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Weed Infestation and Control on a Miscanthus giganteus Plantation in the Marginal Lands of Ukraine

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Abstract. The research was carried out on the waterlogged marginal lands in the zone of unstable moisture of the Central Forest-Steppe of Ukraine. The generalization of the dynamics of changes in the number of weeds in the miscanthus plantations of the first year of growing allows to divide the growing season into three specific periods. The dynamics of weed infestation in *Miscanthus x giganteus* J.M. Greef et Deuter ex Hodk. et Renvoize plantations of the first and subsequent years of growing, monthly accumulation of weed green mass starting from 10th June was studied. The number of weeds in the plantations of miscanthus increased most intensively in the period from the middle of May to early June. In subsequent periods, with the achievement of full projective coverage of the field by plants, the intensity of new weed seedlings' appearance decreased. The most abundant weed species were *Echinochloa crus-galli (L.)P. Beauv.*, *Setaria glauca (L.) P.Beauv.*, *Thlaspi arvense* L., *Sinapis arvensis* L., *Sonchus arvensis* L., and *Chenopodium album* L. All considered herbicides showed the highest level of toxic action to the seedlings of annual cereal weed species. Seedlings of perennials *Sonchus arvensis* L., *Cirsium arvense (L.) Scop.* have not been affected by soil herbicides. The following herbicides: Master Power OD at an application rate of 1.5 l/ha (efficiency 95.0%) or Milagro 040 SC at an application rate of 1.25 l/ha (efficiency 88.0%.) are recommended during the season of plant vegetation.

Key words: miscanthus, weeds infestation, herbicides, marginal lands.

Introduction

Currently, numerous species of *Miscanthus* were actively studied to investigate the influence of genetic and environmental factors (Hodgson et al, 2010; Kharytonov et al., 2019).

Meantime in absolute measures, the largest values were noted for *Miscanthus x giganteus* biomass indexes (Christian et al., 2008). A biological feature of miscanthus plants (*Miscanthus × giganteus* J.M.Greef et Deuter ex Hodk. et Renvoize) is a long period from planting to emergence (from 25 to 30 days) and slow growth and development in the first half of the growing season. Accordingly, the slow initial growth of miscanthus significantly reduces its ability to compete with weeds. In addition, the low planting density leaves a large number of unfilled spaces where weeds can grow. The soil is loosening in the process of planting miscanthus, thereby promoting the germination of weed seeds. In the early stages, young miscanthus seedlings can be easily suppressed by weeds (McCalmont et al., 2017; Winkler et al., 2020). The greatest competition with weeds is observed during the first year of growing and partly in the second year (Borkowska & Molas, 2010; Koncekova et al., 2014; Winkler et al., 2020). Cold tolerance and over-winter survival of first-year stands is also a concern in temperate areas with cold winters and little snow cover (Anderson et al., 2011a). It was indicated also a major risk to viability when soil temperatures drop below -3°C at the 5-cm soil level, with lethal rates of up to 50% at first-year cold (Clifton-Brown & Lewandowski, 2000). Field experiments suggest that although glyphosate and tillage can reduce miscanthus biomass, complete control of a mature stand likely will require more than one growing season (Anderson et al., 2011b). It was shown also the active substances and their maximum application rates, which did not imply a significant phytotoxic effect on miscanthus plants (Anderson et al., 2015). At the same time, other studies have shown that the application of herbicides of both pre- and post-emergence action causes a decrease in miscanthus yield in the first and second years compared to the control treatment, where the crop was grown clear of weeds (Everman et al., 2011; Maksimovich et al., 2016).

There are several tasks of the research as following: a) to clarify the features of weed infestation in *Miscanthus x giganteus* Greef & Deuter plantations in the first and subsequent years of growing; b) to investigate the peculiarities of weed species composition and the dynamics of their germination and to assess the level of the negative impact of weeds on crops; c) to determine the biological efficiency of the herbicides of soil action and herbicides applied during the vegetation of miscanthus plants.

Materials and Methods

The research was carried out in the years 2015–2019 on the experimental field of the State Enterprise Experimental Farm Salyvinky (Ksaverivka-2, Vasylkiv district, Kyiv region), which is located in the zone of unstable moisture in the Central Forest-Steppe of Ukraine with the moderate continental climate. The soil of the experimental field is podzolic chernozem. The experimental field is located in waterlogged lowland and corresponds to unfavourable marginal lands. *Miscanthus × giganteus* variety "Osinnii Zoretsvit" (IBCSB NAAS of Ukraine) was used. Rhizomes were planted in the soil in rows at row spacing of 70 cm and plant density of 15 thousand plants per hectare. The planting design was 70 cm x 90 cm. The main tillage was carried out in August-September with disc cultivators to a depth of 10–12 cm in two tracks in a cross manner with an angle of attack of the discs of 30–35°. Deep furrow ploughing carried out 10−15 days later, after stubbing to a depth of 28−30 cm. To level the field surface, control weed seedlings, and create favourable conditions for the accumulation of soil moisture in winter, continuous cultivation of the field surface to a depth of 5−7 cm carried out on the 10^{th}−15^{th} day after ploughing. Pre-planting soil treatment carried out before planting to a depth of 12–15 cm. This measure provides good conditions for planting rhizomes to a given depth. Rhizomes were planted by hand. The next day after planting the field was rolled. The level of survival of young plants was high and over the years of research varied from 86 to 90%. The number of weed seedlings was counted in the area of 0.25 m^2 in four replications on each site by types of weeds with the subsequent recalculation per 1 m^2. It was supposed to conduct calculations on the following dates: the dynamics of the number of weed seedlings (plants/m^2) and accumulation of weed green mass on the 10th May; 10th June; 10th July; 10th August, and 10th September. The dynamics of the weed mass accumulation in the plantations was determined by the method of total cutting of aboveground parts of weeds within the borders of the counting frame (0.25 m^2) on four plots (total area 1 m^2) in each replication of a treatment. That is, in all replications of all treatments, the aboveground weed mass was calculated on 16 sites. The cut weed biomass was sorted by species and weighed. The gross mass was converted into average mass per 1 m^2. The experiments involved a weed control system in the first year with the use of soil herbicides. Herbicide solution spread on the soil surface and formed a protective herbicide screen after planting miscanthus rhizomes. Active ingredient partially penetrated the upper layer of the soil (0–3 cm) and was available in the soil moisture. It diffused into the seedlings of annual weeds and led to their die off with soil moisture. The solution was applied with a special wheeled gas slit-type sprayer with a bar. The working pressure was 2.2 atmospheres, herbicide solution consumption was 240 l/ha. The level of efficiency of the protective action of soil herbicides assessed by comparing the number of weed seedlings per unit area of treatment with control. Evaluation of the herbicide efficiency was done based on a comparison of the number of weed seedlings in the accounting area before spraying and 20 days after spraying. The difference in the number of seedlings expressed as a percentage of the control. We used the following soil herbicides after planting rhizomes: 1) Frontier Optima SC (dimethenamid - P, 720 g/l) at an application rate of 1.4 l/ha; 2) Dual Gold EC (S-metolachlor, 960 g/l) at an application rate of 1.6 l/ha; 3) Merlin 750, WG (isoxaflutol, 750 g/kg) at an application rate of 0.15 kg/ha. Six consecutive manual weeding carried out in the control treatment. The area of a single plot was 36 m^2. The accounting area was 25 m^2. The experiment was conducted in a randomized block design with four replications. The experiments involved weed control in miscanthus plantations in the first year using herbicides, which were applied by spraying weed seedlings in the tillering stage. We used the following herbicides: 1) Master Power OD (foramsulfuron, 31.5 g/l + iodosulfuron-methyl sodium, 1 g/l + thiencarbazone-methyl, 10 g/l + cyprosulfamide, 15 g/l) at an application rate of 1.5 l/ha; 2) Milagro 040 SC (nicosulfuron, 40 g/l) at an application rate of 1.25 l/ha. The herbicide solution sprayed with a special wheeled gas slit-type sprayer with a bar. The working pressure was 2.2 atmospheres, working solution consumption was 210 l/ha. The yield of the aboveground biomass of miscanthus evaluated by the method of continuous cutting of terrestrial parts of crop plants in the accounting areas (25 m^2) in all replications of treatments. The obtained biomass was weighed, converted to a standard humidity, and expressed per 1 hectare. The obtained experimental data were processed by statistical methods, such as the method of variance, correlation, regression analysis using personal computer and software Excel, and Statistica 12.0.

Results

Rhizomes of miscanthus in the years of the experiment were planted in the middle or late April. Total cultivation of the field before planting provided destruction of wintering weed sprouts and a part of early spring weeds. Favourable weather conditions in a combination with large stocks of weed seeds in the soil ensured the rapid emergence of new weed sprouts soon after planting rhizomes. In the areas of plantations where weed control measures were not applied, new weed sprouts were observed as early as on the 7th-10th day after pre-planting tillage (Fig.1).

Fig. 1. General view of miscanthus plantations of the first year of growing without weed control measures.

At the time of the first calculation of weeds in the miscanthus plantations (10th May) we recorded (on average over the years of the experiment) sprouts of *Thlaspi arvense* L . in the amount of 4.3 plants/m^2, *Sinapis arvensis* L. 3.2 plants/m^2, *Fumaria officinalis* L. 2.9 plants/m^2, Galium 2.3 plants/m^2, *Polygonum convolvulus* L. 2.3 plants/m^2, *Melandrium album* (Mill.) Garke 1.3 plants/m^2, *Cirsium arvense* L. irsium arvvense Scop. 1.2 plants/m^2, and other species. The total number of weed sprouts in this period averaged 38.8 plants/m^2 (Table 1).

At the same time, the green mass of weeds was insignificant and amounted to 18 g/m^2. The emergence of new weed sprouts within one species normally was extended in time and lasted from two weeks to the end of the growing season (Fig.2).

Relatively evenly emerged the sprouts of annual cereal weeds such as *Echinochloa crus-galli*, *Setaria glauca*, and *Polygonum* species. The most extended in time was the emergence of sprouts of *Chenopodium album* L., *Amaranthus retroflexus* L., and some other species. During the next month of joint vegetation of miscanthus plants with weeds, the number of weeds in the plantations increased significantly. At the time of subsequent calculation of weeds (10th July) average number in the plantations was 119.5 plants/m^2. Compared to the previous period, it was increased by 3 times. The total green mass of all weeds in the plantations of miscanthus was 950 g/m^2. It increased significantly in comparison with the indicators of the weed accumulation at the time of last calculation. The largest biomass accumulation was demonstrated by plants of *Chenopodium album* L., 172 g/m^2 (18.1%), *Sinapis arvensis* L., 166 g/m^2 (17.5%), *Thlaspi arvense* L., 60 g/m^2 (6.3%), *Echinochloa crus-galli* L., 57 g/m^2 (5.9%), *Cirsium arvense* L., 50 g/m^2 (5.3%) and other species. The largest indicators of the total accumulation of the aboveground mass of weed plants in the miscanthus plantations in the years of research were recorded on the 10th August 2906 g/m^2.

Table 1. Dynamics of weed accumulation in miscanthus plantations (plants/m^2).

Weed species	Date of calculations				
	10 May	10 June	10 July	10 August	10 September
Chenopodium album L.	1.6	4.6	4.8	4.9	4.9
Amaranthus retroflexus L.	2.2	4.1	4.5	4.7	4.7
Echinochloa crus-galli (L.) *P.Beauv.*	3.4	20.9	31.3	31.5	31.5
Setaria glauca (L.) *Pal Beauv.*	1.9	15.8	16.7	16.9	16.9
Polygonum convolvulus L.	2.3	5.9	5.9	5.9	5.9
Polygonum persicaria L.	2.7	5.7	5.7	5.7	5.7
Thlaspi arvense L.	4.3	6.1	6.1	6.1	6.5
Viola arvensis Murr.	0.9	1.2	1.2	1.2	1.2
Fumaria officinalis L.	2.9	4.2	4.2	4.2	4.4
Galium aparine L.	2.3	1.0	1.0	1.0	1.3

Sinapis arvensis L.	3.2	6.1	6.1	6.1	6.4
Solanum nigrum L.	1.1	2.7	2.9	3.0	3.0
Polygonum aviculare L.	2.1	3.2	3.3	3.3	3.3
Melandrium album (Mill.) Garcke.	1.3	1.9	2.0	2.0	2.0
Sonchus arvensis L.	1.1	5.7	5.9	6.1	6.1
Cirsium arvense L.	1.9	3.4	3.7	3.7	3.7
Other species	3.6	13.3	14.2	14.5	14.8
Total	**38.8**	**105.8**	**119.5**	**120.8**	**122.3**
$LSD_{0.05}$	0.12	0.20	0.22	0.23	0.26

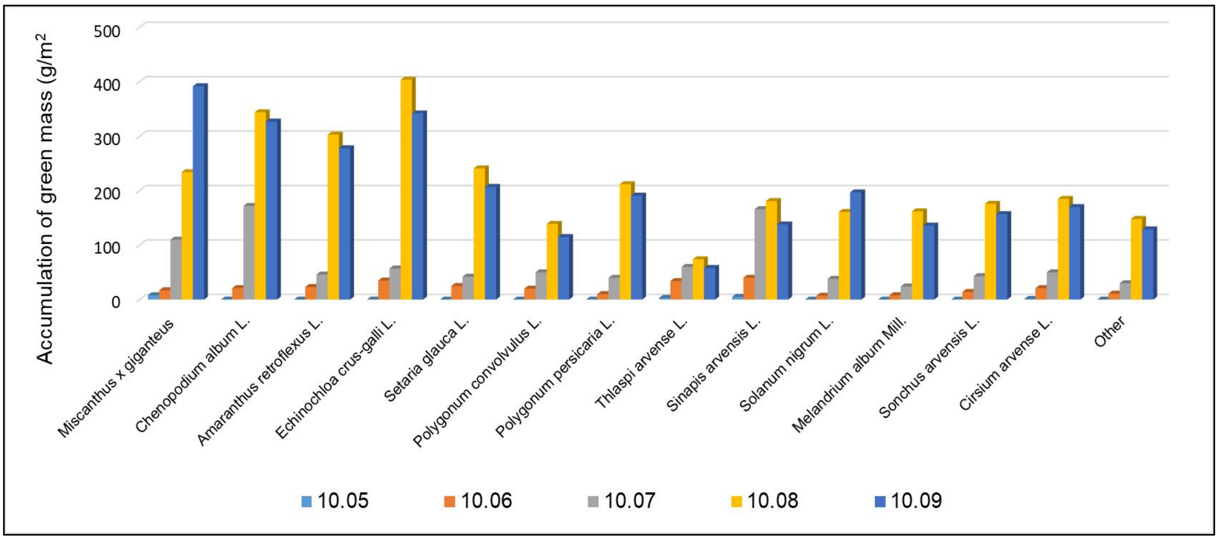

Fig. 2. Dynamics of weed green mass accumulation in miscanthus plantations (g/m^2). *Note:* The total weed green mass includes the following weed species: *Viola arvensis* Murr., *Fumaria officinalis* L., *Galium aparine* L., and *Polygonum aviculare* L. These weeds formed a small amount of green mass (˂50 g/m^2). The total mass of weed green mass on 10 May – 18 g/m^2 ($LSD_{0.05}$ 0.1); 10 June – 330 g/m^2 ($LSD_{0.05}$1.2); 10 June – 950 g/m^2 ($LSD_{0.05}$ 7.8); 10 August – 2906 g/m^2 ($LSD_{0.05}$ 12.5); 10 August – 2585 g/m^2 ($LSD_{0.05}$ 13.1).

The intensity of emergence of new seedlings of wild species decreased significantly in the following periods of joint vegetation of miscanthus and weeds. It can be explained by the gradual and increasingly dense optically projective coverage of the soil surface with leaves of plants that began vegetation earlier.

Calculations conducted on the 10th of August recorded the average values of the accumulation of weed biomass at the level of 2585 g/m^2, which was less than in the previous accounting period by 11.1%. The most widespread in the plantations of miscanthus were *Echinochloa crus-galli* L., 31.3 plants/m^2, *Setaria glauca* L., 16.7 plants/m^2, *Thlaspi arvense* L., 6.1 plants/m^2, *Sinapis arvensis* L., 6.1 plants/m^2, *Sonchus arvensis* L., 5.9 plants/m^2, *Chenopodium album* L., 4.8 plants/m^2 and other species. Based on the experimental data, we found the relationship between the duration of joint vegetation and the accumulation of the green mass of weeds and miscanthus. There is a very strong correlation between the accumulation of the green mass of weeds and the duration of their joint vegetation with miscanthus: -r = 0.9388. The obtained regression equation has a polynomial type of curve: $y = 0.116x^2 + 2.711x$. It is natural to change the accumulation of the green mass of miscanthus depending on the duration of the joint vegetation with weeds.

The regression equation, in this case, has a strong inverse correlation: -r = -0.8628. The value of the decrease in yield is influenced by the following indicators: weed species composition, the intensity of competition between crops and weeds for life factors, the amount of biomass accumulation, as well as the duration of the period of joint vegetation. 37.2 plants/m^2 of weeds was formed to 10th May in the plantations of miscanthus of the second year. The green mass of weeds at this time was quite low, 17.6 g/m^2. It should be noted that in the second year of growing, miscanthus plants grew and developed more intensively, which indirectly affected the number of weed seedlings. There was a decrease in the total number of weeds to 19.2 plants/m^2 for the next accounting period (10th July) in the miscanthus plantations of the second year but the green mass of weeds increased to 85.3 plants/m^2. Such a significant reduction in their numbers was due to the dominance of miscanthus plants and, as a consequence, their complete shading of the field surface. It was due to both a decrease in the number of weed plants and the extinction of some of their species. In particular, such species as *Viola arvensis* Murr, *Gallium aparine* L., *Sinapis arvensis* L., *Echinochloa crus-galli* L., and *Setaria glauca* L. completely disappeared. As of the 10th September, the total number of weeds in miscanthus plantations decreased to 9.8 plants/m^2, green mass of weeds to 28.2 plants/m^2, and in addition to the above species completely absent were such weed species as *Fumaria officinalis* L., *Solanum nigrum* L., and *Melandrium album* Mill (Fig.3). In the third year, it was possible to fully determine the efficiency of weed competition for nutrients and light. It was found that the total number of weeds in the fields of miscanthus in the third year of growing, at the time of the first calculations (10th May) was 26.7 plants/m^2, which was by 28.2 plants/m^2 less compared to the same period in the miscanthus plantations of the second year.

As of 10th July, the total number of weeds in miscanthus plantations of the third year decreased to 9.6 plants/m^2, which was 50% less than in the second year. At the date of the last calculation (10th September), the number of weeds in the plantations decreased to 2.4 plants/m^2, which was less than in the previous year by 75.5%.

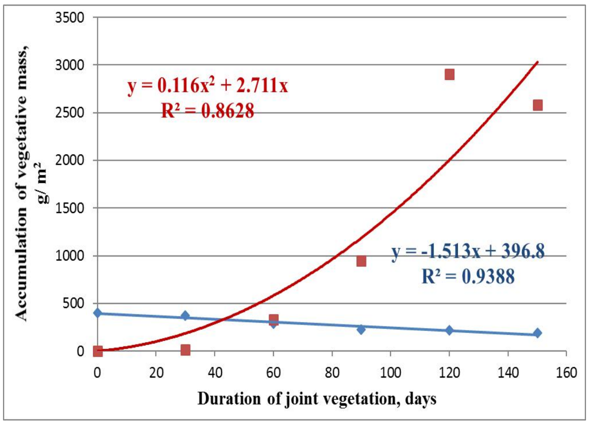

Fig. 3. The relationship between the duration of joint vegetation and the accumulation of green mass of weeds and *Miscanthus x giganteus.*

Many of the species were not present on the field, they could not accumulate vegetative mass, and those that remained did not pose any serious threat to miscanthus plants in the third year of growing. In the process of selecting possible herbicides registered in Ukraine attention was paid to the following requirements: herbicides should not show significant negative effects on crop plants. They are effective against seedlings of annual weeds of both monocotyledonous and dicotyledonous class to provide maximum duration of the protective action. After planting rhizomes we applied soil herbicide Frontier Optima 72% SC. The soil herbicide controlled well dicotyledonous annual weed species such as *Chenopodium album* L. (75%), *Amaranthus retroflexus* L. (77%), *Thlaspi arvense* L. (75%), and *Polygonum persicaria* L. (65%), and annual cereal weed species *Echinochloa crus-galli* L. (83%) and *Setaria glauca* L. (81%). The overall decrease in the number of weed seedlings over the years of research was 72.6% (Fig.4).

The overall decrease in the number of sprouts of dicotyledonous annual weed species was as following: *Gallium* - 47%, *Polygonum* *convolvulus* L. - 51%, *Polygonum persicaria* L.- 54%, *Fumaria officinalis* L. - 57%, *Solanum nigrum* L. - 60%, *Chenopodium album* L. - 64% in the areas of crop plantations where soil herbicide Dual Gold 96% EC was used after planting the rhizomes of miscanthus. Seedlings of perennial weeds of *Sonchus arvensis* L. and *Cirsium arvense* L. were resistant to the herbicide Dual Gold 96% EC. The active ingredient of the herbicide S-metolachlor compared to the previous herbicide was more toxic primarily to seedlings of annual weeds. The decrease in the number of seedlings of annual weeds compared to the indicators in the control treatment averaged 85%. Dicotyledonous weeds were more resistant to the active substance of the herbicide Dual Gold 96% EC. The overall decrease in the number of weed seedlings averaged 66.0%. Effective control of annual weed species emergence by herbicide Dual Gold 96% EC in the plantations of miscanthus lasted about 40 days. New weed seedlings appeared almost simultaneously with similar processes in the areas of plantations, where the soil herbicide Frontier Optima 72% SC was applied. Protection of miscanthus plantations from weeds in the first year of growing with the use of the herbicide Merlin 75% proved to be quite effective in all years of research. The herbicide reliably controlled the seedlings of the most common annual cereal weeds. The decrease in the number of seedlings of *Echinochloa crus-galli* L. was 87%, *Setaria glauca* L. 84% compared to control. The reduction in the number of seedlings of *Chenopodium album* L. was 77%, *Amaranthus retroflexus* L. 80%, *Solanum nigrum* L. 72%, *Thlaspi arvense* L. 68% and *Polygonum convolvulus* L. 67%. The overall reduction in the number of weeds during the years of research was 74.9%, i.e. was higher than the efficiency of all previously tested herbicide formulations.

Using of the postemergence herbicides Master Power OD and Milagro 040 SC was also effective (Fig.5).

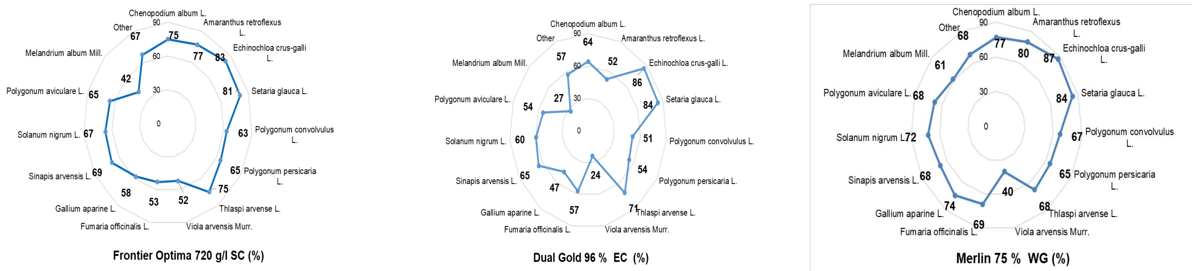

Fig. 4. The efficiency of soil herbicides.

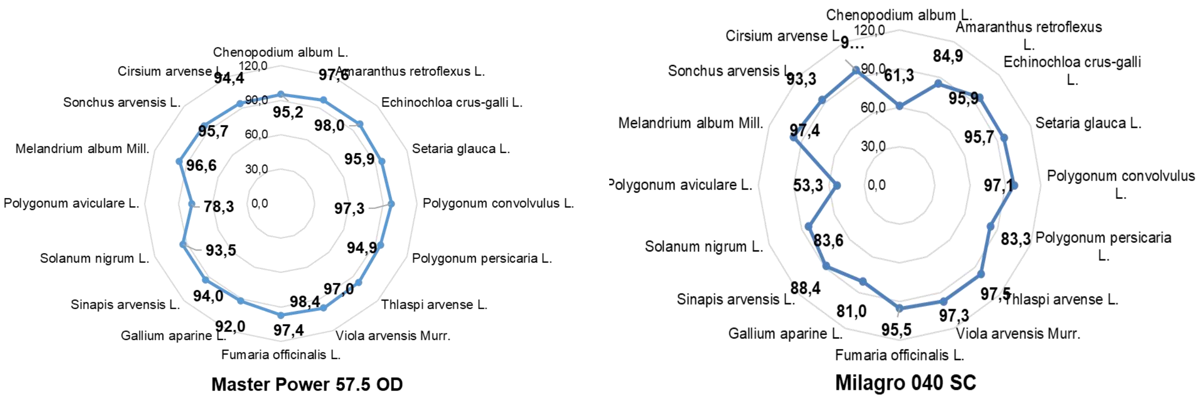

Fig. 5. The efficiency of the post-emergence herbicide Master Power OD (left) and Milagro 040 SC (right).

Application of herbicide Master Power OD (foramsulfuron, 31.5 g/l + iodine sulfuron-methyl sodium, 1 g/l + thiecarbazonmethyl, 10 g/l + cyprosulfamide, 15 g/l) at a normal application rate of 1.5 l/ha in the tillering stage provided a high level of weed control. The number of weed seedlings before spraying averaged 95.1 plants/m ^{2}. After spraying, the die-off rate of weed seedlings reached 95.0%. Most species of weeds that were present in the plantations were quite sensitive to the action of the herbicide. Seedlings of *Chenopodium album* L. died off by 95.2%, *Amaranthus retroflexus* L. by 97.6%, *Echinochloa crus-galli* L. by 98.0%, *Setaria glauca* L. by 95.9%, *Polygonum convolvulus* L. by 97.3%, *Thlaspi arvense* L. by 97.0%, *Viola arvensis* Murr. By 98.4%, *Fumaria officinalis* L. by 97.4%, *Melandrium album* (Mill.) by 96.6%, and *Sonchus arvensis* L. 95.7%.

The average number of weed seedlings in plantations after spraying with herbicide Milagro 040 SC was 93.2 plants/m ^{2}. Calculations after application recorded weeds in the amount of 11.2 plants/m^{2}. The efficiency of the protective action averaged 88.0%. The highest level of sensitivity to the herbicide Milagro 040 SC demonstrated sprouts of *Thlaspi arvense* L. 97.5%, *Melandrium album* (*Mill.*) 97.4%, *Viola arvensis* Murr. 97.3%, *Polygonum convolvulus* L. 97.1%, *Cirsium arvense* L. 96.2%, and other species.

The areas that were treated with the Master Power herbicide during the tillering stage provided a dry biomass yield of 1.71 t/ha, while with Milagro 040 SC the yield was 1.70 t/ha. The maximum yield of dry biomass of miscanthus (1.75 t/ha) was demonstrated in the control treatment without weeds (6 consecutive manual weedings were carried out).

Discussion

There are some difficulties in growing miscanthus in the period after planting rhizomes. In the initial stages of organogenesis, young crops develop a free ecological niche, which is a new plantation. 27 weed species belonging to different classes were noticed by polish scientists (Sekutowski & Rola, 2009). Three dominating weeds were noticed: *Elymus repens* (50-75% of soil coverage), *Artemisia vulgaris* (5-10% of soil coverage), and *Anthemis arvensis* (5-8% of soil coverage). Species diversity of weeds included 34 species, including the Monocotyledons, *Liliopsida,* 5 species, and Dicotyledons, *Magnoliopsida,* 29 species. Soil herbicides are effective in controlling annual weed species in miscanthus plantations. Among herbicides used in the experiments, the highest and most stable results of weed control were shown by Merlin 75% WG 74.9%, while the efficiency of the protective action of herbicides Dual Gold 96% EC was 66.0%, and Frontier Optimum 720 g/l SC 71.3%. The general convenience of using soil herbicides is that they are able to limit the emergence of seedlings of many annual weeds for a long time (in our experiments it was 35−40 days). However, the availability of free ecological niches last persists much longer in the plantations of miscanthus of the first year. After all, young plants due to several objective factors are not able to quickly occupy free space in the plantations. Meantime, the disadvantage of soil herbicides is that they are not able to fully control perennial weeds that form significant reserves of underground parts: roots, rhizomes, tubers, bulb and therefore easily overcome the toxic effects of herbicide formulations (Smith et al., 2015). Accordingly, perennial weeds must be destroyed, or such measures should be provided that do not use soil herbicide formulations against weeds in young miscanthus plantations. A positive feature of all soil herbicides used in our research is that they did not show a significant negative impact on crop plants, which confirmed by other researchers (Anderson et al., 2010; Song et al., 2016). Weed infestation in miscanthus plantations is extended in time and therefore there is always a problem with the right timing of herbicide spraying. Spraying plants in the cotyledons – two-leaf stage provides the highest level of biological activity of all post-emergence herbicides. However, it is not always advisable to focus only on the time of the first weed sprouts appearance. Most weed seedlings come to the surface of the soil after spraying with herbicides. Such seedlings avoid chemical exposure and successfully grow in plantations until autumn. Postponing the time of spraying to a later date, when most weeds are already sprouted, is also not rational. Several postponing herbicides (fluazifop, pyrithiobac, and sulfometuron) may be viable options to control this species if it becomes invasive were to evaluate invasive potential of giant miscanthus (Li et al., 2013). Seedlings of weeds that first come to the soil surface before the time of spraying plantings have time to form 6-8 leaves and acquire significant resistance to the action of herbicide. As a rule, such weeds survive after the action of herbicides. The highest level of weed control efficiency of the post-emergence herbicides tested in miscanthus plantations was shown by Master Power OD and Milagro 040 SC. The reduction in the number of weed seedlings as a result of their action was 95.0% and 88.0%, respectively.

Conclusion

The generalization of the dynamics of changes in the number of weeds in the miscanthus plantations of the first year of growing allows dividing the growing season into three specific periods. The first period – the beginning of active vegetation of all plants on the plantations and their intensive growth and development. Plants occupy available free ecological niches in plantations and develop a protective covering that prevents sunlight coming to the field surface. The second period – the fiercest competition in plantations for the factors of life, especially for the energy of light between crops and weeds of different species. Under such conditions, the emergence of new weed plants almost completely stops. The third period – plants of weeds and crops gradually begin to reduce the area of their leaves, complete the formation of seeds, and reduce the optical density of the projective cover of the soil surface in the plantations.

The number of weeds in the miscanthus plantations grew most intensively in the period from middle May to early June. In subsequent periods, with the achievement of full projective coverage of the field by plants, the intensity of the new weed sprouts emergence decreased. The maximum number of weeds in the plantations was 122.3 plants/m^2. The accumulation of the green mass of weeds in miscanthus plantations was very intense, especially in the period from middle June to middle August. The largest weed green mass accumulation in the years of research was recorded in the middle of August and averaged 2906 g/m^2. It was found that in the second year of growing, miscanthus plants developed more actively. It was indirectly noted in the number of weed seedlings. Thus, as of 10th June, the total number of weed seedlings remained at the previous level, 33.5 plants/m^2, whereas, in the first year of growing their number was 105.5 plants/m^2.

The presence of moisture in the upper layer of the soil in combination with the light, available seed stock in soil, and mineral nutrition ensures the emergence of new weed seedlings, mainly of wintering species. It is a clear the study of weed population dynamics requires the development of new strategies. After all, the plant community unites species completely different in their biology. Post-emergence herbicides allow protecting miscanthus plantations creatively, taking into account the characteristics of the weed species composition, growth stage, the specifics of the herbicide action. Spraying weeds seedlings with herbicides in the cotyledon – the two-leaf stage is the most effective. The most effective weed control measure for the plantations of *Miscanthus x giganteus* before the emergence of the seedlings of the crop will be to carry out spraying the soil with herbicide Merlin 750 WG at an application rate of 0.15 kg/ha. During the growing season, taking into account the specifics of weeds (tillering stage), spraying herbicides Master Power OD 1.5 l/ha or Milagro 040 SC 1.25 l/ha is recommended.

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