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CONTROLLING WEEDS IN SOYBEAN CROPS IN THE RIGHT-BANK FOREST-STEPPE OF UKRAINE

The results of the study of harmfulness of annual weed species in soybean. The role of postemergence herbicides in reducing the weed infestation and increasing yield of soybean. The expediency of adding adjuvants as working solutions for herbicides.
Keywords: *soybean, weeds, harmful weeds, herbicides, yield, biological efficiency*

Introduction. Under the regional program production of oilseeds in 2011-2015 it is planned to increase the production of soybean seeds to 3.5 million tons. This increase production should take place through the implementation maximum genetic potential of modern varieties of crops, rather than extensive way - by increasing of area. It should be noted that the level of productivity of soybean seeds in a production environment in recent years, Ukraine (2001-2012 years) increased only from 1.22 to 1.70 t/ha. In the leading countries that grow soybeans, such as the U.S., Argentina, Brazil, the figure twice as much.

One way to maximize the formation of product varieties is introduction of modern technology varietal rice cultivation [1, 8]. Since soy is endowed with low competitive ability to weeds, protection of crops from weedy vegetation is one of the important factors increase productivity [3]. Yield losses in this culture from the harmful effects of weeds up to 30-50 % or even more. Cause the greatest harm soybean weeds that pop up stairs or simultaneously with steps that culture. They should be destroyed no later than 25-30 days after emergence of culture [1,2].

Weeds reduce the quantity and quality of the crop soybeans as competing with the crop for light, nutrients and soil moisture. For long-term data every hundredweight wet weight of the mixed composition of weeds is shortage of soybean seed yield of 10 kg. Therefore, the current technology of growing soybeans almost impossible without controlling weeds with herbicides [6]. In particular, the research institute of agricultural feed and skirts NAAS found that under conditions of high potential weed infestation of topsoil, and pre-emergency and post emergence harrowing soybean crops make it possible to reduce the number of weeds only 37%, which is insufficient for the formation of high yields of crops [3].

The purpose of research. Install harm the most common weeds in crops of soybeans, *Setaria glauca* (L.) P. Beauv and *Chenopodium album* L. Develop integrated control of weeds in soybean crops .

Material and methods. Field research was conducted in 2011-2013 by the conventional methods [5,7] in the stationary experiment of the State Enterprise "Research Farm "Bokhonytske" of the Institute of Feeds and Agriculture of Podillya of NAAS" in 2010-2012. Soils of the trial field were grey forest mid-loamy by texture, having the following characteristics of topsoil: humus (by Tyurin) - 2.2-2.4%, pH (saline) – 5.2-5.4; hydrolyzed nitrogen (by Kornfield) – 9.0-11.2; labile phosphorus (by Chirikov) – 12.1-14.2, exchange potassium – 8.1-11.6 mg.- equivalent per 100 g of soil.

Weather conditions during the years of growing seasons studies differed significantly from long-term indices for rainfall and temperature conditions. Thus, in 2011 and 2012 respectively rain fell in 97 and 150 mm less than the long-term norm. While in 2013 the total precipitation for April - September were within normal limits. The air temperature in 2011, 2012, 2013 (growing season) was respectively higher by 1,1; 2,5; 1,3 º C in comparison to the average long-term norm. In general, the weather conditions contributed to the growth and development of soybean plants as well as weeds.

Soybean varieties "Omega Vinnitsa ". Method of sowing wide-row (spacing 0.45 m). Seeding - around 660 seeds per 1 ha. The area of the cultivated land in the special field of model experiments for the study of hazard weeds - 1.8 m^2, a fivefold repeating (circuit experiments in Tables 1 and 2). A constant amount of weeds in areas maintained during the growing season by multiple (3-5 days) inspection and destruction of weeds that went down. Harvesting was carried out manually, thus take into account the wet weight of weeds.

In experiments to study the effectiveness of weed biological area sown area was 45 m^2 discount - 36 m^2. Repeated experiment four times . Herbicides have intaking by special hand sprayer PL «System agrotop» equipped with a horizontal rod 2.25 m in the phase of 2-3 leaves trigeminal soy.

Results and discussion. The most common weeds in soybean crops in the central forest conditions in recent years is a *Setaria glauca* (L.) P. Beauv and *Chenopodium album* L. *Setaria glauca* belongs to the late spring weeds. Family - cereal. The number of weeds in our experiments was 81-86 %.

Analysis of studies have shown that soy crops have low competitive ability of the *Setaria glauca* (L.). Thus, even in the presence of 1-5 - you weed this type of seed yield decreased by 2,2-9,8 % (Table 1). With increasing density *Setaria glauca* (L.)

10-25 weed/m^2, crop yield decreased to 12,7-20,7 %, and in the presence of 50 weed/m^2 weed the figure was 33.0 %. With the number of *Setaria glauca* (L.) 100 weed per m^2 plant yield decreased to 51.4 %.

In addition , it was found that when the density of the Chenopodium album L. 1-5 weed/m^2, soybean yield was reduced by 3,2-9,7 % (Table 2). If 10-25 pieces/m2 this weed crop losses were 14,7-24,0 % and 50 weeds/m^2 - 41.2 %.

It should be noted that with increasing density of weeds in crops weight per plant *Setaria glauca* (L.) and *Chenopodium album* L. decreased.

Thus, we can conclude that the yield of soybean seeds has significantly reduced in the presence of 10 plants weeds/m^2 *Setaria glauca* (L.) and *Chenopodium album* L., namely 12.7 and 14.7 %.

Data on the magnitude of decrease in yield are important in the development of an integrated weed management system in which the principal place is the definition of such a measure as an economic threshold usefulness of herbicides or other measures for the destruction of weeds.

Table 1

Exploring hazard Setaria glauca (L.) P. Beauv in soybean crops, the average for 2011-2013

Number of weeds, weeds per m^2	Weed wet weight		Yeild, t/ha	Reducing yield to control	
	g/m^2	one plant, g		t/ha	%
0 (control)	0	0	2,76	0	0
1	65	65	2,70	0,06	2,2
2	111	56	2,61	0,15	5,4
5	228	46	2,49	0,27	9,8
10	400	40	2,41	0,35	12,7
15	513	34	2,36	0,40	14,5
20	582	29	2,27	0,49	17,8
25	674	27	2,19	0,57	20,7
50	1103	22	1,85	0,91	33,0
57,5*	1225	21	1,73	1,03	37,3
100**	1303	13	1,34	1,42	51,4
$LSD_{0,5}$, t/ha			0,11		

* - *data from 2011 and 2013.*

** - *data from 2012*

Soybean crops during application of herbicides were mixed type of weed-infested, dominated by annual dicotyledonous weeds (78-83%) of the total population. Among the grasses dominated *Setaria glauca* (L.) P. Beauv.

Annual dicotyledonous species were represented by *Chenopodium album* L., *Thlaspi arvence* L., *Galinsoga parviflora* Cav. and *Amaranthus retroflexus* L. Among the perennial species encountered isolated instances of *Cirsium arvense* L).

The aim of the research was to study the biological effectiveness of postemergence herbicides are a number of the tank and the mixed as well as the rules reduced their costs in conjunction with the new surface-active substances (surfactants). It is known that these substances provide quality fastening herbicides and increase the stability of working solutions to sediment run-off from the surface of the leaf weeds.

Table 2

Learning harm Chenopodium album L. in soybean crops, the average for 2011-2013

Number of weeds, weeds per m^2	Weed wet weight		Yeild, t/ha	Reducing yield to control	
	g/m^2	one plant, g		t/ha	%
0 (control)	0	0	2,79	0	0
1	88	88	2,70	0,09	3,2
2	158	79	2,62	0,17	6,1
5	295	59	2,52	0,27	9,7
10	527	53	2,38	0,41	14,7
15	673	45	2,28	0,51	18,3
20	750	38	2,19	0,60	21,5
25	874	35	2,12	0,67	24,0
50*	1338	27	1,64	1,15	41,2
$LSD_{0,5}$, t/ha			0,09		

* - *data from 2013*

Postemergence herbicides advantage over ground is the use of herbicides based on economic thresholds of harmfulness of weed species and their composition. In addition, long-term data of the Institute of Plant . VJ St. George NAAS not found evidence postemergence herbicide exposure Bazahran, Harmony and Fyuzilad forte and tank mixtures on nitrogen-fixing nodules of soybean. Pivot herbicide positively affects the formation of nodule bacteria. While soil herbicides Harnes either separately or mixed with other herbicides significantly inhibits the development of nitrogen-fixing nodules [4].

The results of census of the mass of weeds and suggest that a decrease in consumption rates by 30% herbicide pulsar (imazamox 40 g/l) in combination with surfactants Ad'u its herbicidal activity is not decreased. Death of weeds of all kinds 30 days after spraying in the form as to the optimal consumption rate 1.0 l/ha was 88%, and in adjuvant decreased from Ad'u was 88% (Table 3).

Note the characteristic herbicidal action of the herbicide pulsar, which had high herbicidal activity against dicotyledonous weeds that were at the time of spraying in the phase of 2-3 leaves. This is clearly seen on the *Chenopodium album* L. plants, which is in the phase of 2-3 leaves reduced at 92-95 %. While in the phase of 4-5 leaves of this species was resistant to the herbicide Pulsar. These plants do not die completely and were depressed. In addition, this herbicide effectively eliminates annual grassy weeds in phase 1-3 leaves.

Important representatives of the chemical class of herbicides imidazolinone is based on the active ingredient imazethapyr 100 g/l. Upon recommendation of various chemical companies imazethapyr listed in the "List of ..." with the names of pesticide: Euro Lang, Emerald, Paris, Pivot, Picador, Picket, Sapphire, Hammer, Stobob, Tapirs, Fabian, Jupiter. The mechanism of action is

inhibition of imazethapyr enzyme acetolactate synthase ALS, which controls the synthesis of amino acids. Absorbed as the root system and leaf area is characterized by a complex action. If the product gets into the plant after an hour accumulates at points of growth. Visual signs of imazethapyr action on plant weed - chlorosis of young leaves, dwarfism and extinction of plants.

Table 3

Effect of herbicides on weediness and yield of soybean, the average for 2011-2013

Research variant	Application rate of the herbicide, l/ha	Weed quantity, weeds per m^2	*weed desruction, %	Weight of weeds in the end of vegetation, $г/м^2$	Yield	
					t/ha	± to control, t/ha
Control without herbicides	–	148,5	-	533	1,77	-
Kontrol with hand cutting	–	0	100	0(100)	2,54	0,77
Pulsar	1,0	17,5	88	78(85)	2,44	0,67
Fabian	0,1	19,0	87	84(84)	2,32	0,55
Pivot	1,0	18,3	88	86(84)	2,36	0,59
Pulsar +Ad'u	0,7+0,1%	18,0	88	83(84)	2,40	0,63
Fabian + Miura + Ad'u	0,07+0,5+ 0,25	16,8	89	76(86)	2,36	0,59
Nabob + Miura + Ad'u	1,5+0,6+ 0,25	12,5	92	54(90)	2,50	0,73
Pulsar + Nabob + Ad'u	0,7+1,5+ 0,25	17,8	88	75(86)	2,42	0,65
Pivot + Harmony + Ad'u	0,6+6г+ 0,25	20,0	86	88(83)	2,33	0,56
Pivot + Miura + Ad'u	0,6+0,6+ 0,25	17,5	88	64(88)	2,45	0,68
Harmony + Miura + Bazahran	8г+0,6+2,0	18,0	88	68(87)	2,46	0,69
Harmony + Miura	6г+0,4	20,0	86	84(84)	2,45	0,68

** Note: The destruction of weeds 30 days after postemergence herbicides intaking*
In brackets - the reduction weight of weed in % to control 1.

Fabian combined herbicide (imazethapyr + hlorymuron-ethyl) at a rate of consumption of 0.1 l/ha conditioned destruction of weeds of all kinds at 83-87 % and crude supply before building below 84 %. Thus plants weeds that were in the phase of 4-5 leaves revealed a "phase" resistance - that died completely. In addition to the Fabian herbicide Miura (0.5 l/ha) in combination with an adjuvant Ad`u (0.25 l/ha), the spectrum of such a composition extended, causing a decrease in the overall level of weed at 85-89 % and supply of crude has fallen by 86 %. It should be noted that the consumption rate of Fabian was reduced by 30 %, and Miura 20 %, indicating that adjuvants reinforce phytotoxic action of herbicides.

In experiment used herbicide Pivot (1.0 l/ha) after germination of soybean in the phase of 2-3 leaves. Its herbicidal activity appeared to be high. 30 days after spraying, weed-infested overall decreased by 88%.

Despite the high biological effectiveness Pivot, its widespread use is limited for the reason that by making the maximum norm (0.8-1.0 l/ha) turns negative impact on subsequent crops rotation. This is also due to its use in mixture for reducing of consumption rates.

Therefore, to effectively control weeds under conditions of mixed type is the use of weed-infested herbicidal compositions where some of the components have different mechanisms of action. According to the research, appeared to be a promising mix of Pivot Harmony. On the basis of the active ingredient methyl - tyfensulfuron than Harmony synthesized and are listed in the "List

..." the following herbicides: Alpha maize, Harmonyca w, Chancellor, Quantum, Orion , Smith, Titan , Formula , and others. As preparations for systemic effects, they are quickly absorbed by the green parts of dicotyledonous weeds and block the synthesis of amino acids. By Harmony and its analogues sensitive annual dicotyledonous weeds and annual and perennial gramineous species are stable.

In Pivot mixture (0.6 l/ha) + Harmony (6 g/ha) consumption rate decreased Pivot 40%, and Harmony - 20%. In addition to the working solution Ad`u adjuvant (0.25 l/ha) herbicidal activity of this mixture revealed high. Weeds were destroyed by 86 % and their crude supply at the end of the growing season was reduced by 83% compared with control.

The spectrum of action of both cereals and dicotyledonous weeds significantly expanded by using a mixture of Harmony (6 g/ha) + Miura (0.4 l/ha). In these areas effectively suppressed as cereals and broad-leaved species, which resulted in a decrease in the overall level of weed-infested 83-86 %.

Appeared promising herbicidal compound based on components that have different mechanisms of action and spectrum of effects on weeds. This mixture Nabob (1.5 l/ha) and Miura (0.6 l/ha). The mechanism of action is inhibition of the process of photosynthesis. By Nabob (active ingredient, bentazon, 480 g/l) annual most sensitive dicot weeds. Miura belongs to a group of herbicide that control only annual and perennial gramineous species. As the nabob application rate by 50% and added to the working solution as an adjuvant Ad'u, herbicidal activity of the mixture was high. Death of weeds was 88-92 %, and their crude supply decreased by 90 % compared with control.

In an embodiment Pulsar (0.7 l/ha) + Nabob (1.5 l/ha) + Ad'u where Pulsar and application rate nabob were respectively reduced by 30% and 50%, phytotoxic effects on weeds were high. Death of weeds was 84-88 % and the crude mass of weeds that remained was also lower by 86% compared with control 1.

Mixture of Pivot (0.6 l/ha) and Miura (0.6 l/ha) in combination with an adjuvant provided high biological efficiency. Even with a decrease in consumption rates of both components by 40%, death weed was 84-88 %.

Herbicide composition based on optimal consumption rates Harmony (8 g/ha) + Miura (0.6 l/ha) + Bazahran (2.0 l/ha) is designed to control a wide range of weeds at the prevailing distribution of dicotyledonous species. Since the test plots dominated by annual grasses, use of ternary mixtures proved impractical. Expected total destruction of weeds and their control was actually at the level of 85-88 %.

Selectivity of herbicides and their mixtures to plant soybeans in most variants was high. Liquefaction density stairs crops and suppression of their initial growth and development were observed. However, in areas such mixture treated as Fabian + Miura + Ad'u, Pivot + Harmony + Ad'u and herbicide Pulsar (1.0 l/ha) within 12-14 days after spraying on the plants of soybean was observed slight clarification, curling leaves and small plants lag in growth compared with the control. In subsequent periods of significant inhibition of growth and development of crop plants have been recorded, as were found negative effects on plant productivity of soybean.

Productivity growth soybean plants was in direct proportion to the level of weed control in areas. In all the areas where herbicides and brought them to mixture, ensured the preservation of seed yield within 0,55-0,73 t/ha compared with weed control (no herbicides and manual cutting) (Table 3). Indicators of productivity by application of herbicides were close to the level of the yield obtained in control weeds with hand weeding (0.77 t/ha), which testifies to their high selectivity and efficiency.

Conclusions. Soybean crops during the studies had mixed type of weed-infested by the predominance of annual grass weeds, namely 78-83 % of the total. Among the grasses dominated Setaria glauca (L.) P. Beauv., and dicotyledonous - *Chenopodium album* L., *Galinsoga parviflora* Cav., *Amaranthus retroflexus* L.

Soybean plants have low competitive activity to *Setaria glauca* (L.) P. Beauv. and *Chenopodium album* L. With presence of *Setaria glauca* (L.) and *Chenopodium album* L of 10 weeds/m^2, soybean yield decreased by 12.7 and 14.7 %.

Mixtures of herbicides based on components that have different mechanisms of action, provided overall reduction in weed-infested 86-92 % saving indication that harvest within 0,55-0,73 t/ha.

Once the herbicide consumption rates of 20-30% with the addition of adjuvants biological efficacy both in pure form and in mixture not decreased.

References

1. Бабич А.О. Боротьба з бур'янами в посівах сої в Лісостепу України / А.О. Бабич, В.П. Борона, В.С. Задорожний // Пропозиція. – 2001. – № 1. – С. 54-55.

2. Борона В.П. Екологічний аспект застосування гербіцидів в інтегрованій системі захисту сої від бур'янів / В.П. Борона, В.С. Задорожний, В.В. Карасевич // Корми і кормовиробництво : міжвідом. темат. наук. зб. – Вінниця: ФОП Данилюк В.Г., 2012. – Вип. 74. – С. 170-175.

3. Борона В.П. Захист посівів сої від бур'янів в Правобережному Лісостепу України / В.П. Борона, В.С. Задорожний, В.В. Карасевич, Т.М. Чекалюк // Зб. наук. праць 8-ї науково-теорет. конф. Укр. наук. тов. гербологів. – К.: Колообіг, 2012. – С. 23-27.

4. Гутянський Р.А. Вплив грунтових гербіцидів на формування азотфіксуючих бульбочок на сої / Р.А. Гутянський, Р.Д. Магомедов // Посібник українського хлібороба : наук.-практ. зб. – К.: ТОВ «Академпрес», 2013. – Том 2. – С. 78-81.

5. Доспехов Б.А. Методика полевого опыта / Б.А. Доспехов. – М.: Колос, 1985. – 416 с.

6. Комплексна система захисту посівів сої від бур'янів: рекомендації / Харків. ОДА, Ін-т рослинництва ім. В.Я. Юр'єва НААНУ: підгот. В.С. Зуза, Р.А. Гутянський, Р.Д. Магомедов, та ін. – Х., 2011. – 20 с.

8. Методики випробування і застосування пестицидів / [Трибель С.О., Сігарьова Д.Д., Секун М.П. та ін.] ; за ред. С.О. Трибеля. – К.: Світ, 2001. – 448 с.

9. Петриченко В.Ф. Оцінка технологічних прийомів вирощування сої в умовах Правобережного Лісостепу / В.Ф. Петриченко, С.І. Колісник, С.Я. Кобак та ін. // Вісник аграрної науки. – 2013. –№ 13, Спец. вип. – С. 57-62.

Анотація

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Контролювання бур'янів у посівах сої в Правобережному Лісостепу України

Наведено результати з вивчення шкодочинності однорічних, видів бур'янів у посівах сої. Встановлено роль післясходових гербіцидів у зменшенні забур'яненості та підвищенні урожайності сої. Обгрунтована доцільність додавання ад'ювантів до робочих розчинів гербіцидів.

Ключові слова: *соя, бур'яни, шкідливість бур'янів, гербіциди, урожайність, біологічна ефективність*

Аннотация

Задорожный В.С., Карасевич В.В., Мовчан И.В., Колодий С.В.

Контролирование сорняков в посевах сои в Правобережной Лесостепи Украины

Приведены результаты изучения вредоносности однолетних видов сорняков в посевах сои. Установлено роль послевсходовых гербицидов в уменьшении засоренности и повышении урожайности сои. Обоснована целесообразность добавления адъювантов к рабочим растворам гербицидов.

Ключевые слова: *соя, сорняки, вредоносность сорняков, гербициды, урожайность, биологическая эффективность.*