SCIENTIFIC HORIZONS

Journal homepage: https://sciencehorizon.com.ua

Scientific Horizons, 24(10), 35-42

UDC 633.11:632.954

DOI: 10.48077/scihor.24(10).2021.35-42

Effectiveness of Herbicides in Winter Wheat Crops

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Article's History:

Received: 22.09.2021

Revised: 20.10.2021

Accepted: 21.11.2021

Suggested Citation:

Gurmanchuk, O., Plotnytska, N., Nevmerzhytska, O., Pavlyuk, I., & Moshkivska, A. (2021). Effectiveness of herbicides in winter wheat crops. *Scientific Horizons*, 24(10), 35-42.

Abstract. To obtain high yields of winter wheat, it is important to control the contamination of crops with weeds. It is known that yield losses can be 30% or more due to the presence of segetal vegetation in wheat crops. With intensive technology of growing winter wheat, the chemical method of protection against weeds is an extremely important element. The paper highlights data on the species composition and class of contamination of winter wheat agrocenosis. The effectiveness of herbicides and their tank mixtures in winter wheat crops to reduce the presence of the weed component, increase grain yield and quality in the conditions of Luginsky District of Zhytomyr region on sandy loam soils during 2019-2021 was studied. It is established that the structure of the weed component of agrophytocenosis of winter wheat in farm conditions is dominated by dicotyledonous weed species, namely: field mustard (*Sinapis arvensis* L.), wild radish (*Raphanus raphanistrum* L.), wild pansy (*Viola tricolor* L.), shovelweed (*Capsella bursa-pastoris* L.), toadpipe (*Equisetum arvense* L.), and blue bottle flower (*Centaurea cyanus* L.), the share of which is 64.8%. Graminaceous species of weeds are represented by silky bent grass (*Apera spica-venti* L.), couch-grass (*Elytrigia repens* L.), rye brome grass (*Bromus secalinus* L.). The technical efficiency of the studied herbicides with the separate and joint application was in the range of 60.8-94.6%. The highest indicator of technical efficiency of herbicides in winter wheat crops, which is 94.6%, was obtained in an experiment using a tank mixture of Granstar Pro 75 + Apiros 75 preparations, with norms of 0.025+0.013 kg/ha, as well as an increase in wheat grain yield by 2.0 t/ha compared to the contaminated control. Spraying winter wheat crops with herbicides during the growing season allows improving the quality indicators of the grain yield structure. In particular, the content of protein and fibrin increases by 1.1 times; the moisture content of grain decreases by 1.0-1.1 times, and the content of dirt impurity decreases by 2.8-6.7 times, compared to the control version

Keywords: winter grains, weeds, chemical protection, yield, technical efficiency, agrophytocenosis

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INTRODUCTION

Among all field crops grown in Ukraine, winter wheat is the most important and popular among both farmers and the private sector. This is evidenced, first of all, by the areas under this grain crop, which in recent years occupy an average of 6.3 million hectares, which is approximately 23% of the total area of crops [1].

The popularity of winter wheat is conditioned upon a number of factors: it is used for making flour, cereals, pasta, for feeding livestock and poultry, etc. High protein content, which can be up to 15% in soft wheat varieties, a considerable amount of carbohydrates and starch, vitamins A, B, D, E, PP, essential amino acids, etc. increase the value of winter wheat grain compared to other cereals. The most important thing in economic terms is that winter wheat is in great demand as an export crop. Ukraine occupies an important place in this regard, as it is one of the top ten wheat exporting countries in the world. Every year, the export of the main grain crop from the country accounts for about 17-19 million tonnes. Winter wheat is a crop that produces large yields on soils with a high agricultural background and slightly smaller ones with a low one, but at the same time remains highly profitable. Its average yield on soils with a high bonus is 5-7 t/ha, while on less fertile soils it is possible to get 3-4 t/ha [2].

The soil and climatic conditions of all regions of Ukraine are mainly suitable for growing winter wheat. However, some annual temperature fluctuations during certain periods of wheat growth, as well as changes in moisture supply, force producers to resort to certain adjustments in the technology of growing crops in different zones. This crop produces good yields using various cultivation technologies, in particular conventional, minimal or zero. Important techniques in the technological process of growing winter wheat are the selection of varieties, sowing dates, balanced nutrition, and protection from harmful organisms. The varietal resource of winter wheat, which is currently formed in Ukraine and recommended for production, consists of almost 80% of varieties of Ukrainian selection. They are characterised by above-average and increased winter hardness, high drought resistance, resistance to lodging, etc. Sowing dates are also of great agrotechnical importance and affect the size of the resulting crop. In recent years, the terms of sowing in various soil and climatic zones of Ukraine deviate from the recommended ones. This indicator is influenced by weather conditions, soil moisture reserves, the quality of seed material, and a number of other factors. Depending on the ecological zone of winter wheat cultivation in Ukraine, the recommended sowing dates are from the first decade of September to the first decade of October [1; 2].

Another factor affecting the growth, development and yield of winter wheat is the fertilizer application system and the correct application of nitrogen fertilizers. To obtain high yields of winter wheat, a considerable role is given to controlling the contamination of crops [3]. It is known that crop losses due to the considerable presence of segetal vegetation in wheat crops can be 30% or more. Contaminated winter wheat crops cannot fully provide themselves with moisture and nutrients, and they also receive a limited amount of light [4]. In addition, the area of nutrition decreases, which limits the growth of the root system and thickens crops due to weeds, which leads to a decrease in air movement between plants and, accordingly, a deterioration in the overall phytosanitary state of agrocenosis. Weeds can also be used as reserves of many pathogens and pests, which also leads to a negative impact on the yield of winter wheat [5].

Sowing of winter wheat is mainly carried out by seeders designed for continuous sowing with row spacing of 15-19 cm, but in recent years, many farms have experienced wider row spacing of 20-50 cm, which, in turn, requires more attention to control the contamination of crops [6]. Increasing the width of row spacing creates more favourable conditions for weed germination, that is, a "free ecological niche" appears [7]. Therefore, regulating the level of presence of the weed component in the agrocenosis of winter wheat at all stages of its organogenesis is one of the factors for preserving grain yield and quality. The use of agrotechnical measures to destroy weeds in winter wheat crops does not always allow getting the maximum result. For effective control of segetal vegetation in the agrocenosis of winter wheat, a comprehensive approach to solving this problem is necessary, including the use of herbicides [3; 8].

The purpose of the research was to establish the effectiveness of herbicides and their tank mixtures in the agrocenosis of winter wheat in the conditions of Ukrainian Polissia. The objectives of the study were to establish the species composition of segetal vegetation, select suitable herbicides, and determine their effectiveness against the most common types of weeds, as well as their impact on the yield and quality of winter wheat grain in the conditions of Ukrainian Polissia.

LITERATURE REVIEW

With intensive technology of growing winter wheat, the chemical method of protection against weeds is an extremely important element. With the correct selection of herbicides, their timely use in compliance with all the requirements on this crop, the presence and negative impact of the weed component can be minimised [5]. The range of drugs that are presented on the Ukrainian market for regulating the number of weeds in wheat crops is sufficient and can meet the needs of almost any farm. Wheat can be attributed to crops on which the widest "line" of herbicides can be applied. It is represented, in the vast majority, by chemicals for the destruction of dicotyledonous weed species, but there are a certain number of chemicals that have a detrimental effect on

grain species. There are herbicides that combine the ability to destroy dicotyledonous and grain weed species. In addition, there are preparations with a soil effect or a weakly expressed soil effect on weeds.

The most popular herbicides on winter wheat are chemicals based on active ingredients: tribenuron-methyl, dicamba, florasulam, etc. [9]. To regulate the number of dicotyledonous perennial weed species in the agrocenosis of winter wheat, mixtures of several active substances from the group of sulfonylureas and synthetic auxins are used [10]. Among the drugs that negatively affect the development of grain weeds in the agrocenosis of winter wheat, manufacturers often use monitor 75 WG, Axial 045 EC, Puma super 144 EW [11].

In recent years, the use of herbicides in the autumn period has been quite popular, but not all of the chemicals allowed for use on winter wheat are suitable for this purpose. When using some chemicals in the autumn period, there may be a negative impact on wheat plants and, accordingly, on the future harvest [12]. In addition, a combination of two chemicals Grodil maxi 375 OD and Zenkor liquid 600 SC with norms of 0.11 and 0.3-0.4 l/ha, respectively, is recommended for use in the autumn period in agrocenosis of winter wheat. The use of this mixture is quite effective, but it is impractical on light sandy soils and soils with low humus content. The advantage of the mixture of these drugs is their long-term protective effect, which, under optimal conditions in winter, continues in spring, while ensuring the initial spring growth with almost no weeds [13].

More effective and widespread is the use of chemicals in the agrocenosis of winter wheat in the spring after the resumption of crop vegetation. The positive side of using herbicides in spring is that winter, wintering and early spring weed species germinate in wheat agrocenosis, which allows more carefully selecting herbicides or their tank mixtures. Therewith, if the treatment is carried out as late as possible but within the permissible phase of crop development, a very high efficiency of controlling the number of weeds in winter wheat crops can be obtained. Although with the later use of herbicides, it is possible to lose the crop due to the competition of weeds with winter wheat plants for solar energy, moisture, and nutrients at the beginning of its growth and development. In addition, there is a possibility of overgrowth of segetal vegetation in the wheat agrophytocenosis, which also negatively affects the effectiveness of herbicides [14]. Considering the fact that the effect of chemical preparations may vary slightly depending on soil and weather conditions, the authors of this paper conducted special studies to determine the effectiveness of herbicides in regulating the amount of segetal vegetation of winter wheat agrocenosis.

MATERIALS AND METHODS

Field studies were conducted during 2019-2021 in the conditions of farm "Obriy" of Luginsky District of Zhytomyr region. On the farm, sandy loam, sod-podzolic soils are characterised by the following indicators: humus (according to Tyurin and Kononova) – 1.10-1.23%, easily hydrolysed nitrogen (according to Cornfield) – 57-66 mg/kg of soil, mobile phosphorus (according to Chirikov) – 108-170 mg/kg of soil, exchange potassium (according to Chirikov) – 76-104 mg/kg of soil, pH_{sol} – 5.7-6.4. Weather conditions during the study period were somewhat different in terms of indicators from long-term data but did not cause a considerable negative impact on the development of winter wheat.

Winter wheat in the experiment was grown using minimal soil treatment technology. The previous crop in the experiment was soy. After collecting the previous crop, the soil was treated with the DAN 2.1 unit (discoplow with a roller), pre-sowing cultivation, and sowing. The Kraevid wheat variety, characterised by increased resistance to pathogens and stress factors, was sown at the experimental sites. The seeding rate was 4.5 million tonnes of grain per 1 hectare. Sowing was carried out with a row spacing of 15 cm. The seed material was used well cleaned and calibrated with mandatory pickling before sowing with fungicidal and insecticidal chemicals. In all variants of the experiment, mineral fertilizers were used, in particular, during sowing, 100 kg of physical weight of ANP fertilizer NPK was locally applied to the rows at the rate of 16:16:16+6S per hectare; 100 kg per hectare of ammonium nitrate was superficially scattered on frozen-thawed soil, and another 50 kg of physical weight of the same fertilizer was applied in the phase of the beginning of stem elongation. Spraying of wheat plants with the studied herbicides and tank mixtures was carried out in the tillering phase before the stem elongation using a mounted sprayer OGN 600 with a working fluid consumption rate of 200 l/ha. During the growing season of wheat, crops were protected from pests and pathogens. Harvesting was carried out by direct combining using the Niva SK-5m combine.

The species composition of weeds in wheat agrocenosis was determined using atlases and reference books [15]. Studies on the effectiveness of herbicides were conducted according to the following scheme: 1. Contamination control (water treatment); 2. Granstar Pro 75, v.g. (d.r. tribenuron-methyl – 750 g/kg) – 0.025 kg/ha; 3. Prima, s. e. (d. r. florasulam 6.25 g/l + 2-ethylhexyl ether 2.4-D 452.5 g/l) – 0.5 l/ha; 4. Apiros 75, v. g. (d. r. sulfosulfuron – 750 g/kg) – 0.026 kg/ha; 5. Granstar Pro + Apiros, 0.025 kg/ha+0.013 kg/ha; 6. Granstar Pro + Prima, 0.025 kg/ha+0.3 l/ha. The size of the experimental site was 0.5 hectares. The experiment is repeated three times, and the placement of sites is systematic. Records of contamination of winter wheat crops were carried out three times during the growing season: the first – before the use of herbicides; the second – on the 30th day after application; the third – before harvesting. The level of contamination of winter wheat agrocenosis was assessed on a five-point scale, where 1 point is a very weak degree of contamination (1-5 pcs/m^2), and 5 points – a very strong degree of contamination (more than 100 pcs/m^2) [16].

The technical effectiveness of herbicides was calculated 30 days after their application, in comparison with the initial contamination and with a mandatory adjustment for control according to the generally accepted method. After harvesting wheat, its quality indicators were studied according to the methods [17]. Mathematical processing of the obtained research results was carried out by the method of variance analysis according to methodology B.A. Dospekhov [18].

RESULTS AND DISCUSSION

Over the years of research, the specific and quantitative composition of weeds in winter wheat crops has been studied. When studying the species belonging of segetal vegetation in winter wheat crops in the conditions of farm "Obriy" of the Luginsky District of Zhytomyr region, it was established that dicotyledonous weed species are dominant, the share of which in the overall structure of contamination was 64.8% (Fig. 1).

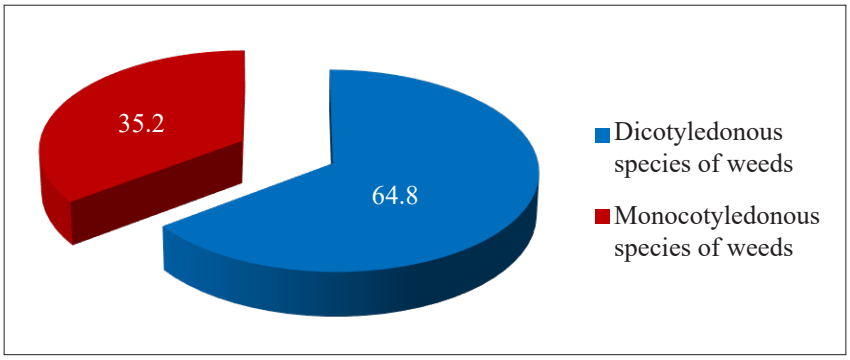

Figure 1. *Ratio of single- and dicotyledonous weed species in winter wheat crops under the conditions of farm "Obriy", 2019-2021*

Among dicotyledonous weeds, the dominant species were: field mustard *(Sinapis arvensis* L.*)*, wild radish (*Raphanus raphanistrum* L.), wild pansy (*Viola tricolor* L.), shovelweed (*Capsella bursa-pastoris* L.), toadpipe (*Equisetum arvense* L.) and blue bottle flower (*Centaurea cyanus* L.) (Fig. 2). In the agrocenosis of winter wheat, the following types of cereal weeds prevailed: silky bent grass (*Apera spica-venti* L.), couch-grass (*Elytrigia repens* L.), rye brome grass (*Bromus secalinus* L.).

In winter wheat crops, when accounting, 24.9% of the detected weed species were only 1-2 specimens on the accounting site. In particular, these are such cereal types of weeds as common oatmeal (*Avena fatua* L.), annual bluegrass (*Poa annua* L.*)*, black grass (*Alopecurus myosuroides* L.), etc. Single specimens of pig weed (*Chenopodium album* L.), canada thistle (*Cirsium arvense* L.), purple deadly (*Lamium purpureum* L.), doorweed (*Polygonum aviculare* L.), water pepperwort (*Polygonum hydropiper* L.), small-flower galinsoga (*Galinsoga parviflora* L.), wild chamomile (*Chamomilla suaveolens* L.) have been identified from dicotyledonous species of segetal vegetation.

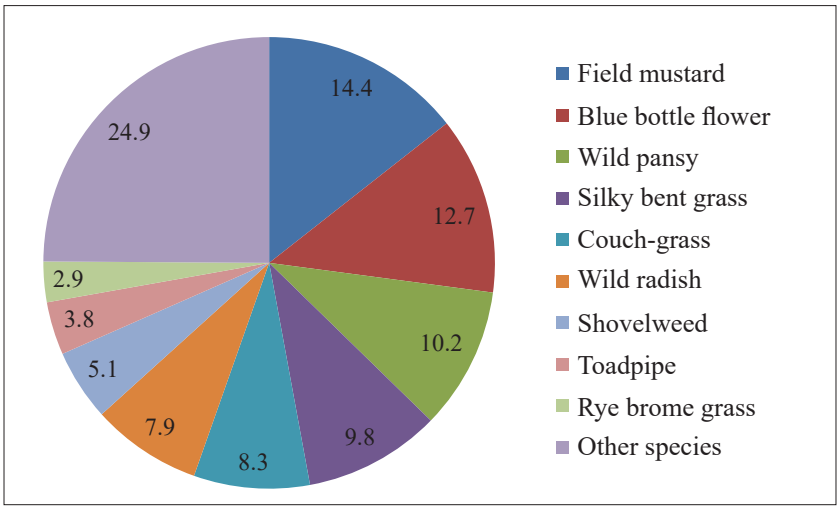

Figure 2. *Structure of winter wheat crops contamination in the conditions of farm "Obriy", 2019-2021*

According to the results of monitoring the phytosanitary condition of winter wheat crops in the Polissia zone of Ukraine, conducted by N.V. Hrytsiuk et al., the synusia weed is represented by nine species from six

families. The largest percentage of the detected weeds were rye brome grass and silky bent grass, belonging to annual winter crop species [10].

To ensure high and stable yields of winter wheat on poor sod-podzolic soils of Polissia, one of the main methods in the technology of its cultivation is the control of the weed component. Analysis of the structure of winter wheat crops contamination showed that the agrophytocenosis of this crop was characterised by a mixed class of contamination, namely dicotyledonous-monocotyledonous. That is, dicotyledonous species predominate in the composition of the weed synusia of winter wheat agrocenosis, which must be considered when using chemicals in regulating the number of weeds.

In certain soil and climatic conditions, studies are conducted to determine the effectiveness of chemicals against various types of weeds in winter wheat crops. In particular, the effectiveness of diflufenican, clopiralide, and fluroxipir against broad-leaved weed species and their impact on wheat yield was confirmed in Iran [9]. In addition, the use of a mixture of fluroxypir and 2,4 D after germination is effective in controlling the number of *Viola arvensis* in spring wheat crops [14]. The use of a post emergence herbicide based on the active substance isoproturon in Pakistan allows regulating the number of *Avena fatua, Convolvulus arvensis, Melilotus indica, Cirsium arvense,* and *Fumaria indica* in wheat crops [13].

That is why in the conditions of Ukrainian Polissia, a study was conducted to determine the effectiveness of herbicides and their tank mixtures for a comprehensive solution to the problem of contamination of winter wheat crops. The initial contamination of crops before the use of the studied chemicals was in the range of 48.9-51.1 pcs/m^2 (Table 1). The obtained results of the study allow asserting the expediency of using herbicides separately and in mixtures to control the amount of segetal vegetation in winter wheat crops.

Table 1. *Effectiveness of herbicides in winter wheat crops (2019-2021)*

Research variant	Number of weeds, initial, pcs/m^2	Number of weeds, 30 days after application of the chemical, pcs/m^2	Technical efficiency, %	Number of weeds, before harvesting, pcs/m^2
Contamination control (water treatment)	48.9	51.7	–	60.2
Granstar Pro 75, v. g., 0.025 kg/ha	49.8	17.7	66.4	27.8
Prima, s. e., 0.5 l/ha	51.1	21.2	60.8	29.3
Apiros 75, v. g., 0.026 kg/ha	50.4	20.1	62.3	23.4
Granstar Pro 75 + Prima, 0.025+0.3 kg, l/ha	49.9	8.7	83.5	25.4
Granstar Pro 75 + Apiros 75, 0.025+0.013 kg/ha	50.5	2.9	94.6	8.5
HIP_{05}	0.11	0.02	–	0.03

In particular, the use of herbicides Granstar Pro 75, v. g. (0.025 kg/ha), Prima, s. e. (0.5 l/ha), Apiros 75, v. g. (0.026 kg/ha) contributed to a decrease in the number of weeds on the 30th day after the use of chemicals by 2.4-2.8 times compared to the initial contamination. Mixtures of Granstar Pro+Apiros, 0.025 kg/ha+0.013 kg/ha and Granstar Pro+Prima, 0.025 kg/ha+0.3 l/ha showed high efficiency against weed synusia in winter wheat agrocenosis and contributed to a decrease in its number by 5.7-17.4 times compared to the initial contamination of experimental plots.

In the variants of the experiment using each of the studied herbicides with their separate application (Granstar Pro 75, Prima, s. e., Apiros 75), technical efficiency was obtained at the level of 60.8-66.4%. When studying the effect of a tank mixture of Granstar Pro 75 + Prima preparations with norms of 0.025+0.3 kg, l/ha, the decrease in the presence of the weed component in crops was 83.5%, compared with the contamination control. The use of a tank mixture of herbicides Granstar Pro 75 + Apiros 75 at a rate of 0.025+0.013 kg/ha, respectively, contributed to the reduction of weeds in the agrophytocenosis of winter wheat by 94.6%, which was the most effective option in the experiment. The high effectiveness of this combination of chemicals can be explained by the fact that it can control grain species of weeds, the share of which is about 35% of the total, due to the herbicide Apiros 75.

After considering the number of segetal vegetation before harvesting, 60.2 weeds per 1 m^2 were recorded in the control version of the experiment. In three variants of the experiment using each of the studied herbicides separately, as well as when using the Granstar Pro 75 + Prima tank mixture before harvesting winter wheat, the number of weeds in crops was in the range of 23.4-29.3 pcs/ m^2. The smallest number of weeds before harvesting, which

was 8.5 pcs/m^2, were observed in a variant of the experiment using a mixture of Granstar pro 75 + Apiros 75 chemicals with appropriate standards.

With a decrease in the presence of the weed component in the agrophytocenosis of winter wheat, a positive effect on crop yield indicators was noted (Table 2). In the control version of the experiment (water treatment), the lowest yield of winter wheat grain was obtained, which was 1.4 t/ha. In the variants of the experiment using the studied herbicides, the yield was preserved separately at the level of 1.4-1.5 t/ha. For the use of a tank mixture of Granstar Pro 75 + Prima chemicals, an increase in the yield of winter wheat grain in the range of 1.6 t/ha was obtained. The largest preserved grain yield of the studied crop (2.0 t/ha) was obtained when using a mixture of Granstar Pro 75 + Apiros 75 preparations with norms of 0.025+0.013 kg/ha, respectively.

***Table 2**. Influence of herbicides on the yield of winter wheat grain (2019-2021)*

Research variant	Chemicals consumption rate, l/ha, kg/ha	Yield, t/ha	Preserved harvest	
			t/ha	% to contamination control
Contamination control (water treatment)	–	1.4	–	–
Granstar Pro 75, v. g.	0.025	2.9	1.5	107.1
Prima, s. e.,	0.5	2.8	1.4	100.0
Apiros 75, v. g.,	0.026	2.8	1.4	100.0
Granstar Pro 75 + Prima	0.025+0.3	3.0	1.6	114.3
Granstar Pro 75 + Apiros 75	0.025+0.013	3.4	2.0	142.9
HIP_{05}	–	0.03	0.01	–

The study of the effectiveness of herbicide use and their tank mixtures on winter wheat allows drawing conclusions about the feasibility of their use. In particular, if the studied herbicides are used singly, then their technical efficiency is 60.8-66.4%, and when using tank mixtures of these same chemicals, it increases from 83.5% to 94.6%.

After analysing the study data, it should be noted that the highest efficiency in the use of herbicides was obtained in the version with the Granstar Pro 75 + Apiros 75 tank mixture. In the authors' opinion, this is explained by the ability of the active substances of these two herbicides to control both dicotyledonous and grain species of weeds in winter wheat crops.

For the sale of winter wheat grain, quality indicators are of great importance, in particular: protein content, fibrin content, nature, humidity, and dirt admixture. It is known that grain quality largely depends on the genotype of the variety [2], and the effect of herbicide treatments is not fully studied. That is why the main quality indicators of the resulting winter wheat grain were evaluated. The conducted studies established that the use of herbicides allows improving the quality indicators of grain yield, in comparison with the contaminated control (Table 3). In particular, the content of protein and fibrin increases by 1.1 times. The highest levels of protein and fibrin content were obtained in the experiment version using the Granstar Pro 75 + Apiros 75 tank mixture, which amounted to 13.9% and 31.3%, respectively. Grain humidity in all the studied variants was within the normal range and did not exceed 13.7-14.0%. In the control version, this indicator was 14.6%, which required drying the resulting crop to remove excess moisture.

***Table 3**. Influence of herbicides on the quality indicators of winter wheat grain (2019-2021)*

Research variant	Protein content, %	Fibrin content, %	Grain size, g/l	Grain humidity, %	Dirt admixture, %
Contamination control (water treatment)	12.8	28.5	748.3	14.6	4.7
Granstar Pro 75, v. g., 0.025 kg/ha	13.8	30.7	757.5	13.9	1.4
Prima, s. e., 0.5 l/ha	13.8	30.9	756.5	13.9	1.5
Apiros 75, v. g., 0.026 kg/ha	13.8	30.8	755.9	14.0	1.7
Granstar Pro 75 + Prima, 0.025+0.3 kg, l/ha	13.9	31.1	758.7	13.7	0.9
Granstar Pro 75 + Apiros 75, 0.025+0.013 kg/ha	13.9	31.4	764.9	13.7	0.7
HIP_{05}	–	–	21.4	–	–

Dirt admixture in the control variant was the largest and amounted to 4.7%, which required additional measures for post-treatment of grain. When using herbicides singly, the indicator of dirt admixture decreased by 2.8-3.4 times, and when using tank mixtures of chemicals – by 5.2-6.7 times, compared to the control.

CONCLUSIONS

The structure of the weed component of winter wheat agrocenosis in the conditions of farm "Obriy" in Luginsky District of Zhytomyr region is dominated by dicotyledonous weed species, the share of which is 64.8%. Dicotyledonous weeds are represented by the following dominant species: field mustard *(Sinapis arvensis* L.*)*, wild radish (*Raphanus raphanistrum* L.), wild pansy (*Viola tricolor* L.), shovelweed (*Capsella bursa-pastoris* L.), toadpipe (*Equisetum arvense* L.) and blue bottle flower (*Centaurea cyanus* L.). Among the grain species, the following were most often found: silky bent grass (*Apera spica-venti* L.), couch-grass (*Elytrigia repens* L.), rye brome grass (*Bromus secalinus* L.).

The use of herbicides Granstar Pro 75, v.g. (0.025 kg/ha), Prima, s. e. (0.5 l/ha), Apiros 75, v. g. (0.026 kg/ha) reduces the number of weeds by 30 days after the use of chemicals by 2.4-2.8 times, and mixtures of chemicals Granstar Pro+Apiros, 0.025 kg/ha+0.013 kg/ha and Granstar Pro + Prima, 0.025 kg/ha+0.3 l/ha – 5.7-17.4 times, compared to the initial contamination. The highest indicator of technical efficiency of herbicide use in winter wheat crops, which is 94.6%, was obtained in a variant of the experiment using a tank mixture of Granstar Pro 75 + Apiros 75, with norms of 0.025+0.013 kg/ha. The use of herbicides Granstar Pro 75, v. g. (0.025 kg/ha), Prima, s. e. (0.5 l/ha), Apiros 75, v. g. (0.026 kg/ha) contributes to an increase in the yield of winter wheat grain in the range of 1.4-1.5 t/ha. The use of a mixture of herbicides Granstar Pro 75 + Apiros 75, with norms of 0.025+0.013 kg/ha contributes to an increase in wheat grain yield by 2.0 t/ha, compared to the contamination control. Treatment of wheat crops with herbicides allows improving the quality indicators of the crop structure, in particular, the protein and fibrin content increases by 1.1 times; grain moisture decreases by 1.0-1.1 times, and the content of dirt admixture decreases by 2.8-6.7 times compared to the control variant. The highest quality indicators of the crop structure were obtained in a variant of the experiment using the Granstar Pro 75 + Apiros 75 tank mixture.

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Ефективність гербіцидів у посівах пшениці озимої

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Анотація. Для отримання високих урожаїв пшениці озимої важливим є контроль забур'яненості посівів. Відомо, що втрати урожайності за значної присутності сегетальної рослинності у посівах пшениці можуть становити 30 % і більше. При інтенсивній технології вирощування пшениці озимої хімічний метод захисту від бур'янів є надзвичайно важливим її елементом. У статті висвітлено дані щодо видового складу, класу забур'яненості агроценозу пшениці озимої. Досліджено ефективність гербіцидів і їх бакових сумішей у посівах пшениці озимої на зменшення присутності бур'янового компоненту, збільшення урожайності та якості зерна в умовах Лугинського району Житомирської області на супіщаних ґрунтах протягом 2019–2021 рр. Встановлено, що у структурі бур'янового компоненту агрофітоценозу пшениці озимої в умовах господарства переважають дводольні види бур'янів, а саме: гірчиця польова (*Sinapis arvensis* L.), редька дика *(Raphanus raphanistrum* L.), фіалка триколірна (*Viola tricolor* L.), грицики звичайні *(Capsella bursa-pastoris* L.), хвощ польовий *(Equisetum arvense* L.) та волошка синя (*Centaurea cyanus* L.), частка яких становить 64,8 %. Злакові види бур'янів представлені метлюгом звичайним *(Apera spica-venti* L.), пирієм повзучим (*Elytrigia repens* L.), бромусом житнім *(Bromus secalinus* L.). Технічна ефективність досліджуваних гербіцидів за роздільного та сумісного їх внесення становила у межах 60,8–94,6 %. Найвищий показник технічної ефективності гербіцидів у посівах пшениці озимої, що становить 94,6 %, отримано у варіанті досліду із застосуванням бакової суміші препаратів Гранстар Про 75 + Апірос 75, з нормами 0,025+0,013 кг/га, а також отримано зростання урожайності зерна пшениці на 2,0 т/га, порівняно із забур'яненим контролем. Обприскування посівів пшениці озимої гербіцидами у період вегетації дає можливість покращити якісні показники структури врожаю зерна. Зокрема, вміст білку та клейковини зростає у 1,1 раза; вологість зерна знижується у 1,0–1,1 раза, а вміст сміттєвої домішки знижується в 2,8–6,7 рази, у порівнянні із контрольним варіантом

Ключові слова: озимі зернові, бур'ян, хімічний захист, урожайність, технічна ефективність, агрофітоценоз