DOI: 10.34101/ACTAAGRAR/1/12513

Results of weed surveys in greening plants

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SUMMARY

Greening crops play an essential role in Hungary's agriculture. Weeds can also cause many problems during the development of greening plants. Our research aimed to evaluate the weed control properties of greening crops sown with different germination rates. Analysis of the effect of crop rotations on weed density. Comparison of weed growth in control, fertilised and greened areas. In October of 2021, a weed survey was carried out in lupin (Lupinus albus L.), common vetch (Vicia sativa L.), oil radish (Raphanus sativus var. oleiferus L.) and buckwheat (Fagopyrum eculentum Moench). During the weed survey, we determined the different weed species and their abundance. In terms of seed rates, the higher seed rates for lupin, oil radish, and buckwheat may be worth choosing for weed suppression. Plots in rotation III had the lowest weed incidence of all greening crops. The probable reason for this finding is that there was no prior greening in rotation III. For greening, the choice of buckwheat and oil radish will result in higher weed pressure. The most important weeds were the cereals sown before the greening crop. Fertilised plots had minimally fewer weeds than control plots. Research results show the difficulties of weed control in herbicide-free greening crops.

Keywords: *Greening crop; weed; germination rate; crop rotation*

INTRODUCTION

Greening consists of a combination of different practices, including crop diversification and the use of organic secondary crops. Under rules of the new Common Agricultural Policy, greening will be a precondition for all direct payments from 2023. There are several advantages to involve greening crops in crop rotations. This includes the ability to mobilize soil nutrients. The root system of greening plants improves soil moisture retention too. The soil water air ratio also improves. Greening plants play an important role in maintaining biodiversity. These characteristics can all lead to increased yields of the main crop (Agroinform, 2021).

One of the difficulties caused by weeds is that they often take up water and nutrients more quickly and in greater quantities than the cultivated crop. They can often overgrow the crop and thus shade it. Weeds can cause the soil temperature to decrease by up to 4 ºC, which slows down the uptake of nutrients and water by the roots of crop (Ekwealor et al., 2019). Weeds and cultivated crops may have common pathogens and weeds may provide areas for pests to grow.

Many positive effects can result from the application of the greening plants we have examined (lupin, common vetch, oil radish, buckwheat), but weeds can inhibit their development. Lupin cultivation in Western Australia has failed in the past due to several factors, including inadequate weed control. The cultivation of lupins caused a build-up of nitrogen in the soil and had a disease-preventive effect on the following cereal crop. In drier areas, lupin yields may be low but when grown in rotation with cereals, lupins have provided benefits to the farming system that went beyond a simple measure of yield (Marsh et al., 2000). Common vetch is a legume crop, which is widely sown in the Eastern-Mediterranean region of Turkey. The crop is generally grown for a variety of purposes, such as fodder in agricultural rotation, green manuer, or animal feed in the region (Soylu et al., 2020). Common vetch sown alone can provide significant amounts of nitrogen for the following crop. It also grows well in mixtures with cereals, which provide adequate weed control (Anil et al., 1998). One of the most commonly found in greening mixtures is oil radish (Sipos, 2020). Oilseed radish is known for its large leaves and strong root system. A study in Germany found that oil radish produced the biggest root dry matter of all tested crops, and reduced the density of spring weeds by more than 81% in some experiments (Brust et al., 2014). Several green manure crops have good weed suppressing abilities, such as oil radish and buckwheat, among others (Neurburg and Sárközy, 1993). Buckwheat is a crop that can be sown as a main crop but is also suitable for second sowing. It has the advantage of early harvesting and a short growing season. It can be grown under unfavorable conditions (Gonda, 2016).

The problems of weed infestation in the crops under discussion are refered in fewer literature sources. The objective of this research was to determine the evaluation of the weed control efficacy of greening crops sown at different germination rates. In addition, examined the effect of crop rotations on the number of weeds. Comparison of weed conditions in control, fertilised and greened areas.

MATERIALS AND METHODS

Study area, period and greening plant species

On the humic sandy soil of the Agricultural Research Institute of Nyíregyháza, in the autumn of

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2019, several greening plants were used as a second crop for experimental purposes, following different rotations. The greening plants in which the weed surveys were conducted were sown in August 2021 in a second sowing. In October 2021, one replicate weed survey per plot was carried out using a 50x50 cm sampling frame in white-flowered lupin (*Lupinus albus* L.), common vetch (*Vicia sativa* L.), oil radish (*Raphanus sativus var. oleiferus* L.) and buckwheat (*Fagopyrum eculentum* Moench) greening plants.

Experimental settings

Greening crops were sown in the field at different rates in 4 replicates per rotation. *Table 1* shows the seed standards.

Plots that had been treated with an active component of 80 kg of nitrogen per ha throughout the primary crop-growing season were also included in the experiment. We applied 3 different rotations in the field (*Table 2*).

Table 1: **Greening plants sown with different germination rates**

Seed standards			
Lupin (*Lupinus albus* L.)	300K g ha^{-1}	500K g ha^{-1}	650K g ha^{-1}
Common vetch (*Vicia sativa* L.)	2MM g ha^{-1}	2.5MM g ha^{-1}	3MM g ha^{-1}
Oil radisih (*Raphanus sativus var. oleiferus* L.)	800K g ha^{-1}	1.5MM g ha^{-1}	2MM g ha^{-1}
Buckwheat (*Fagopyrum eculentum* Moench)	2.3MM g ha^{-1}	3MM g ha^{-1}	3.8MM g ha^{-1}

K=Thousands; MM=Million; g=germ

Table 2: **Crop rotations used in the area**

Crop rotations		
I.	Crop rotation	Oat (*Avena sativa* L.) – Grenning crops – Triticale (×*Triticosecale*) – Greening crops
II.	Crop rotation	Triticale (×*Triticosecale*) – Greening crops – Oat (*Avena sativa* L.) – Greening crops
III.	Crop rotation	Maize (*Zea mays* L.) – Stubble – (×*Triticosecale*) – Greening crops

The first greening plants in rotations I and II were in the field for 2 months and then incorporated into the soil. Stalks of maize in crop rotation III were incorporated into the soil after harvest. Using the weed survey, we have determined the number of weed species and quantified the number of undesirable cereal plants that returned to the area.

Data processing methods used

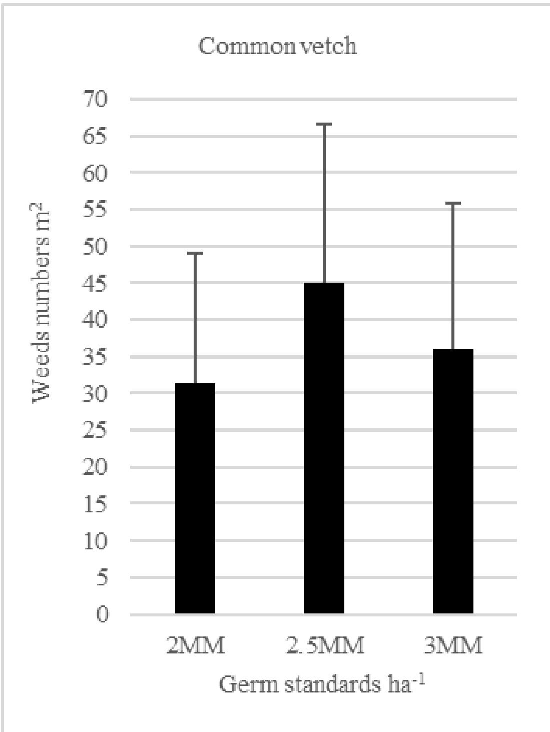
The spreadsheet program Microsoft Office Excel 2016 was used to organize the measurement data, and the results were used to calculate the mathematical standard deviation. The IBM SPSS Statistics 22 software environment was used to conduct analysis of variance, the Duncan test, and homogeneity analysis. Microsoft Office Word 2016 was used to summarize the text in the results.

RESULTS AND DISCUSSION

Seed standard results

The less amount of weeds were found in plots with the highest seed rates of lupin, oil radish, and buckwheat. The exception is common vetch, where we counted the lowest number of weeds in the plots sown with the lowest seed rate (*Figure 1*). The least amount of weeds, 23.3 weeds m^2, were found in buckwheat plots planted with 3.8 million germs ha^{-1}. The lupin plots with a 300 thousand germs ha^{-1} density we recorded the highest weed frequency at 45.3 weeds m^2. No statistically justifiable difference was found. The differences were only of a trend nature.

Figure 1: **Results of the quantity of weeds in common vetch according to the seed norm (Nyíregyháza, 2021)**



The error bars represent the standard deviation in the figure.

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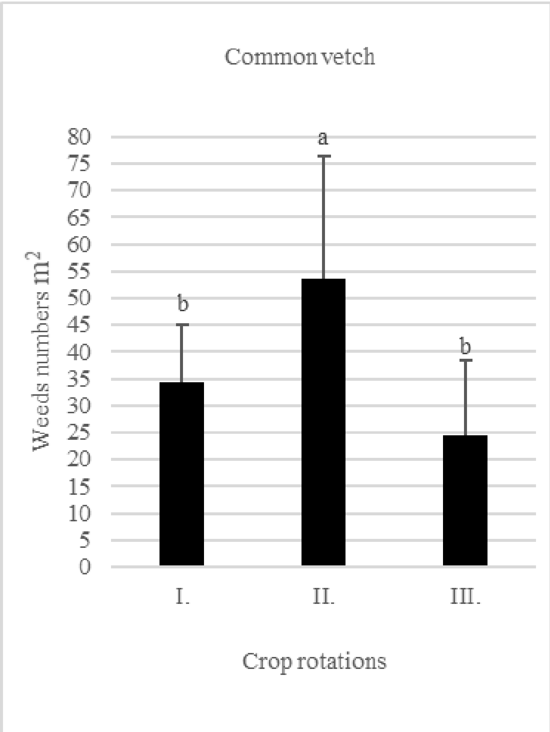
Results by crop rotation

Plots in rotation III had the lowest weed prevalence of all greening crops. The crop rotation III was maize - stubble - triticale - greening. Examining the common vetch plots, 24.3 weeds m^2 were observed in rotation III, which was significantly different from the results of rotation II, where 53.7 weeds m^2 were observed, as illustrated in *Figure 2*.

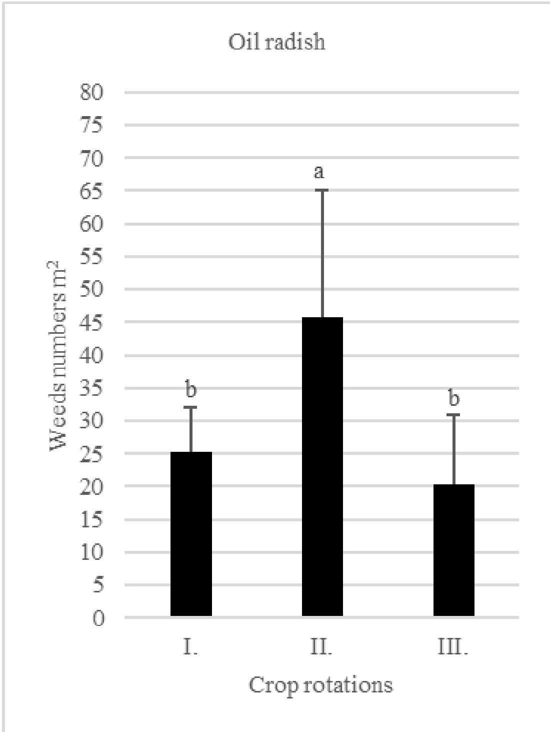
When the oil radish plots were examined in terms of rotations, rotation III showed 20.3 weeds m^2, which was much lower than the findings of rotation II, which showed 45.7 weeds m^2 (*Figure 3*).

Figure 2: **Results of the quantity of weeds in common vetch according to the crop rotations (Nyíregyháza, 2021)**



The error bars represent the standard deviation in the figure. The means of groups of homogeneous subgroups are shown. When a parameter differs significantly between treatments, the letters indicate this.

Figure 3: **Number of weeds in oil radish according to the crop rotations (Nyíregyháza, 2021)**



The error bars represent the standard deviation in the figure. The means of groups of homogeneous subgroups are shown. When a parameter differs significantly between treatments, the letters indicate this.

Comparison of weed infestation rates in greened, fertilised and control areas

The buckwheat plots had the lowest amount of weeds, with just 28.9 weeds m^2, when compared to the greened, fertilised, and control plots. Buckwheat is generally acknowledged for its capacity to control weed growth. This is because of its allelopathic characteristics among other factors. It is obvious that buckwheat, both as a plant and as a residue, has a potent weed-suppressing impact (Falquet et al., 2015). To investigate the allelopathic effects of buckwheat on weeds, Tohru and Takako (1995) cultivated buckwheat alone with weeds under field conditions. Buckwheat strongly reduced the amount of common purslane, white goosefoot, cockspur grass, and green amaranth (*Amaranthus lividus*). The oil radish plots had 30.4 weeds m^2, the second-lowest weed density. Mikó (2009) experienced excellent weed suppression in his experiments with white mustard (*Sinapis alba*) and oil radish and mustard-oil radish mixtures, achieving complete weed suppression in several of his experiments. Oil radish can sprout as early as 3 days after sowing, if conditions are right that will grow quickly and suppress weeds (Jacobs, 2012). The highest number of weeds was found in the lupin plots with 43.1 weeds m^2. According to Mikó's (2009) experiment, among several greening plants, lupin is also slow to develop in the beginning, hence its weed suppression capacity is only medium, with 18.7% weed cover in the area. The control plots had almost the same number of weeds m^2 as the spring vetch plots. There were just slightly fewer weeds in artificial fertilised plots than in control plots. The results are shown in *Figure 4*.

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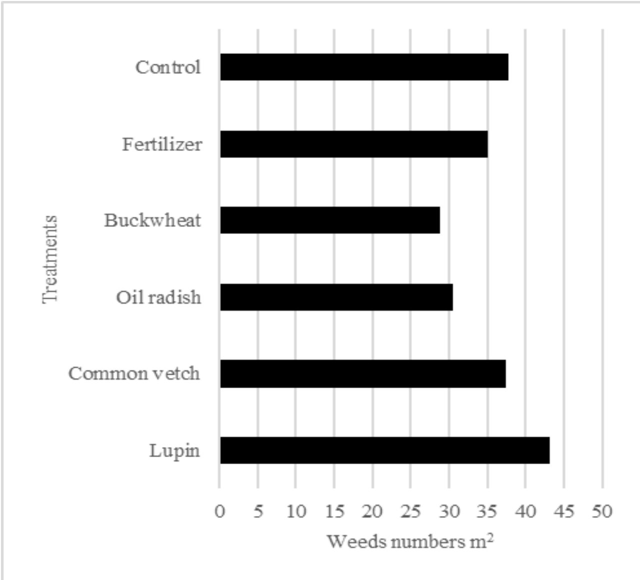
Figure 4: **Results of comparisons of weed infestation in greened, chemical fertilised and control areas (Nyíregyháza, 2021)**

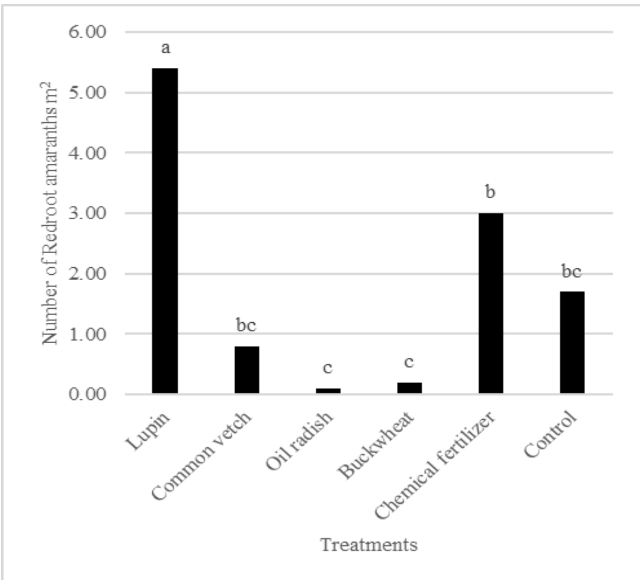


Number of redroot amaranth (*Amaranthus retroflexus*) in the studied area

The following weed species were documented in the studied area: common wild oat (*Avena fatua*), volunteer triticale (×*Triticosecale*), redroot amaranth (*Amaranthus retroflexus*), common purslane (*Portulaca oleracea*), prickly lettuce (*Lactuca serriola*), european bindweed (*Convolvulus arvensis*), creeping thistle (*Cirsium arvense*) white goosefoot (*Chenopodium album*), curlytop knotweed (*Persicaria lapathifolia*), volunteer sunflower (*Helianthus annus*), bladder hibiscus (*Hibiscus trionum*), field pennycress (*Thlaspi arvense*), maple-leaved goosefoot (*Chenopodium hybridum*), cockspur grass (*Echinochloa crus-galli*), common ragweed (*Ambrosia artemisiifolia*), charlock mustard (*Sinapis arvensis*), perennial sow-thistle (*Sonchus arvensis*).

Cereal crops sown as the main crop dominated the area as weeds. The second most dominant weed was redroot amaranth. The largest number of lupin plots had 5.4 weeds m^2, which the Duncan test determined to be significantly higher than the other treatments. The outcomes are shown in *Figure 5*.

Figure 5: **Number of redroot amaranth collected in the different treatments (Nyíregyháza, 2021)**



The means of groups of homogeneous subgroups are shown. When a parameter differs significantly between treatments, the letters indicate this.

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CONCLUSIONS

The seed rates were not significantly different, although for lupin, oil radish, and buckwheat, the greater seed rate would be preferable for weed suppression. Of all the greening crops, rotation III plots had the least amount of weeds. This is most likely because rotation III didn't include any greening at all. Better weed pressure is felt when using buckwheat and oil radish. These results show that buckwheat is a successful competitor against weeds and that this is partly due to the allelopathic effects of buckwheat, and from the perspective of weed suppression, its quick early development is also essential. The oil radish also produced efficient weed suppression due to its ability to cover the soil, so it shades well and has a strong, deep-penetrating root system. The number of other weed species was minimal in comparison to the cereals, also due to the weed suppression ability of the cereals.

ACKNOWLEDGEMENTS

"Project no. C1771371 has been implemented with the support provided by the Ministry of Culture and Innovation of Hungary from the National Research, Development and Innovation Fund, financed under the KDP-2021 funding scheme."

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