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IMPACT OF THE APPLIED SPRAYERS IN LEAF FERTILIZATION ON THE SIZE AND QUALITY OF TIMOTHY GRASS SEEDS CROP (*PHLEUM PRATENSE* L.)

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Summary. Two types of sprayers: standard XR110 03 and ejector ID 120 03 were used in the research. Mass of 1000 seeds, their energy and germination ability were determined in seeds samples collected after flail, second drying and purifying. Germination energy was determined after 7 days, while germination ability after 10 days at Jacobsen germination apparatus according to PN-79/R-65950 standard. On the basis of the obtained results, slightly higher values of the obtained parameters of standard sprayers were reported. However, differences were statistically insignificant (α=0.05). One may assume that in case of fodder grass cultivated for seeds, better quality of crop is obtained at a lower spectrum of drops for a sprayed working liquid.

Key words: timothy grass, slotted sprayers, ejector sprayers, seeds crop, seeds quality

Introduction

Plants need a sustained mineral fertilization, both with macro and micro-elements for correct course of life processes. Micro-elements, although they are collected in very small amounts, significantly influence cultivated plants yielding and quality features [Czuba 1996; Gorlach 1991]. The following are included in micro-elements indispensable for correct course of life processes in case of grass: copper (Cu), manganese (Mn) and zink (Zn) [Ruszkowska, Wojcieska-Wyskupajtys 1996].

Leaf feeding of plants is justified by numerous research; plants collect nutritive substances not only by a root system, but also by aboveground parts. Leaf fertilization has many advantages. Mainly it gives an opportunity of fast and effective completion of nutrients directly to leaves, not depending on the water availability in soil and functioning of the root system [Michalojć, Szewczuk 2003; Wojcieska 1985]. Moreover, on account of lower concentration of active substance, leaf fertilization constitutes lower (in comparison with soil fertilization) load for natural environment [Doruchowski, Hołownicki 2003; Mrówczyński, Roth 2009].

Effective and environmentally friendly spraying technique will play a significant role in carrying out this task. Drift of sprayed liquid, pre-evaporation, formation and dripping of too large drops of applied liquid from the leaf surface are the most frequent phenomena. However, one could have recently noticed that even higher technical requirements of agrochemical applications are set forth by law regulations, especially in relation to sprayers. Working liquid should be applied precisely and it should cover the whole surface of leaves of the cultivated plant as much as possible. Only in this way, achieving intended effects is possible. However, in order to realize this objective, all factors loading the efficiency of the performed operation should be limited.

A correct selection and operation of sprayers have a significant meaning for the spraying quality. According to Parafiniuk and Sawa [2006] and Wehmann [2007] the size and spectrum of working liquid drops is a significant element. Therefore, selection of sprayers is carried out on the basis of catalogues and values of volume median diameter VMD. The size of drops produced by sprayers is very significant. It influences degree of covering protected plants and consequently efficiency of preparations [Parafiniuk et al. 2009; Webb et al. 2002].

Small drops are very susceptible to drifting caused by wind, which consequently causes sedimentation of plant protection substances in undesirable places [Hołownicki et al. 2005].

Liquid distribution on the sprayed surface is a significant factor, which may considerably influence the effect of particular chemical substance. A precise outlet in a sprayer guarantees application of strictly determined dose of working liquid. A properly selected spraying angle, even transverse distribution and the selected size of drops ensure even coating of plants along the whole working beam [Hołownicki et al. 2011].

The objective of the paper

The objective of the paper was to determine the impact of the applied sprayer type on crop and quality of seeds of 'Skald' variety timothy grass. Standard sprayers XR 110 03 and ejector sprayers ID 120 03 were used. Assessment of production effects was carried out on the basis of seeds crop and measurement of mass of 1000 seeds as well as determination of seeds germination energy and germination power. Research had a field character and was carried out on twelve experimental plots.

Material and research methodology

A field experiment which was a basis of the research was carried out in 2009-2012 in a private individual farm in Śląskie voivodeship. Acid brown soil, soil evaluation class IV occurred there (pH_{KCl} amounted to 5.4). Soil richness in available forms of potassium, manganese and zinc was average, while the content of available forms of phosphorus and copper was low.

In a vegetation period (April-September) sums of atmospheric precipitation was in 2010, 2011 and 2012 respectively: 718.1 mm; 385.4; 312.3 while average air temperature in this period was respectively: 15.2, 15.6 and 17.5ºC.

The experiment was located in experimental plots of 1 are area in 4 repetitions. Plots, where leaf fertilization was carried out, constituted samples. Mineral soil fertilization was applied in the following doses. 60 kg $P_2O_5 \cdot ha^{-1}$ in the form of triple superphosphate, 80 kg $K_2O \cdot ha^{-1}$ in the form of 57% potassium salt and100 kg $N \cdot ha^{-1}$ in the form of ammonium nitrate were inoculated in Spring.

While, in leaf fertilization the following forms and doses of micro-elements were applied:

– Zinc chelate 14% Zn (chelator EDTA+DTPA) in a dose of 100 g $Zn \cdot ha^{-1}$,
– Manganese chelate 14% Zn (chelator EDTA+DTPA) in a dose of 100 g $Zn \cdot ha^{-1}$,
– Copper chelate 12% Zn (chelator EDTA+DTPA) in a dose of 60 g $Zn \cdot ha^{-1}$,

Spraying solutions were prepared by solving proper weighed amount of chelates including micro-elements in such water volume that volume of the utility liquid was equal to 300 $dm^3 \cdot ha^{-1}$. Tap water of average degree of hardness was used for this purpose. First leaf spraying with all fertilizers was carried out in the phase of spraying a stalk, while the other two weeks later.

Spraying was carried out with the use of farm tractor Zetor 5211 with a suspended field sprayer Pilmet 815 of a working width 15 m. Two types of sprayers were used for application of a leaf fertilizer: a standard sprayer XR 110 03 and an ejector sprayer ID 120 03. Sprayers were located 50 cm from each other and localization of a beam over a sprayed canopy was maintained at 50 cm height. Before field experiments, sprayers were subjected to laboratory experiments in order to confirm compatibility of liquid outflow with nominal outflow. During spraying, an aggregate was mowing with the speed 4 $km \cdot h^{-1}$. Spraying was carried out in the evening at the wind speed of 1.5–1.7 $m \cdot s^{-1}$, ambient temperature of 20–25°C and air humidity of 60–65%.

In autumn, grown grass was mowed to the height of 10-12 cm over the ground since too low defoliation may considerably lower crops of seeds in the subsequent year. The final date of mowing was in the third decade of September. the whole seed plantation was carefully harrowed in order to remove dead plant remains and to stimulate plants vegetation Next year in Spring.

In order to eliminate weed infestation of two-leaves plants, spraying of experimental fields in the phase of grass tillering was applied. At strong weed infestation of two-leaves plants the following were used: Chwastox Extra 330SL, Aminopielik D and Starane 250 SL and Gold 450EC respectively in the amounts: 1.5; 1.5 and 0.6; 1.5 $l \cdot ha^{-1}$. Single stubborn weeds were destroyed point-wise with Roundup preparation. While one-leaf weeds were combated at the beginning of September and Spring, soon after beginning of vegetation, with Stomp 330 EC preparation in the amount of 5 $l \cdot ha^{-1}$ dissolved in 300 l of water. Moreover, preventive spraying of all experiments against pets was carried out with liquid Owadofos 50 (1–2 $l \cdot ha^{-1}$) or Decise 2.5 EC (0.3 $l \cdot ha^{-1}$). The first spraying was carried out in early spring, during beginning of vegetation, the second after heading of plants but before their flowering.

Harvesting of timothy grass fell on the end of the third decade of July and first days of August. Harvesting of seeds was carried out with a field combine of Winterstieger make type NM-ELITE. One-phase harvesting was applied. After seeds harvesting, hay and post harvest remains were removed from plots.

Seeds were initially purified after threshing at a fanner type k/WP 05. Second drying was carried out in a roofed, permeable to air room until humidity under 14% was obtained. After second drying, seeds were purified again. Mass of 1000 seeds, their energy and germination ability were determined in samples collected after flail, second drying and purifying. Germination energy was determined after 7 days, while germination ability after 10 days at Jacobsen germination apparatus according to PN-79/R-65950 standard [Grzesiuk and Kulka 1981].

The obtained results were statistically developed, applying analysis of variance and $NIR_{(0.05)}$ according to Tukey.

Results and a discussion

As a result of spraying with micro-elements with the use of standard sprayers XR 110 03 higher crop of timothy grass seeds were reported (table 1).

Table 1. Yield of timothy grass seeds (per $kg \cdot ha^{-1}$) depending on the sprayers type used in fertilization

Tabela 1. Plon nasion tymotki łąkowej (w przeliczeniu na $kg \cdot ha^{-1}$) w zależności od typu rozpylaczy zastosowanych w nawożeniu

Type of a sprayer	Years of full use		
	2010	2011	2012
Control sample	448.2	312.7	286.4
XR 110 03	667.4	469.2	442.3
ID 120 03	621.9	427.1	421.2
$NIR_{(0.05)}$	75.1	56.3	50.2

The obtained yield of seeds from plots, where fertilizers were applied with XR sprayers, was higher than the yield of seeds from facilities were ID 120 03 ejector sprayers were used, at the average by 36.2 $kg \cdot ha^{-1}$ while this difference was not statistically significant (α=0.05). Successive decrease of yielding in subsequent years of use is a species characteristic. Determination of the mass of 1000 thousand seeds was the next analysed property, results of denotations were presented in table 2.

The highest mass of one thousand seeds with reference to average values from years of research were reported in case of fertilizing with a standard sprayer and the lowest in a facility without leaf fertilization. As a consequence of using standard sprayers a higher mass of one thousand seeds by 4.7% was obtained after using standard sprayers and by 2.6% after using ejector sprayers. Figure 1 and 2 presents changes of energy values and germination abilities depending on the type of sprayers. Leaf application of the applied micro-elements with the use of standard sprayers caused that higher values of germination energy was obtained; a little lower values were obtained on seeds of plants sprayed with ejector sprayers and the lowest in the sample facility (without leaf fertilization). As a result of using standard and ejector sprayers the increase of values was obtained (expressed in directed numbers) respectively by 8.1% (at the average) and 5.2% in comparison with a sample facility. In case of the next analysed feature, which was germination ability a similar effect was reported. As a result of using standard sprayers higher values by 9.1% and by 5.2% in case of using ejector sprayers were obtained (in directed numbers).

Table 2. Mass of one thousand seeds of timothy grass (g) depending on the type of sprayers used in fertilization

Tabela 2. Masa tysiąca nasion tymotki łąkowej (g) w zależności od typu rozpylaczy zastosowanych w nawożeniu

Type of a sprayer	Years of full use		
	2010	2011	2012
Control sample	0.497	0.491	0.486
XR 110 03	0.523	0.511	0.509
ID 120 03	0.509	0.504	0.500
$NIR_{(0.05)}$	0.015	0.008	0.009

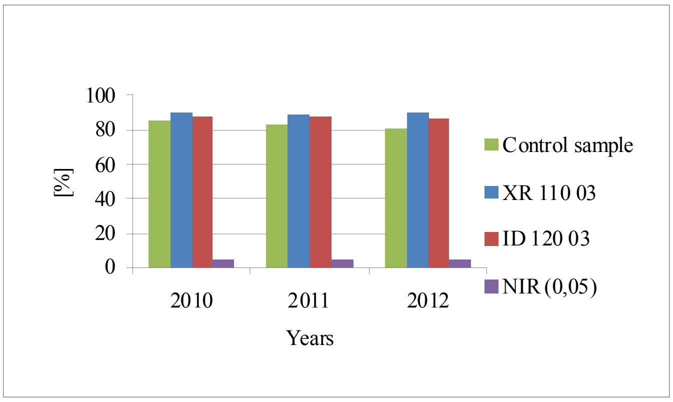

Fig.1. Germination energy depending on the type of sprayers

Rys.1. Energia kiełkowania w zależności od typu rozpylaczy

Research results prove existence of differences in yield and seeds quality with the use of standard and ejector sprayers. Existence of these differences may be related to the size of drops produced by the researched sprayers. In case of smaller drops, leaf blades of timothy grass were more evenly coated with applied fertilizer. Michałojć and Szewczuk [2003] proved that nutrients do not move from a leaf blade through the whole surface but only through pores reaching a cell wall. Number of pores on the bottom side of a leaf blade is bigger than on the upper side. Therefore, one may make assumptions that smaller drops covered the bottom side of a leaf blade to a bigger extent than drops obtained from ejector sprayers. This conclusion is confirmed by results obtained by Hołownicki et al. [2011], who stated that coating plants during spraying with drops of a smaller diameter is significant. With reference to the obtained results, also Parafiniuk et al. [2009] proved that a sprayer type has no significant meaning in case of the seeds yield and the size of compressive force of seed, which they reported in analogous research on winter wheat and spring wheat.

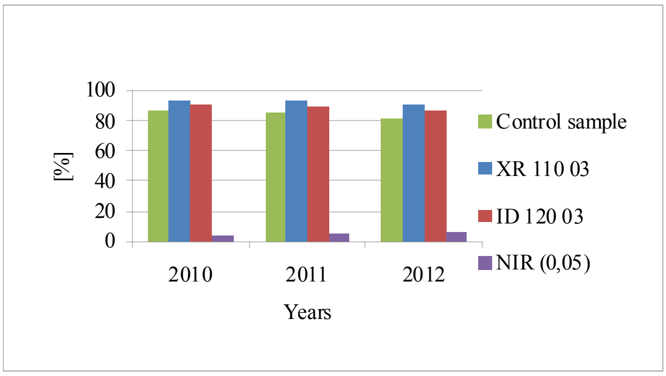

Fig.2. Germination ability depending on the type of sprayers
Rys.2. Zdolność kiełkowania w zależności od typu rozpylaczy

Moreover, the fact that at high temperature and water deficiency in soil, the number of pores on a leaf has not changed, is a crucial element. Spraying should be carried out in the evening or in the morning, some also recommend night hours. Number of active pores also decreases along with the leaf age [Maleszewski, Kozłowska-Szerenos 1998].

Conclusions

1. In case of using standard sprayers during fertilization, higher yield of timothy grass seeds was obtained in comparison to ejector sprayers. Simultaneously, one should indicate that in comparison to the yield obtained from facilities, where ejector sprayers were used, no statistical differences on the level α=0.05were reported.
2. The highest mass of one thousand seeds was reported in case of timothy grass seeds sprayed with standard sprayers, while the values were lower in case of ejector sprayers. Effects of both types of sprayers were statistically insignificant. Significance of differences was reported in case of comparing the researched types of sprayers with a sample facility.
3. No significant difference between the sizes of germination energy and ability were reported concerning the sprayers type.

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WPŁYW ZASTOSOWANYCH ROZPYLACZY W NAWOŻENIU DOLISTNYM NA WIELKOŚĆ I JAKOŚĆ PLONU NASION TYMOTKI ŁĄKOWEJ (*PHLEUM PRATENSE* L.)

Streszczenie. Do badań wykorzystano dwa typy rozpylaczy: standardowe XR110 03 oraz eżektorowe ID120 03. W próbach nasion pobranych po wymłóceniu, dosuszeniu i wyczyszczeniu oznaczono masę 1000 nasion, energię i zdolność kiełkowania. Energię kiełkowania oznaczono po 7 dniach, natomiast zdolność kiełkowania po 10 dniach na kiełkowniku Jacobsena wg normy PN-79/R-65950. Na podstawie uzyskanych wyników stwierdzono, nieco wyższe wartości oznaczanych parametrów na korzyść rozpylaczy standardowych, jednak różnice te były statystycznie nieistotne (α=0,05). Można przyjąć, że przy trawach pastewnych uprawianych na nasiona, lepszą jakość plonu uzyskuje się przy mniejszym spektrum kropel dla rozpylanej cieczy roboczej.

Słowa kluczowe: tymotka łąkowa, rozpylacze szczelinowe, rozpylacze eżektorowe, plon nasion, jakość nasion

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