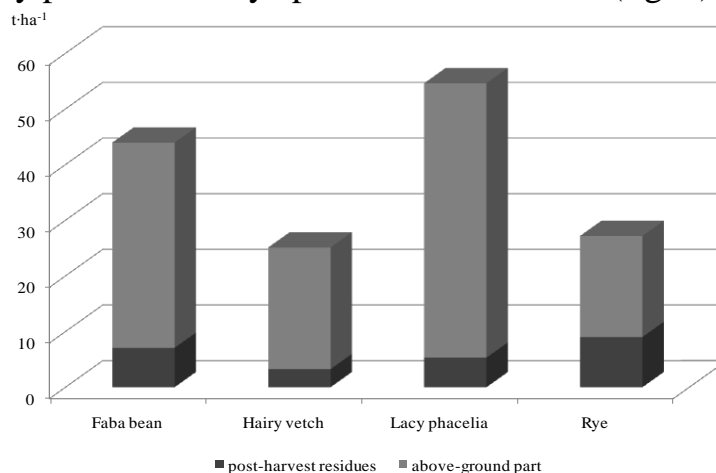


Fig. 5. Yield of fresh matter of summer catch crop residues in the studies from 1986-1988

The respective shares of residues in the whole biomass of the catch crops were as follows: 11.4, 12.7, 9.2 and 33.1%. Rye was the dominant producer of fresh matter due to its extended fibrous root system and well-branched above-ground part. As a result, the quantity of rye residues was the greatest, 9.0 t·ha⁻¹ fresh matter, although the fresh matter yield produced by the whole plants was lower than faba bean and lacy phacelia. The amounts of nitrogen supplied to the soil by leguminous residues were similar and equalled 19.3 and 19.5 kg per 1 ha for faba bean and hairy vetch, respectively (fig. 6).

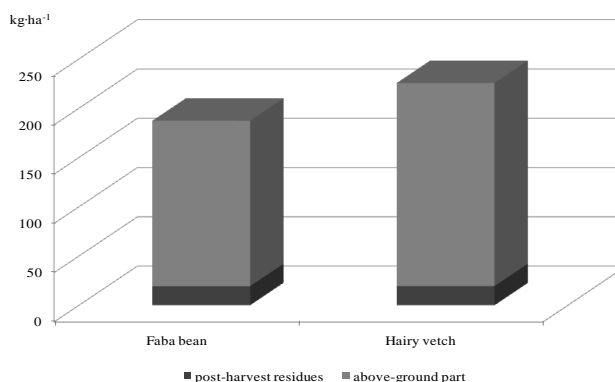


Fig. 6. The amount of nitrogen supplied to the soil with the summer catch crop residues in the studies from 1986-1988

The per-one-hectare organic matter amount supplied to the soil by rye cultivated as a summer catch crop corresponded to 7.9 t farmyard manure (fig. 7).

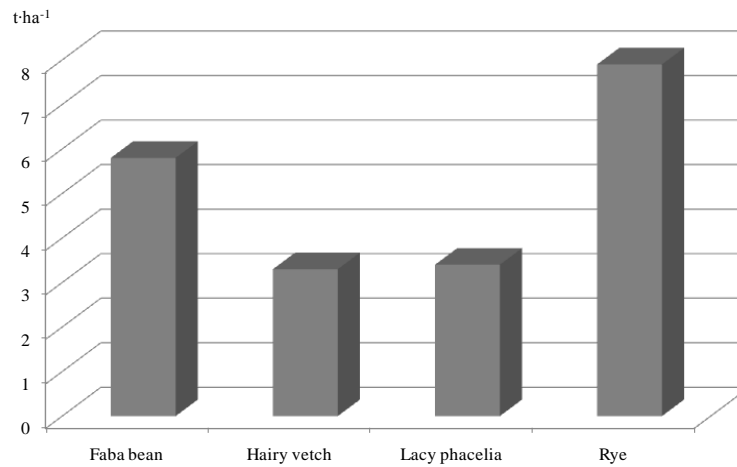


Fig. 7. Yield of organic matter of summer catch crop residues corresponded to the following farmyard manure quantities

The evaluation of the effect of green manures on yields of the subsequent plants indicated that all the studied species, when cultivated as summer catch crops, in the first year after incorporation increased the marketable yield of white cabbage compared with the control where no organic manure had been applied (fig. 8).

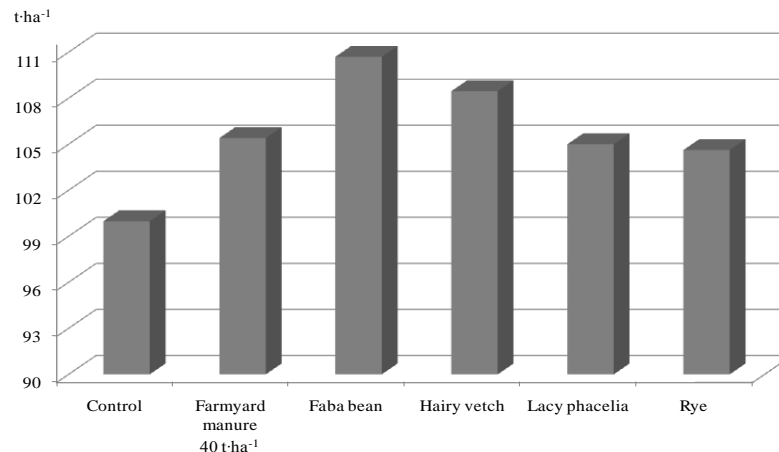


Fig. 8. Direct effect of summer catch crops on the marketable yield of white cabbage in the studies from 1986-2006

Faba bean and hairy vetch seemed to be better manures than farmyard manure applied at the rate of 40 t-ha⁻¹. Compared with the non-manured control, the yield increase produced by the afore-mentioned catch crops was about 10 t-ha⁻¹. Yields of white cabbage cultivated after the catch crop of lacy phacelia and rye were similar to the yields of plants grown after farmyard manure. The yield-enhancing influence of summer catch crop green manures was also observed in the second year after incorporation (fig. 9).

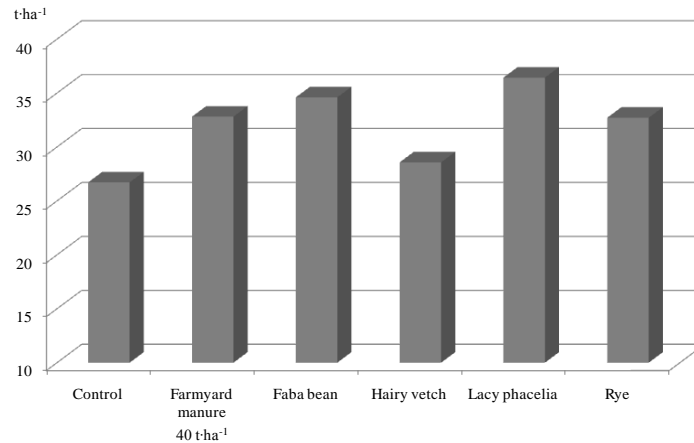


Fig. 9. Secondary effect of summer catch crops on the marketable yield of onion in the studies from 1986-2006

Lacy phacelia and faba bean had a particularly favourable effect on onion yield. The yield increases were higher compared with 40 t·ha⁻¹ farmyard manure incorporated at the same time. The yield-enhancing effect of rye in the second year after cultivation was similar to farmyard manure. After hairy vetch, onion yields were by 13% lower than after farmyard manure and yet they were by 7% higher compared with the non-manured control. In the study conducted over 2002-2006, the highest onion yield was harvested in the second year after serradella incorporation (fig. 10); it was by about 5 t·ha⁻¹ higher compared with farmyard manure incorporated at the same time.

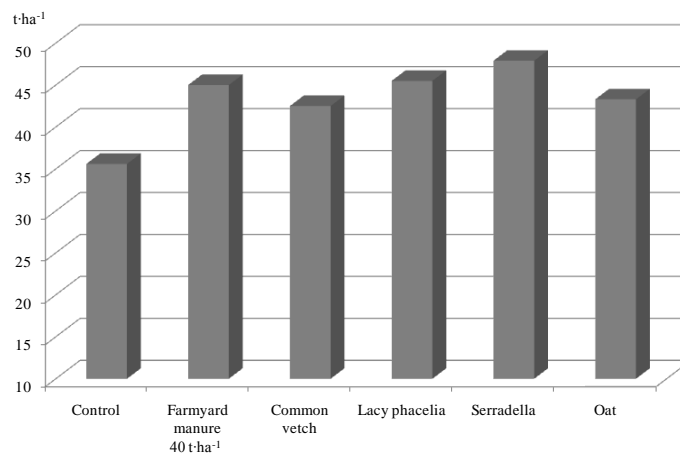


Fig. 10. Secondary effect of summer catch crops on the marketable yield of onion in the studies from 2002-2006

Onion yields recorded after the summer catch crop of lacy phacelia were similar to the yields after farmyard manure; after oat and common vetch they were lower than the yields after farmyard manure but much higher compared with the non-manured control.

Conclusions

- Of the plants cultivated as summer catch crops, lacy phacelia, sunflower and faba bean produced the highest biomass yields.

- Faba bean was the summer catch crop legume which supplied most nitrogen to the subsequent crops.
- Rye cultivated as a summer catch crop produced the greatest quantity of residue biomass.
- All the species examined in the studies contributed to increased marketable yields of vegetable crops cultivated in the first and second year after summer catch crop incorporation, compared with non-manured control.
- Yields of vegetables cultivated after faba bean, hairy vetch and serradella in the first year after their incorporation were higher or similar to the yields of the crops following farmyard manure applied at the rate of 40 t ha⁻¹.
- The secondary effect of green manures similar to or greater than the impact of farmyard manure was observed after lacy phacelia, faba bean and rye when cultivated as summer catch crops.

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Анна Занієвич-Бажковська, Іоланта Франчик, Роберт Роза, Едіта Костерна. Зелені добрива в овочівництві.

Вивчено доцільність застосування в літніх проміжних посівах кінських бобів, вики волосатої, фацелії мереживний, жита, вівса, соняшника, амаранту червоного як зелених добрив під

Анна Занієвич-Бажковська, Іоланта Франчик, Роберт Роза, Едіта Костерна. Зеленые удобрения в овощеводстве.

Изучена целесообразность применения в летних промежуточных посевах конских бобов, вики волосатой, фацелии кружевной, ржи, овса, подсолнечника, амаранта красного в качестве зеленых

овочеві культури. Виявлено їхній вплив на врожайність овочів у перший і другий рік після посіву.

Ключові слова: зелене добриво, органічне добриво, проміжні культури, біомаса, урожайність.

удобрений под овощные культуры. Виявлено их влияние на урожайность овощей в первый и второй год после посева.

Ключевые слова: зеленое удобрение, органическое удобрение, промежуточные культуры, биомасса, урожайность.