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PROTECTION OF WINTER WHEAT CROPS AGAINST WEEDS ON ORDINARY CHERNOZEMS OF THE NORTHERN STEPPES OF UKRAINE

The paper presents the results of the integrated system of soft winter wheat crops protection against weeds after nonfallow predecessors. The system is based on the surface tillage, fertilizing of wheat with nitrate (1.2-1.5 c/ha) and using a new generation of herbicides with a diverse spectrum of effect on specific biogroups of weeds.
Key words: *winter wheat, weeds, herbicides*

Introduction. In the conditions of the Northern Steppe of Ukraine and other parts of the world the soft winter wheat (Triticum aestivum) is a major food crop for bread and various bakery products making [1]. Its grains are used in the processing of alcohol as well as for the production of bioethanol.

The Steppe of Ukraine is characterized by an amble heat reserve and photosynthetically active solar radiation and the shortage of fertile moisture in the soil at the time of sowing of winter crops and high infestation of the top soil with seeds and vegetative reproductive organs of weeds after nonfallow predecessors (maize for silage, peas, winter wheat, perennial grasses, sunflower, buckwheat, millet, etc.) [2,3].

Therefore, the system of wheat crops protection against weeds is of primary importance in wheat cultivation after the above mentioned predecessors. The maximum effect will be provided by this innovative system which involves the following steps:

- Assessment by land users of the crop development situation as well as an agrotype and threshold of infestation of their crops with weeds;
- Reduction of the mechanical stress on the soil (by way of surface tillage);
- Utilization of the most efficient (best) herbicides in combination with wheat plant growth stimulants and regulators;
- Timely execution of a complex of field works which provides active growth and development of a major crop (wheat) and biological inhibition of weeds with its plantings at all stages of organogenesis.

Materials and methods. The experiments were conducted at the State Enterprise "Dnipro" SI Institute of Agriculture of the Steppe Zone of the National Academy of the Agrarian Sciences of Ukraine during 2011 – 2013 by carrying out field and on-the-farm research in accordance with the accepted methods [4,5,6].

The top soil in the experiments was mid-clay loam low humic chernozem with the following percentage of organic matters: 3.1-3.2% of humus in the plowing layer; 0.17-0.19% of gross nitrogen; 0.12-0.13% of phosphorus and 2.1-2.2% of potassium. The wheat (variety: "Spivanka") was sown on September 15-18 with the grain seeder "C3-3.6" with the rate of 5 mln. psc/ha. Along with sowing, complex fertilizers (ammophoska, nitroammophoska) were added in the rows in the amount of 10-12 kg/ha of the active ingredient. Ammonium nitrate (1.0 c/ha) was used for the spring feed up of the crops. Herbicides were applied in the phase of full tillering, i.e at the beginning of the stem-extension stage, with a compact boom sprayer "OM-6" on the basis of "T-25" with the water flow rate of 250-300 l/ha. The record plot was 42m^2 with a threefold repetition. The crops were gathered using a small-size harvester "Sampo-500".

Results and discussion. Over the 3 years of experiments the winter wheat crops sown after different predecessors were mostly infested with 15 species of annual and 7 species of perennial weeds reproduced by roots or sprout with an economic threshold of infestation (Table 1).

Table 1

Qualitative and Species Composition of Sprouts of Annual Weeds and Rosettes of Perennial Weeds in Winter Wheat Crops (Variety: Spivanka) Prior To Application of Herbicides (average for 2011-2013)

Botanical name	Weed density, (pcs./m²)	The same in %
1. Common ragweed	35,2	31,5
2. Mountain spleenwort	16,4	14,8
3. White dead nettle	0,8	0,7
4. Corn gromwell (Lithospermum arvense)	1,6	1,4
5. Shepherd's purse	2,1	1,9
6. Descurainia sophia	10,3	9,3
7. Spring groundsel	3,3	2,9
8. Pig weed	2,8	2,5
9. Cleavers grass	9,4	8,4
10. Fumaria Schleicheri	1,4	1,2
11. Field larkspur	3,1	2,8
12. Sisymbrium Loeselii	0,9	0,8
13. Field pennycress	16,1	14,5
14. Climbing buckwheat	4,1	3,8
15. Sumpfweed	0,3	0,03
16. *Field bindweed, virgate spurge, Tatar lettuce, Canada thistle* and field milk thistle	3,9	3,5
Total:	111,7	100

According to the scientists herbalists presence of only 1-2 ragweed plants in the cultivated crops should become a signal for the land user for their destruction [7, 8, 9, 10].

As shown in Table 1, the highest abundance of sprouting after the predecessors studied in the experiments with the wheat was observed in ragweed, a harmful quarantine weed, which achieved 35.2 pcs/m^2 or 31.5%. Mountain spleenwort, an early weed with a skinny stem, also goes to the fields rapidly enough (following the perennial grasses) the density of which was fixed at the level of 16.4 pcs/m^2 or 14.8% which is a relatively high negative indicator of its occurrence. As can be seen from the data in the above table, except the field pennycress (16.1 pcs/m^2 or 14.5% respectively), the density of other species of weeds in the experiments was either quite low (cleavers grass, Descurainia Sophia, etc.) or they were met only once (Sisymbrium Loeselii, white dead nettle, corn gromwell, etc.).

In recent years, rye brome, an early thin stem weed, becomes increasingly common in the winter wheat crops in the Northern Steppe of Ukraine, especially after sparseness of perennial grasses. It came out at the phase of the crop ear formation reaching the middle and upper tiers of the crop haulm stand resulting in significant reduction in the yielding capacity and quality of grains. In our experiments, the Puma Super herbicide provided the best effect in controlling rye brome, 7.5% - 1.0 l/ha after spraying the crops in the phase of 2-3 leaves of the weed at the level of 60-65% with respect to control (without herbicide). This creates a need for further search for herbicides which could provide more effective destruction of thin stem weeds in the wheat crops.

Let us look into the effectiveness of the winter wheat weed protection system in more detail by the years of our research (Table 2). The data given in the table confirm the higher effectiveness of such herbicides as Esteron (var. 2) and Puma Super (var. 3) as well as the tank mixture of these

herbicides (var. 4). Their regulated application made it possible to prevent the loss of 0.8 and 1,17 t/ha respectively of the wheat corn.

The data obtained during the experiments show that the largest biomass of weeds in the air dry state was in the control (without herbicides) – 24.3 g/m^2. In application of the tank mixture of Esteron + Puma Super the biomass of weeds turned to be the smallest – 2.6 g/m^2. Quite interesting observations were made in the study of Ellay Super herbicide (15 g/ha). From year to year its effect is getting closer to the maximum positive indicators due to the formula of the active ingredient properly selected by the DuPont Company, Switzerland. Thus, tribenuron-methyl (500 g/kg) effectively inhibits the growth and development of ragweed, spring dandelion, Fumaria Schleicheri and cleavers grass, the weeds that infest winter wheat most of all. In its turn, Metsulfuron-methyl (200 g/kg) which is also included in Ellay Super as an active ingredient, actively inhibits sprouting of Sisymbrium Loeselii, corn bindweed and other root and sprout perennials.

Table 2

Winter Wheat Yield (t/ha) at 14% Moisture By Years of Research With Account Of Crop Weediness and Moisture Supply

Variant of the experiment	Biomass of weeds in the air dry state before harvesting (g/m²)	2011	2012	2013	Average for 3 years
1. Without application of herbicides (control)	24,3	2,2	2,3	2,7	2,4
2. Esteron, 85% - 0,8 l/ha in the phase of spring tillering of wheat (standard)	3,7	2,7	3,3	3,9	3,3
3. Puma Super, 69% - 1,0l/ha spring spraying in the phase of 2-3 leaves of rye brome	3,9	2,8	3,5	3,9	3,4
4. Esteron, 0,8l/ha + Puma Super- 0,8l/ha (herbicide tank mixture) in the phase of spring tillering of wheat	2,6	3,1	3,8	4,1	3,7
5. Granstar Gold, 75 w.s.g. – 18 g/ha	3,0	3,0	3,6	3,8	3,5
6. Ellay Super, 70 w.s.g. – 15 g/ha+PAR Trend – 0,3 l/ha	1,8	3,3	3,7	4,2	3,7
7. Peak – 20 g/ha	5,0*	3,1	3,5	3,9	3,5
LSD 0,95%, t/ha					0,7

Note The low harvest data in 2011 are caused by an acute shortage of moisture in the winter wheat crops compared to other years*

It should be noted that in the experiments against a negative effect of rye brome, ragweed, field pennycress and field bindweed we successfully used a tank mixture of Esteron (0.8 l/ha) and Puma Super (0.8 l/ha) which suspended the negative effect of the above mentioned weeds by 73.7% on average over three years of research. It was observed that the reference herbicide Esteron had the most positive technical effect in our experiments (80.3%). It also should be noted that in the experiments with the winter wheat Granstar Gold, a well-known herbicide, was recorded to have a positive effect (including the impact of 2.4 D) on annual and perennial dicoduledonous weeds,

which was due to the effect of tribenuron-methyl (750 g/kg) on weeds in the spraying phase, starting from 2-3 leaves and up to the leaf-tube formation inclusive. The said agent destroyed the described above biogroups of weeds by 78.7%. These data suggest that there is no doubt we need to continue to study the effect of these herbicides on other types of weedy plants in the future.

Conclusion.

1. The use of the system of integrated protection of winter wheat crops against weeds makes it possible to improve agro-ecological conditions of winter wheat cultivation and increase the yielding capacity of this crop by 1.2 – 1.5 t/ha.

2. According to the obtained data a higher yield of wheat was achieved due to application of the tank mixture of Esteron (0.8 l/ha) and Puma Super (0.8 l/ha) at a rate of 2.8 t/ha. A positive effect of these herbicides was observed in destruction of not only ragweed and rye brome but also of such weeds, common in winter wheat crops, as field pennycress, Descurainia sophia and Sisymbrium Loeselii. A significant harvest (2.7 t/ha) was also reaped in the areas where the tank mixture of Ellay Super (15 g/ha) and PAR Trend (0.3 l/ha) was applied.

The highest technical effect on various biogroups of weeds was recorded in the areas where such herbicides as Esteron (80.3%), Granstar Gold (78.7%) and Esteron + Puma Super (73.7%) were applied.

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Анотація

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Захист посівів озимої пшениці від бур’янів на чорноземах звичайних північного Степу України

Представлені результати інтегрованої системи захисту насіннєвих посівів озимої м’якої пшениці від бур’янів після непарових попередників. Вона заснована на поверхневому обробітку ґрунту, підживленням пшениці селітрою (1,2-1,5 ц/га) та використанням гербіцидів нового покоління, які мають різний спектр дії на певні біогрупи бур'янів.

Ключові слова: *озима пшениця, гербіциди, бур’яни*

Аннотация

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Защита посевов озимой пшеницы от сорняков на чернозёмах обыкновенных северной Степи Украины

Представлены результаты интегрированной системы защиты семенных посевов озимой мягкой пшеницы от сорняков после непаровых предшественников. Она основана на поверхностной обработке, подкормку пшеницы селитрой (1,2-1,5 ц/га), использованием гербицидов нового поколения, которые имеют разный спектр действия на определенные биогруппы сорняков.

Ключевые слова: *озимая пшеница, гербициды, сорняки*