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SOYBEAN PERFORMANCE DEPENDING ON THE PROTECTIVE MEASURES APPLICATION

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Наведено результати багаторічних досліджень видового складу бур'янів та їх шкідливості у фітоценозі сої. Виявлено комплекс заходів захисту, що сприяють зменшенню чисельності та шкодочинності бур'янів у посівах культури.

***Ключові слова**: фітоценоз сої, бур'яни, шкодочинність, гербіциди, продуктивність сої.*

At present the problem of protecting crops from weeds is one of the most important. It has been established that in the absence of necessary level of protection against weeds in agricultural crops in the area of Forest steppe weeds from the soil can absorb most accessible forms of the compounds mineral nutrients: nitrogen — to 160–200 kg/ha; phosphorus — up to 55–90 kg/ha; potassium — to 170–250 kg/ha. Loss of vegetation common soybean and weeds can reach 20–50% in normal-row method of sowing and 40–80% or more — in wide-crops. Competitive weed activity in stressful conditions is intensified maximum, particularly under low moisture and high soil temperatures.

Only from the upper (0–5 cm) soil, and from it more than 80% of all plants weeds sprout, and under favourable weather conditions and sufficient moisture in the steppe during the growing season, on average, in 2337 units/ha weed are able to grow.

According to FAO, the average losses from weeds in the world agriculture exceed 20 myllyard dollars United States [1–3, 88–89].

Purpose. Establishing harmfulness of weed coenosis in soybean crops and investigating measures to protect plants from weeds.

Task. Experimental investigating the species and number of weeds and identifying effective agronomic and chemical measures of soybean protection.

The object of the study was soybean crops and harmfulness of weed coenosis for crop performance.

MATERIALS AND METHODS

Research was performed during 1984–2014 in PSATU and KSAES IFAP NAAS.

The potential infestation of arable soil was carried by sampling with drill set in 10–30 points each field and the subsequent laundering them on sieves with 0.25 mm diameter holes. After drying weed seeds were separated and counted and then transferred to 1 m^2 and 1 hectare. In soybean crops structure was determined by species of weeds determinant and weight of weeds by gravimetric method. Area of accounting plots was 25–50 m^2 with triple and quadruple repetition, and random and systematic placement.

Field experiments to detect biological and chemical efficiency of farming methods were performed in accordance with conventional methods [3].

Herbicides were applied with knapsack sprayer before sowing in the soil and in the phase of 2–3 true leaves of soybean with working solution consumption rate of 200 liters/ha. Soybeans were sown with wide-row spacing of 45 cm and course-lines with a width of 15 cm between rows.

RESULTS AND DISCUSSION

Examination of experiments and farms located in the right-bank forest-steppe showed that the arable soil layer has an average from 400 to 3800 pcs./m^2 or 400 mln. pcs./ha to 3.8 milliad pcs./ha seeds of annual weeds. In the ground seeds of annual weeds are prevailing and make up 87–90% of the total. In more than two-thirds of arable land the level of debris and weed-infested crops has increased dramatically and such perennial weed species cause particularly high harmfulness. First of all, they are pink thistle, sow-thistle yellow thistle garden, couch, bindweed field and others.

We studied the formation of weed species in soybean crops. Observations have found that soy was littered with 65 weed species of different biological groups. The dominant ones among them are 42 species. In average during the years of observations on 1 m^2 we counted 133.4 weeds with their weight of 1997.5 g/m^3, including annual crops which made 59.5%, and dicotyledonous ones which made up to 40.5%.

More often we met those species which have the closest match of agrobiological peculiarities to crop (yellow foxtail, Echinochloa crus-galli, lamb's quarters, amaranth species, small-flower galinsoga, shepherd's purse, Talabani field, bitterling rough, horse daisy and others). Perennial species made up 1.4% of agrocenoses but harmfulness of thistles bindweed field and couch was great because of their resistance to chemical farming and population control measures. Average annual yield losses of soybean seeds from harmfulness of weed coenosis makes 7.1–16.2 kg/ha, or 30–80% (Table 1).

Table 1

Soybean agrocenosis weediness under meteorological conditions 1984–2014 years

No.	Years of observation	Total of weeds and their weight		Including annual				Meteorological indicators		
				monocotyledonous		dicotyledonous		precipitation, mm		HTC
		pieces/m^2	g/m^2	pieces/m^2	%	pieces/m^2	%	per year	during the growing season	
1	1984	85.1	512.3	48.4	68.6	26.7	31.4	547.0	424.1	1.68
2	1985	90.4	501.4	60.3	66.7	30.1	33.3	636.1	398.4	1.48
3	1986	75.6	381.6	42.5	56.2	33.1	43.8	591.0	324.2	1.0
4	1987	70.9	235.5	52.7	74.3	18.2	25.7	591.8	410.6	1.46
5	1988	121.4	782.3	70.4	58.0	51.0	42.0	619.6	454.1	1.68

End of Table 1

No.	Years of observation	Total of weeds and their weight		Including annual				Meteorological indicators		
				monocotyledonous		dicotyledonous		precipitation, mm		HTC
		pieces/m^2	g/m^2	pieces/m^2	%	pieces/m^2	%	per year	during the growing season	
6	1989	86.2	1403	56.8	65.9	29.4	34.1	675.2	516.5	1.7
7	1990	110.5	2158	85.2	77.1	25.3	22.9	401.1	226.8	0.87
8	1991	168.4	2310.1	110.8	65.8	57.6	34.2	749.5	441.2	1.51
9	1992	175.9	2176	125.7	71.5	50.2	28.5	523.7	279.0	0.92
10	1993	253.4	3127	184.5	71.6	71.9	28.4	624.1	426.0	1.7
11	1994	269.8	3362	196.3	72.8	73.6	27.2	603.1	470.8	1.91
12	1995	242.0	2908	178.1	73.6	63.9	26.4	521.2	366.0	1.38
13	1996	83.4	910.9	50.2	60.2	33.2	39.8	546.1	350.6	1.21
14	1997	78.5	2015.1	33.6	42.8	44.9	57.2	556.8	420.4	1.4
15	1998	115.4	1967.4	60.1	52.1	55.3	47.9	803.7	597.1	1.86
16	1999	101.6	2105.9	52.5	51.7	49.1	48.3	1086.7	669.2	2.08
17	2000	92.3	1803.5	48.3	52.3	44.0	47.7	1000.0	661.3	2.52
18	2001	56.6	2041	25.4	44.9	31.2	55.1	1136.9	755.8	2.74
19	2002	51.7	1605	24.9	48.2	26.8	51.8	1006.5	783.6	2.62
20	2003	181.3	3401	89.7	49.5	91.6	50.5	723.7	525.4	1.5
21	2004	179.8	2813	113.6	63.2	66.2	36.8	939.6	661.7	2.2
22	2005	167.1	1854	123.4	73.8	43.7	26.2	956.7	483.4	1.64
23	2006	212.5	3015	98.7	46.4	113.8	53.6	1035.2	750.5	2.38
24	2007	301.6	3622	166.3	55.1	135.3	44.9	1097.8	733.8	2.38
25	2008	60.9	1548	29.4	48.3	31.5	51.7	1205.4	773.7	2.18
26	2009	66.7	1353	30.3	45.4	36.4	54.6	944.3	651.1	1.64
27	2010	134.1	1837	80.8	60.3	53.3	39.7	1320.2	841.8	2.54
28	2011–2014	101.5	4181	50.4	49.6	51.1	50.3	851.7	588.5	1.82
	Average	133.4	1997.5	81.8	59.5	51.4	40.5	796.2	535.2	1.8

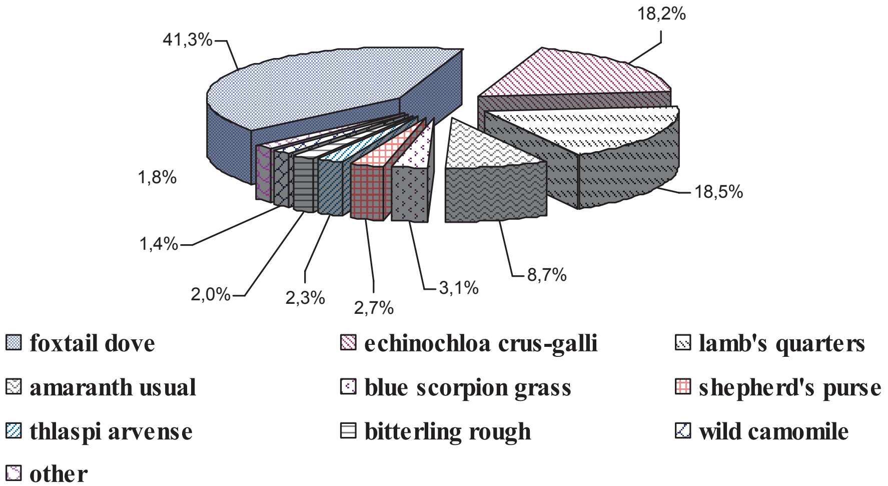
Grass weeds were presented with yellow foxtail (*Setaria glauca* (L.) P. Beauv.) – 55.0 pcs./m^2 and Echinochloa crus-galli (*Echinochloa crusgalli* (L.) P. Beauv.) – 24.2 pcs./m^2. Predominant representatives of flowering weeds were lamb's quarters (*Chenopodium album* L.) – 24.7 pcs./m^2, with ahnuta amaranth (*Amaranthus retroflexus* L.) – 11.6 pcs./m^2, blue scorpion grass (*Galinsoga parviflora* Cav.) – 4.2 pcs./m^2, shepherd's purse (*Capsella bursa-pastoris* (L.) Medik) – 3.6 pcs./m^2, talabani field (*Thlaspi arvense* L.) – 3.1 pcs./m^2, bitterling rough (*Persicaria scabra* (Moench) Moldenke) – 2.6 pcs./m^2, wild camomile (*Tripleurospermum inodorum* (L.) Sch. Bip.) – 2.4 pcs./m^2, other wild thistles (*Sonchus arvensis* L.), garden thistles (Sonchus oleraceus L.), bindweed field (*Convolvulus arvensis* L.) and couch (*Elytrigia repens* (L.) Nevski) – 1.8 pcs./m^2 (Table 2, Figure). We established that soybean crops are infested with mainly annual cereal and

Table 2

Soybean weed harmfulness depending on the using protection measures

No.	Variant	Years	Quantity weeds, pcs./m^2 / % death	The mass of weeds, g/m^2 / % death	Average yield, c/ha	Growth, ± to control c/ha
1.	Control C/0*	1984–1987	80.5 / 0	407.7 / 0	7.1	0
2.	Control C/1**		23.7	24.1	9.0	1.9
3.	Applying of soil herbicide Acetal (atsetohlor) — 6.0 l/ha		99.3	99.2	16.5	9.4
1.	Control C/0	1990–1994	244 / 0	3162.4 / 0	5.8	0
2.	Control C/1		50.8	48.3	10.2	4.4
3.	Continuous application of Acetal (atsetohlor) — 5.0 l/ha		83.4	82.9	20.4	14.6
4.	Continuous banding of Acetal (atsetohlor) — 2.0 l/ha		71.3	73.8	19.1	13.3
1.	Control C/0	1992–2000	148 / 0	2016 / 0	6.3	0
2.	Continuous application of Acetal (atsetohlor) — 5.0 l/ha		80.7	81.0	14.9	8.6
1.	Control C/0	1993–1997	86.4 / 0	803.4 / 0	11.4	0
2.	Control C/1		35.6	36.7	16.1	4.7
3.	After germination application of tank mixtures Nabu 1.5 l/ha + Harmony — 10 g/ha		87.4	81.3	22.5	11.1
1.	Control C/0	1995–1997	105 / 0	1262 / 0	10.6	0
2.	Control C/1		66.6	60.1	15.5	4.9
3.	After germination application of tank mixtures Galaxy-Top — 1.5 l/ha + Poast 2.0 l/ha		98.9	96.4	26.8	16.2
1.	Control C/0	2001–2005	122 / 0	181.4 / 0	8.1	0
2.	Continuous application of Harnesses (atsetohlor) (2,0 l/ha)		86.8	83.4	22.9	14.8
1.	Control C/0	2005–2010	108.4 / 0	1028 / 0	10.4	0
2.	Applying of soil herbicide Harnes (atsetohlor) — 3.0 l/ha		95.1	93.4	18.8	8.4
3.	After germination application of Pivot — 1.0 l/ha		97.3	96.4	19.0	8.6
1.	After germination application of Basagran (2.0 l/ha) + Harmoni (10 g/ha) + Pantera (1.0 l/ha)	2010–2014	98.1	58.4	28.2	16.3
	Average	41	127.8	1442.1	17.8	9.5

Comment: * Control C/0 – without herbicides and protection measures, ** Control C/1 – without herbicides with agrotechical protection measures.



Structure of weed species of soybean agrophytocenoses (average for the years 1984—2014)

dicotyledonous species. Number of perennial weeds makes up to 30% of the weed-infested. They appear mainly in the second half of the growing season of crops. For the purpose of processing soybean crop protection measures, taking into account the general and specific weed-infested and hydrothermal conditions in our study we looked at the effectiveness of farming and chemical methods of plant protection, especially the effectiveness of a number of preparations, their tank mixtures, range of actions in different ways and norms in their applying before and after planting and during the soybean growing season.

Our studies found that taking the density of soil layer made up 0–10 cm at the beginning of the growing season in all variants of the experiment did not change and was in the optimal range. But at the end of the growing season in areas with wide-sowing method (45 cm) we observed consolidation as the top layer (0–10 cm) within 1.33–1.39 and lower (10–30 cm) — 1.48–1.53 g/cm^3.

Soil bulk density with the expansion of the rows increased, caused by the passage of tractors through aisle and intense rainfall during the growing season of crops. The usual row method of sowing marked topsoil compaction (0–10 cm).

The usual row method of sowing (15 cm) with the norm of seeding 900 thousand seeds/ha (variety Zirnytsia), and before and after sprouting harrowing with following additional harrowing crops in phase one true leaf without making weed herbicide ensured weed reduction by 86% (in the check with the application of herbicide by 87%).

Conducting agronomic crop protection measures significantly affected the size of the surface assimilation soybean plants throughout the growing season and its effectiveness, which determines the purity of photosynthesis productivity, increasing this figure by 7.8%. Depending on the version of the protection crops from weeds from budding phase to the phase of ripening seeds net productivity of photosynthesis increased to 9.0–9.7 g/m^2 per day. This is because the soybean plants at this time strongly shaped leaf surface and had more intense dry weight accumulating on the options, free of weeds.

The greatest photosynthetic capacity was among soybean plants sown by wide-width method of row spacing (45 cm) and implementation of before and after sprouting harrowing in the phase of the 1 st true leaf crops — 181.6 thousand. m^2×d./ha, which accordingly affected the formation of yield structural elements, seed productivity and product quality.

Using our developed agrotechnical weed control measures without using herbicides provides 2.3–7.8% increase in yield with a simultaneous decrease in herbicide load on the soil and environment. We found that the total weediness was lower in the variant where Acetal (5.0 l/ha) was brought continuously under cultivation, destruction of weeds was 83.4%, including: cereals — 92.1 and dicotyledonous — 63.6%. The effect of belt applying of Acetal (2.0 l/ha) was slightly lower compared with the continuous application. The overall decline of weediness constituted only 71.3%, including: cereals — 80.0 and dicotyledonous — 51.1%. Before harvest weeds number in version with the herbicide application after sprouting of Galaxy-Top + Poast (1.5 + 2.0 l/ha) made up 12 units/m^2 or just 101.5 g/m^2 wet weight. Only some species resistant to this herbicide mixture preserved. Tank mixtures of herbicides on the basis of the Galaxy-Top + Poast were more suppressed to perennial and annual dicotyledonous weeds. Using tank mixtures with Bazahran + Poast contributed to increasing productivity growth and amounted to 10.3–11.0 c/ha, Galaxy-Top with Harmony — 12.5 c/ha and Galaxy-Top with Poast — 16.2 c/ha (56.2%) (Table 2).

Over the years of studies we found out high effectiveness of the herbicide Acetal (2–6 l/ha), applied after sowing before crop germination. It influenced on weeds toxically throughout the soybean growing season. Before harvesting total weediness reduced by 83.8–95.9%, including cereals — by 92.9–99.7% and dicotyledonous — by 79.5–89.6%. This herbicide in such rates significantly reduced the number of such weeds as blue scorpion grass, ivy-chickweed, yellow foxtail, bristle grass, prickly grass by91–100%, black nightshade — 88.4–100, pink thistle — 50.5–72.2 lamb's quarters — 68.3–89.6, amaranth usual — 64.2–98.3, shepherd's purse, field pennycress — 82.2–100.0 knotweed, dock-leaved persicaria — by 70.8–100%. Under continuous application after sowing to crop germination of acetal (5l/ha), the total weediness decreased by 83.4%, including: cereals — 92.1, dicotyledonous — 63.6%.

After germination applying herbicides in the mixture Flex + Fyuzilad (0.4 kg/ha a.i. + 2 l/ha) on vegetating plants reduces the overall soybean weediness by 82.3%, including: cereals — by 92.3 % dicotyledonous — by 59.4%.

Applying abovementioned mixture of herbicides provided 7.3 t/ha increase of soybean variety Kyiv 27. A mixture of herbicides Nabu + Harmony (1.5 l/ha + 10 g/ha), applied on vegetating weeds, provided overall weediness reduction by 87.4%, while the number of cereal grass species by 93.4% dicotyledonous — by 78.9%. Compared with the control (C1) due to reducing the number of weeds, soybean yield increased by 6.4 kg/ha. Varieties differ by biological requirements to environmental conditions and they react differently to using of herbicides.

Such mixtures have broad spectrum of influence on monocots and dicotyledonous weed species that reduce weediness and favour growth and productivity. After germination applying of Bazahran (2.0 l/ha) + Harmony (10 g/ha) + Panther (1.0 l/ha) provided a decrease in cereal and dicotyledonous weed species by 98.1%, which contributed to increase (16.3 kg/ha) compared to the control.

The introduction of conventional row seeding method with high seed rate (800–900 thousand. seeds per 1 ha) and application of 2–3 component tank mixtures of herbicides is the next step in saturation ecological niches and allows to have new levels of crop productivity with the least cost to implement and it is a new step in the theoretical justification of environmental regulation of its weediness, as evidenced by the request numbers 95052394, 95052395, 95052397.

CONCLUSIONS

In the conditions of sufficient moisture of right-bank forest-steppe soybean yield loss from weed-infested crops was, on average, during the years of research, 30–80% of the potential. We established that arable soil layer has an average of 400 to 3800 pieces/m^2 seeds of annual weeds. Annual weed seeds are prevailing in the ground and make up 87–90% of the total. Observations have found that soy is littered by 65 weed species of different biological groups. The dominant among them are 42 species. For 28 years of observations, on 1 m^2 we counted 133.4 weeds with their weight 1997.5 g/m^2, including annual crops — 59.5%, dicotyledonous — 40.5%.

The use of agrotechnical methods of weed protection under high farming culture allows obtaining high yields with applying of herbicides. Efficiency of Atsedal, Harness and Trophy (atsetohlor) on soybean crops, where annual cereal and flowering weeds mass emergence is expected, is quite stable. Using after germination tank mixtures of herbicides with different action spectrum, including Bazahran (2.0 l/ha) with Tsytovit (0.5 l/ha), Bazahran (2.0 l/ha) with Poast (2.0 l/ha) and Galaxy Top (2.0 l/ha) of Harmony (15 g/ha) and Pivot (1.0 l/ha) provide high efficiency in reducing crop weediness, and the costs of their use are recovered by significant increase in productivity. Research in this direction will continue in the future.

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УДК 633.31/37:631.461

ВПЛИВ КОМПЛЕКСНОЇ ІНОКУЛЯЦІЇ НАСІННЯ НА ҐРУНТОВУ МІКРОФЛОРУ АГРОФІТОЦЕНОЗУ ЗЕРНОБОБОВИХ КУЛЬТУР

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Обґрунтовано можливість інтенсифікації мікробіологічних процесів у ризосфері чорнозему південного на різних стадіях онтогенезу бобових культур завдяки інтродукції гетеротрофних і автотрофних мікроорганізмів. Застосування поліфункціональних мікробних препаратів впливає на коефіцієнти мінералізації, оліготрофності і мікробіологічної трансформації органічної речовини, але інтенсивність цих процесів залежить від інокулятів. Застосування мікробних препаратів підвищує продуктивність насіння бобових і вміст сирого протеїну в насінні.

***Ключові слова**: мікробні препарати, бобові рослини, ґрунтові мікробіологічні процеси, структура врожаю.*

Аналіз сучасного вітчизняного і світового досвіду з питань застосування корисних мікроорганізмів в агробіотехнології підтверджує можливість створення продуктивних рослинно-мікробних асоціативних і симбіотичних систем і вказує на необхідність вивчення умов для їх ефективного функціонування у ґрунті [1–3].