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FORMATION OF THE SPECIES COMPOSITION OF WEEDS IN THE SOY AGROPHYTOCENOSIS IN THE EASTERN WOODLAND-GRASS AREA OF UKRAINE AND INFLUENCE OF THEIR DENSITY ON SOY YIELDING CAPACITY

Formation of the species composition and proportions of biological groups of weeds in the soy agrophytocenosis were established depending on weather conditions in the Eastern Woodland-Grass Area of Ukraine. Changes in soy yielding capacity were detected at different degree of weediness of soy crops with annual and perennial weeds.
Key words: *weeds, soy, agrophytocenosis, yielding capacity, weediness of crops*

Introduction. The level of reduction in yields of soy seeds substantially depends on the species composition of weeds and their harmfulness. As investigations show, the soy produces heavy yield of seeds at good lighting of the crops. That is why the major losses take place as a rule in the phytocoenosis with domination of tall species of weeds. More than 60 species of weeds are represented in different regions of soy crops cultivation. At that, there is a tendency for decrease of the number of weed species both in soy crops and in other agricultural crops and their stabilization. If there were 90-120 various species in the crops at the beginning of the 60ies, their quantity in the crops made 32-40 species at the beginning of the 21st century [5, 6]. Harmfulness of various species of weeds mainly depends on weather-climatic conditions and the area of crop cultivation. According to the literature data, availability of five weeds in 1 m^2 may lead to decrease of the yield for 22%, availability of 10 weeds in the crops decreases grain harvest for 38% [2, 3, 4].

The most active growth of parasite vegetation in the soy crops is observed during the spring-summer period, and if at that time one manages to suppress the weeds, the crops will be comparatively clear at the next sowing. During the years when a sharp deficit of moisture is observed at the beginning of crop vegetation, the major part of emerging plants appears during later periods creating additional problems for protection of the crops. For optimization of crops protection measures against weeds, first of all, it is necessary to know exactly the species composition of weeds in every certain agrocoenosis. Therefore, development of high-efficient chemical protection systems of soy crops against weeds mainly depends on completeness of study of the weed phytocoenosis and species composition of weeds.

Materials and methods. The goal of researches was to study regularities of formation of the species composition of weeds in the soy agrophytocenosis and loss of its biological crop yield depending on different proportion of annual and perennial weeds in the Eastern Woodland-Grass Area of Ukraine. The researches were conducted in 2007-2009 at the research field of the Kharkiv National Agrarian University named after V.V. Dokuchaev. The soil of the experimental field is black soil typical, leached, low humus, heavy loamy with good physical and mechanical properties and high biological activity. The content of total humus (by Tyuryn) in the arable soil layer is 4.65 – 4.99%, mobile phosphorus is 6.23 – 8.12 and exchangeable potassium is 11.9 – 16.6 mg per 100 g of dry soil. Climatic conditions during the years of researches were different; differ from each other and from the average long-term values. The model field researches were conducted in six-time repetition on the accountable plot of 6 m^2. The weediness of seeding in the experiment is determined by account-weighting methods, crops yield – handily from accounting area and standard humidity transformation.

Results and discussion. The monitoring of the species composition of weeds in soy crops conducted by us revealed dominant availability of annual monocotyledon and dicotyledon weeds in the crops (Tab. 1). At visual observations over moisture availability during the spring-summer

period 2007, it was noted that sprouts of the wild buckwheat and lamb's quarters appeared the first ones. Seeds of the purslane, shepherd's purse, cleavers and redroot pigweed sprang after them. Seeds of cockspur grass, yellow foxtail, bulbous bluegrass, field pennycress sprang rather later when the air temperature reached +20-25ºC. It should be stated that the weather conditions in 2008 were such that rather low temperature held up during the first and second ten-day periods of May compared to the average long-term data. That is why sprouts of early spring weeds appeared first, then hibernating ones and plants of late spring gramineous weeds appeared in the third ten-day period when the temperature increased. Appearance both of early and late spring weeds was observed during other periods.

Table 1

Species composition of weeds of soy agrophytocenosis, pcs./m^2

No.	Species composition of weeds	Quantity of weeds			Average in 2007-2009
		2007	2008	2009	
1	Creeping thistle *(Cirsium arvense)*	1.2	1.4	0.9	1.2
2	Field sow thistle *(Sonchus arvensis)*	0.9	0.6	0.3	0.6
3	Field bindweed *(Convolvulus arvensis)*	0.6	0.9	0.8	0.7
4	Couch grass *(Elytrigia repens)*	3.2	2.3	2.6	2.7
5	Other perennial weeds	0.2	0.6	0.1	0.3
6	Wild buckwheat *(Poligonum convolvulus)*	1.9	2.7	3.2	2.6
7	Redroot pigweed *(Amarantus retroflexus)*	6.6	8.9	4.3	6.6
8	Cleavers *(Gallium aparine)*	0.9	6.6	2.1	3.2
9	Lamb's quarters *(Chenopodium album)*	15.9	10.1	1.3	9.1
10	Shepherd's purse *(Capsela bursa pastoris)*	0.6	0.5	0.1	0.4
11	Purslane *(Portulaca olerace)*	1.8	2.7	1.8	2.1
12	Field pennycress *(Thlaspi arvense)*	0.5	0.0	0.1	0.2
14	Other annual dicotyledons	0.6	0.1	0.8	0.5
17	Yellow foxtail *(Setaria glauca)*	15.0	7.8	6.6	9.8
20	Bulbous bluegrass *(Poa bulbosa)*	7.1	5.6	6.2	6.3
21	Cockspur grass *(Echinochloa crus-galli)*	8.9	6.9	17.8	11.2
22	Other annual monocotyledons	1.4	0.8	0.5	0.9
	Total	67.3	58.5	49.5	58.4

Total weediness of crops during the years under research was characterized as weediness of high degree (49.5-67.3 pcs./m^2). The share of perennial plants in the total quantity of weeds made 9.4%, that of annual dicotyledons made 42.3%, that of annual monocotyledons made 48.3% (Fig. 1).

Creeping-rooted weeds dominated among perennial ones, namely creeping thistle *(Cirsium arvense)*, field sow thistle *(Sonchus arvensis)*, field bindweed *(Convolvulus arvensis)*, and couch grass *(Elytrigia repens)* dominated among rhizome weeds. Weediness of soy crops with perennial weeds during the years under research was characterized as weediness of average degree (9.8-10.7 pcs./m^2).

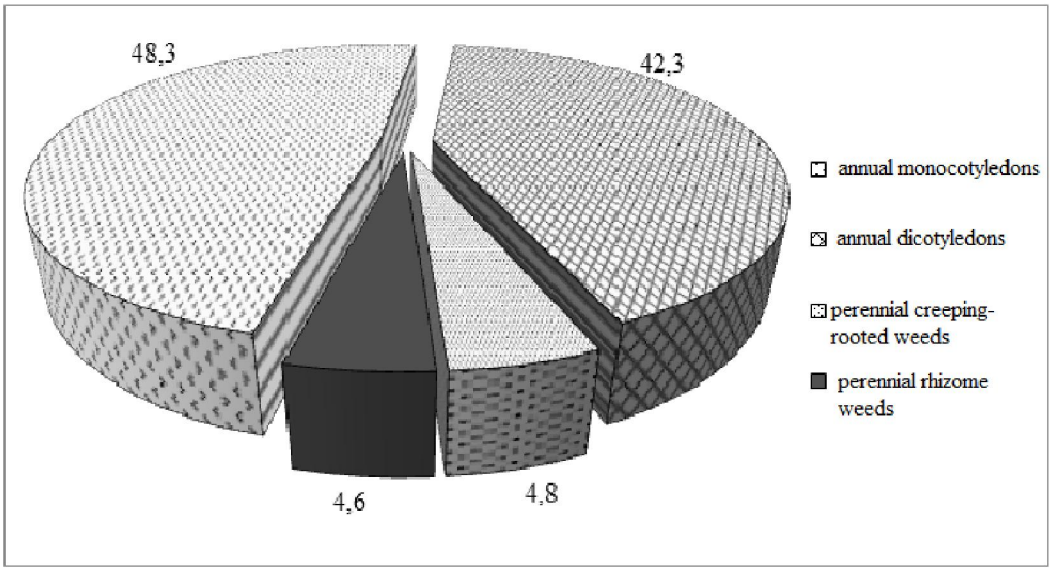

Fig. 1. Ratio of biological groups of weeds in soy crops, average for 2007-2009

The ratio of species of perennial weeds during the years under research is presented on Fig. 2.

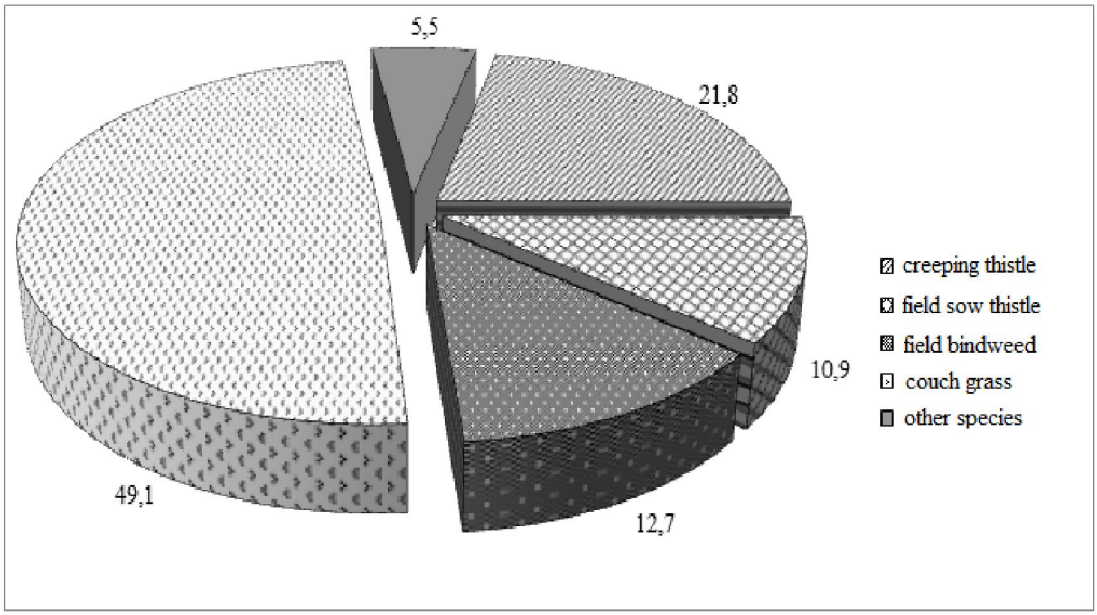

Fig. 2. Structure of the species composition of perennial weeds in soy crops, average for 2007-2009

Based on the data of Fig. 2 it can be seen that the prevailing numbers in soy crops during the years under research were taken by creeping thistle *(Cirsium arvense)* and couch grass *(Elytrigia repens)* which in the aggregate made 70.9% from the total numbers of perennial weeds. All other perennial weeds came up in small quantity compared to the above-stated species.

Subdominants, however not less harmful, in soy crops were dicotyledon annual species of weeds: lamb's quarters *(Chenopodium album)*, redroot pigweed *(Amarantus retroflexus)*, cleavers *(Gallium aparine)*, wild buckwheat *(Poligonum convolvulus)*, shepherd's purse *(Capsela bursa pastoris)*, field pennycress *(Thlaspi arvense)*, purslane *(Portulaca olerace)*. The ratio of the stated species of weeds is presented on Fig. 3.

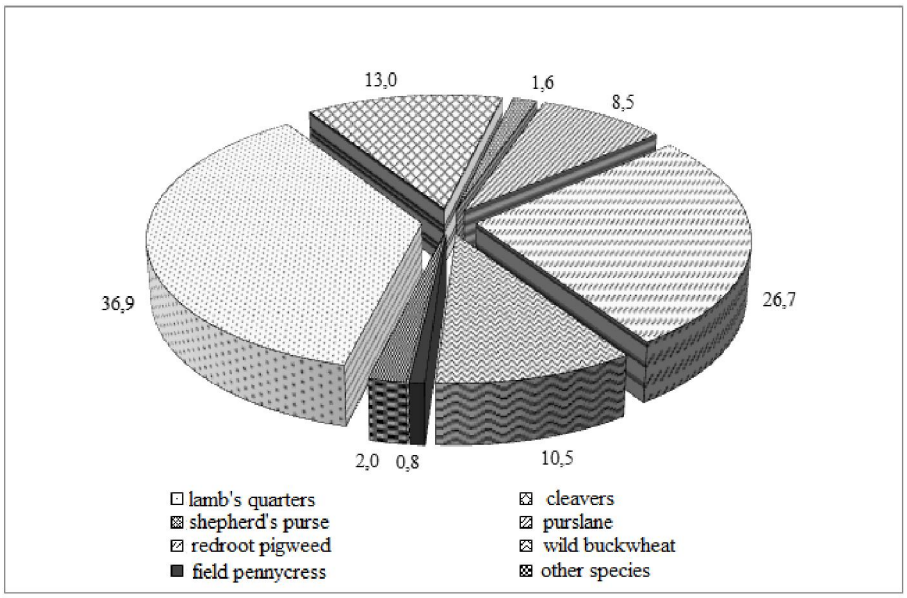

Fig. 3. Structure of the species composition of annual dicotyledon species of weeds in soy crops, average for 2007-2009

Based on the data of Fig. 3 it can be seen that among annual dicotyledon species of weeds there were lamb's quarters (36.9%), redroot pigweed (26.7%) and cleavers (13.0%) that came up in significant quantity in soy crops. In particular, this refers to 2007 and 2008 when rainfalls took place at the initial period of organogenesis of crops and weeds.

If studying annual monocotyledon weeds, during the years under research the following species were present: yellow foxtail *(Setaria glauca)*, cockspur grass *(Echinochloa crus-galli)*, wild oat *(Avena fatua)*, bulbous bluegrass *(Poa bulbosa)*. The ratio of annual spring weeds during the years under research is presented on Fig. 4.

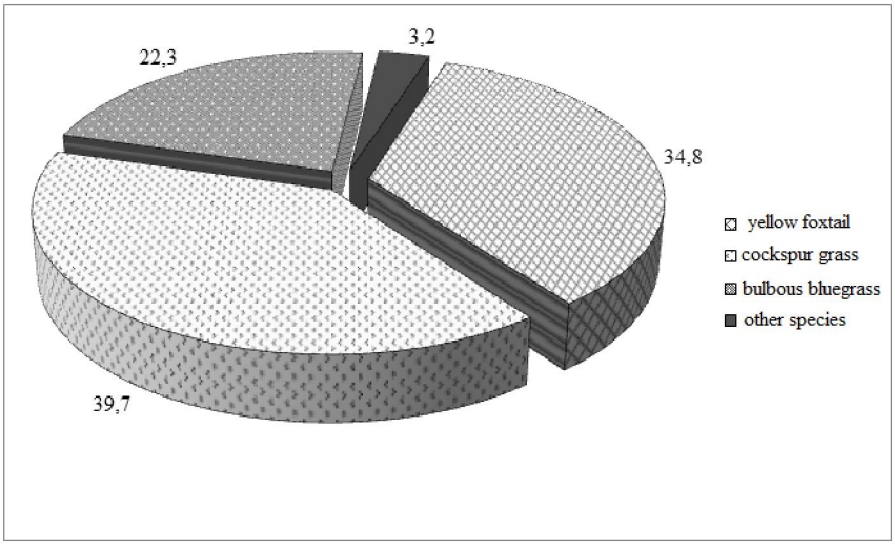

Fig. 4. Structure of the species composition of annual monocotyledon species of weeds in soy crops, average for 2007-2009

It can be seen from the data given in Fig. 4 that among annual monocotyledon species of weeds in soy crops the following species prevailed: cockspur grass (39.7%) and yellow foxtail (34.8%).

Therefore, formation of the species diversity of weedy vegetation in soy crops depended, first of all, on weather conditions of the region under research. We observed practically simultaneous sprouting both of early and late spring weeds at quick growth of air temperature and availability of accessible moisture in soil.

The summarized data for the three years of researches demonstrate that late spring species of weeds prevail in the soy agrophytocenosis of the Eastern Woodland-Grass Area of Ukraine. Among annual monocotyledon weeds: cockspur grass (39.7%), yellow foxtail (34.8%), bulbous bluegrass (22.3%); among annual dicotyledons: redroot pigweed (26.7%). Among early spring species the most common are annual dicotyledons: lamb's quarters (36.9%), cleavers (13.0%), wild buckwheat (10.5%). Perennial weeds were represented by couch grass (49.1%), field sow thistle (10.9%) and creeping thistle (21.8%), field bindweed (12.7).

Studying of competitive relations between cultivated plants and weeds is made in many directions. Studying of the competition phenomenon based on decrease of plant yielding capacity depending on density of weeds and the period of their stay in crops is among the most common ones. Competitive relations are characterized, besides other factors, by the crucial period of weed harmfulness.

The majority of researchers affirm that the soy herbocrucial period comes on the 25th-30th day of plant vegetation and ends on the 45th-50th day [1, 2, 7, 8]. Taking into account species weediness of the soy agrophytocenosis of the region under investigation and high degree of weediness we studied harmfulness of annual and perennial weeds during the crucial period of soy development during model micro-field researches. There were 13 variants of weediness backgrounds artificially created by means of pulling which were studied during the model researches. The ratio between annual and perennial weeds and total weediness of the crops retained against emergence of seedlings of up to 50 days of soy vegetation. The research results are given in Tab. 2.

Table 2

Yielding capacity of soy plants depending on the weediness degree, average for 2007-2009

Quantity of weeds, pcs./m^2			Yielding capacity of one plant, g	Biological crop yield, t/ha	Loss of crop yield	
Total	including				t/ha	%
	annual	perennial				
0	-	-	43	2.26	-	-
5	4	1	40	2.15	0.11	4.9
5	3	2	38	2.08	0.18	8.0
10	8	2	30	1.62	0.64	28.3
10	6	4	28	1.49	0.77	34.1
20	17	3	29	1.53	0.73	32.3
20	14	6	24	1.34	0.92	40.7
30	26	4	25	1.35	0.91	40.3
30	22	8	22	1.17	1.09	48.2
40	35	5	23	1.28	0.98	43.4
40	40	10	20	1.09	1.17	51.8
50	44	6	23	1.21	1.05	46.5
50	38	12	19	1.00	1.26	55.8
HIP_{05}				0.26		

According to the data in Tab. 2, real loss of soy grain yield (0.64-0.77 t/ha or 28.3-34.1%) is observed at the quantity of weeds of 10 pcs./m^2. At increase of the quantity of weeds up to 30-50 pcs./m^2 losses of the grain yield gradually increase, and in case of maximum weediness they made practically a half of the biological crop yield (46.5-55.8%). It should be also stated that increase of perennial weeds at the expense of annual ones in the soy agrophytocenosis leads to higher losses in the grain yield (for 5.8-9.3%). Such changes in the soy grain yield at different degrees of crop weediness are observed at the expense of decrease of yielding capacity of one soy plant at permanent density of crops. Hence, during development and study of the chemical protection system of soy plants it is necessary to take into account that during the herbocrucial period of its development weediness of crops should be kept at the level of 10 pcs./m^2 with the quantity of perennial weeds of not more than 2 pcs./m^2.

Conclusions. The mixed type of weediness with prevailing annual monocotyledon and dicotyledon weeds (90.6%) is formed in the soy agrophytocenosis of the Eastern Woodland-Grass Area of Ukraine at the at the initial periods of organogenesis. The ratio between them was in average close to 1:1. Such widespread weeds as cockspur grass and yellow foxtail dominated among annual spring species of weeds, and lamb's quarters and redroot pigweed dominated among dicotyledon species of weeds in the soy crops. The most considerable decrease of soy crop yield under effect of weeds was observed at weediness of 10 pcs./m^2. The loss of crop yield made from 28.3 to 34.1% compared to the control. Further increase of weediness up to 30 pcs./m^2 resulted in gradual decrease of crop yield up to 40.3-48.2%.

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Аннотация

Свиридов А.М., Панасенко О.Л.

Формування видового складу бур'янів в соєвому агрофітоценозі Східного Лісостепу України та вплив їх щільності на продуктивність сої

Встановлено формування видового складу та співвідношення біологічних груп бур'янів в агрофітоценозі сої залежно від погодних умов Східного Лісостепу України. Виявлено зміни продуктивності сої при різному ступеню забур'яненості посівів сої малорічними та багаторічними бур'янами.

Ключові слова: *бур'яни, соя, агрофітоценоз, продуктивність, забур'яненість посівів*

Аннотация

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Формирование видового состава сорняков в соевом агрофитоценозе Восточной Лесостепи Украины и влияние их плотности на производительность сои

Установлено формирование видового состава и соотношения биологических групп сорняков в агрофитоценозе сои в зависимости от погодных условий Восточной Лесостепи Украины. Выявлено изменение продуктивности сои при различной степени засоренности посевов сои малолетними и многолетними сорняками.

Ключевые слова: *сорняки, соя, агрофитоценоз, продуктивность, засоренность*

посевов