INFLUENCE OF NON-CHEMICAL WEED CONTROL METHODS AND BIOLOGICAL PREPARATIONS ON WEED INFESTATION IN THE ORGANICALLY GROWN SPRING OILSEED RAPE

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Introduction

Weeds are natural component of plant communities in cultivated land (Debeljak *et al*., 2008). All weed control methods reducing weed density are important, therefore they must be used in combination with certain agricultural plant production technologies. Mechanical weeding in row spacing is more common in organic farms and can significantly reduce weed density (Praczyk, 2005). Organic weed control methods include the thermal weed control. Wet steam technology used to control weeds (exposure time 1–2 s) destroys not only plants on the soil surface, but also the seedlings on the topsoil layer (Kerpauskas *et al*., 2006). The ability to manipulate crop-weed interaction is essential in organic farming system (Rasmussen *et al*., 2000). Plants are smothering weeds naturally in dense crop due to the lack of light. Various biological preparations often have a different effect on crop yield and weed infestation (Pekarskas *et al.*, 2012). **The aim of the research:** to identify the influence of non-chemical weed control and biological preparations on spring oilseed rape crop weed density and seed yield.

Materials and Methods

The field experiment was carried out at the Aleksandras Stulginskis University (ASU) Experimental Station in 2014. Soil of the experiment field – Basic epihypogleyic luvisol (*Hapli-Epihypogleyic Luvisol*). Treatments of the experiment: **factor A** – non-chemical weed control: 1) thermal (wet steam); 2) mechanical (inter-row loosening); 3) smothering (self-regulation). **Factor B** – biological preparations: 1) not used; 2) used. Spring oilseed rape 'Fenja' was grown (8 kg ha^{-1}). In the treatment where biological preparations were used, before sowing rape seed was processed with bio-organic fertilizer Nagro (Bioplante) (0.5 liters/10 liters of water per tonne of seed), and crop during the growing sprayed three times with a biological preparation Konflic. Using the thermal and mechanical weed control oilseed rape was grown within 48 cm row spacing. The weed control was provided by applying thermal control method: using mobile thermal wet water steam device (thermal power – 90 kW, performance – 120 kg h^{-1} steam, fired by liquefied gas). Steam temperature – 99 °C, the thermal exposure time – 2 seconds. For mechanical weed control space between rows was loosened twice by using KOR-4.2-01soil loosener.

Prior application of thermal and mechanical control weed seedling analysis was carried out at 3–4 leaf stage of the rape. In each field four 0.10 m^2 plots were randomly selected, labeled and weed species and seedling numbers were recorded. The second time the same analysis was carried out on the marked plots 5-7 days after the application of weed control methods. The efficiency of different weed control methods (E) on the change in weed seedlings number was calculated by the following formula:

$$E = (S1-S2) / S1 * 100\%, \text{ where} \quad (1)$$

S1 – weed seedling number in 1 m^2 prior application of control methods

S2 – weed seedling number in 1 m^2 after application of control methods

Before rapeseed harvest in each experimental plot, in each out of 4 x 0.25 m^2 plot weed count was established as well as analysis of botanical composition, weeds were dried and weighed. The total number of weed was converted into units per m^{-2}, and the dry weight of weeds into g m^{-2} (Stancevičius, 1979).

Two-factor field experiment was arranged using split-plot method. The initial plot area was 60 m^2, net plot area – 20 m^2. Research was carried out with 4 replications. Data from these experiments were statistically evaluated according to the Fisher criteria and LSD test (Raudonius *et al*., 2009). Statistical analysis of the research data was performed by using the computer program

SPLIT PLOT from software SELEKCIJA (Tarakanovas, Raudonius 2003). The data of weed dry weight were transformed using the function $y = lnx$ prior to statistical evaluation.

Results

There was found 73.1 - 146.8 units per m2 of weed seedlings before the weed control was applied in oilseed rape crops. Most of the weeds emerged in plots where thermal weed control was used, also with and without the use of biological preparation. After implementation of weed control in the oilseed rape crop the numbers of weeds varied from 19.5 to 162.5 units per m2. Evaluating the efficiency of different weed control on weed seedlings number was established that without the using of biological preparations, mechanical weed control efficiency was 1.9 times greater than the thermal (Fig.).

Thermal weed control efficiency with using biological preparations was 1.3 times higher than the mechanical one. Weed suppressing efficiency was negative during both years of the research.

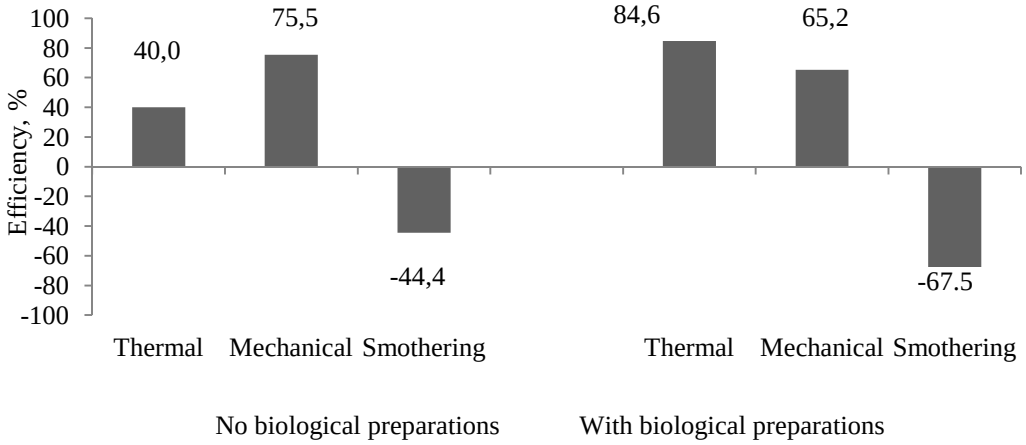

Fig. 1. The efficiency of different weed control methods and biological preparations on the change of weed seedling number in spring oilseed rape crop, 2014.

Short-lived weeds dominated during all research period: white goosefoot (*Chenopodium album* L.), wild mustard (*Sinapis arvensis* L.), common chickweed (*Stellaria media* (L.) Vill), purple dead-nettle (*Lamium purpureum* L.) and others. Long-lived – perennial sowthistle (*Sonchus arvensis* L.), creeping thistle (*Cirsium arvense* (L.) Scop), broadleaf plantain (*Plantago major* L.), field horsetail *(Equisetum arvense* L.*)*. The significantly lowest number of weeds before oilseed rape harvest, in comparison with other weed control methods, was found after using the mechanical weed control, without usage of biological preparations (from 1.7 to 4.3 times) and using biological preparations (from 1.8 to 4.6 times) (Table). The use of biological preparations as compared to their non-use, significantly reduced the number of weeds by 15.6 per cent in plots with weed control method smothering.

Table

Weed number and dry weight and spring oilseed rape yield, 2014

Weed control method (Factor A)	**Biological preparation (Factor B)**	**Weed number. m^{-2}**	**Weed dry weight, g m^{-2}**	**Rape seed yield t ha^{-1}**
Thermal	–	30.5b	186a	1.67b*
	+	26.8b	63a	1.96a*
Mechanical	–	18.2c	43b	2.06a
	+	14.8c	90a	2.03a
Smothering	–	80.0*a	93ab	1.94ab
	+	67.5*a	55a	2.00a

Note: means not sharing a common letter (a,b,c) (Factor A) and with asterisk (Factor B) are significantly different ($P < 0.05$).

Without the use of biological preparations, mechanical weeding, comparing to thermal, significantly reduced weed dry weight by 4.3 times. Using biological preparations different weed control methods had no significant effect on weed dry weight. The largest oilseed rape yield was determined using mechanical weed control. Thermal weed control using water steam without the use of biological preparations, compared to mechanical method, significantly reduced oilseed rape yield by 18.9 percent. The use of biological preparations as compared to their non-use, significantly increased rapeseed yield by 17.4 percent, only in plots where thermal weed control was used.

Conclusion

1. Without the use of biological preparations for mechanical weed control the efficiency was 1.9 times higher than using thermal. With the use of biological preparations thermal weed control efficiency was 1.3 times greater than the mechanical.
2. Significantly lower weed number from 1.7 to 4.6 times in comparison with other weed control methods was obtained in plots with mechanical weed control, without biological preparation, as well as with using them. The lowest dry weight of weeds found after using mechanical control and without the use of biological preparation.
3. The highest seed yield of oilseed rape was determined in plots were mechanical weed control was used. The use of biological preparations significantly increased rapeseed yield by 17.4 percent only in plots with thermal weed control.

References

1. Debeljak M., Squire G. R., Demšar D., Young M. W., Džeroski S. (2008). Relations between the oilseed rape volunteer seedbank, and soil factors, weed functional groups and geographical location in the UK. *Ecological Modelling*, Vol. 212, p. 138–146.
2. Kerpauskas P., Sirvydas A. P., Lazauskas P., Vasinauskienė R., Tamošiūnas A. (2006). Possibilities of weed control by water steam. *Agronomy Research*, 4 (Special issue), p. 222–225.
3. Praczyk T. (2005). *Zwalczanie chwastów. Rozdział w: Technologia produkcji rzepaku. Wydawnictwo Wieś Jutra*, Warszawa, p. 97–107.
4. Pekarskas J., Raškauskienė A., Sinkevičienė J., Genys, V. (2012). Ekologiškų žieminių rugių auginimas ekologinės gamybos ūkyje beariminės žemdirbystės būdu. Žmogaus ir gamtos sauga: 18-osios tarptautinės mokslinės-praktinės konferencijos medžiaga. P. 75–78.
5. Raudonius S. ir kt (2009).*Mokslinių tyrimų metodika*. Akademija (Kauno r.). 119 p.
6. Rasmussen J., Asceeard J. (1995). Weed control in organic farming systems. ***In***: *Ecology and integrated Farming Syste* //IACR-Long Ashton Research Station. Bristol (UK): John,Wiley Sons Ltd, p. 49–67.
7. Tarakanovas P., Raudonius S. (2003). *Agronominių tyrimų statistinė analizė taikant kompiuterines programas „ANOVA" iš paketo Selekcija ir Irristat*. Akademija, Kėdainių r., 57 p.
8. Stancevičius A. (1979). *Piktžolių apskaita ir laukų piktžolėtumo kartografavimas.* Vilnius. 37 p.