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OPTIMIZATION OF THE SYSTEM OF IRRIGATED WINTER WHEAT PROTECTION AGAINST HARMFUL ORGANISMS IN SOUTHERN UKRAINE

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Abstract. The research findings show that the highest effectiveness in irrigated winter wheat protection against harmful organisms is provided with the application of seed disinfectant Serticor 050 FS (1 l/t), fungicide Alto Super 330 EC, emulsion concentrate, together with herbicide Peak 75 % water-soluble granules (0.45 l/ha + 0.020 kg/ha) in the stem elongation phase, as well as fungicide Amistar Extra 280 SC suspension concentrate (0.5 l/ha) at the beginning of flowering, and insecticide Enzhio, 24.7 % suspension concentrate (0.18 l/ha) at the beginning of milky ripeness of grain.

The study determined that Konka variety had a seed yield of 3.59 t/ha, which is 8.2 % more than in Khersonska 99. The combined application of biopreparations Trichodermin and Gaupsin proved to be the most effective. Avatar had an advantage over other micronutrients under study and allowed gaining a 7.3-14.2 % seed yield increase. Dispersion analysis confirms that microfertilizers take up the greatest proportion (58.2 %) in the impact on the formation of winter wheat yield. The effect of varietal composition (20.0 %) and plant protection (16.1 %) was also high.

Keywords: *Winter wheat, diseases, harmful organisms, weeds, preparations, effectiveness*

Introduction. Winter wheat is the main food crop grown in all soil and climatic zones of Ukraine. Harmful organisms are among the many factors that affect its yield. Under the steppe conditions, smut diseases, root rot, powdery mildew, septoriosis, orange leaf rust, various types of weeds, cereal aphids, wheat thrips, chinch bugs and others are hazardous. They lead to a significant loss of crop yield and cause deterioration in its quality [3].

Considering the foregoing, there is a need to study the effectiveness of comprehensive measures for the protection of winter wheat crops against diseases, pests and weeds.

Analysis of recent research findings and publications. In many countries of the world, various aspects of winter wheat protection against harmful organisms are being investigated. In Ukraine, in particular, the application of herbicides Estrone, Grantar gold, Esteron + Puma super provided the highest

technical efficacy for different biogroups of weeds [4, p. 119]. The spraying of crops in the phase of milky ripeness of grain with pyrethroid insecticide Karate Zeon 050 CS, microencapsulated suspension, is an effective method of chemical protection of winter wheat against suctorial pests [5, p. 149].

At the same time, the possibility of using an integrated program of wheat protection from harmful organisms is shown under the conditions of Poland [6, p. 226]. In Serbia (in semi-arid regions), a study was conducted on integrated wheat protection against the most common fungal diseases [7, p. 1].

The aim of research. is to study the efficacy of chemical pesticides and biopreparations combined with microfertilizers in their complex application against harmful organisms of winter wheat.

Research methods. The research was carried out on the test field of the Institute of Irrigated Agriculture of the National Academy of Agrarian Sciences of Ukraine in 2008-2016. The soil of experimental sites is dark chestnut medium-sandy weakly salined; it is characterized by a well-developed soil profile; humus content in the 0-30 cm soil layer is 2.1 %, total nitrogen makes up 0.18 %, the content of phosphorus is 0.16 %, the soil also has an increased potassium content of 2.6 %.

Diagnosis of diseases and identification of harmful organisms were carried out according to the methods provided in a number of publications [1, 8]. Generally accepted techniques were used to perform field studies [2].

Results and discussion. The research results show that presowing treatment of seeds with desinfectants contributed to increased germinating power, growth intensity, even stands and a significant reduction in the spread and development of fungul diseases. So, the infestation of smut diseases in Lamardor 400 FS and Serticor 050 FS variants decreased by 100 %, that of fusarial and helminthosporious root rot by 78.3; 82.3 and 80.2; 84.0 %, respectively (Table 1).

The efficacy of Vitavaks 200 FF in the control of smut diseases and root rot is lower than in the variants with Lamardor 400 FS and Serticor 050 FS.

Throughout the years of research, shepherd's purse (Capsella bursa pastoris L.) and tansy mustard (Descurania Sophia L.) dominated in the species composition of weeds on the experimental field of irrigated winter wheat, at 46.3 and 25.6 %, respectively The weediness of

1. Effectiveness of seed disinfectants for Khersonska Awnless winter wheat variety (average for 2009-2011)

Seed disinfectant	Disinfectant application rate, l/t	Growth intensity, %	Laboratory germination, %	Effectiveness, %			
				bunt of wheat	loose smut	root rot	
						fusarial	helminthosporious
Control (without treatment)	–	83.0	88.5	–	–	–	–
Lamardor 400 FS, flowable suspension concentrate	0.15	86.9	93.2	100.0	100.0	78.3	82.3
Serticor 050 FS, suspension concentrate	1.0	87.4	93.8	100.0	100.0	80.2	84.0
Vitavaks 200 FF, water suspension concentrate	2.5	85.8	91.4	98.7	99.2	74.8	80.2

crops with creeping thistle (Cirsium arvense L.) and common ragweed (Ambrozia artemiziifolia L.) was 9.8 % and 14.3 %, respectively. Other weeds made up 4.0 %.

We experimentally studied herbicides Granstar 75 %, water-soluble granules, Peak 75 %, water-soluble granules, Grodil Maxi 37.5 %, oil dispersion. They were applied in combination with a fungicide at the stem elongation stage. The number of weeds after 30 days after chemical treatment was 4.6-10.2 times lower, whereas in the control it increased by 6.3 % (Table 2).

The results of the experiment indicate that herbicide Grodil Maxi 37.5 %, oil dispersion, was the most effective on experimental plots of winter wheat, which contributed to a decrease in weediness by 98.5-99.0 %. In this case, we achieve effective control of such types of weeds as creeping thistle, tansy mustard, shepherd's purse and common ragweed.

In variants with the application of herbicides Granstar 75 %, water-soluble granules, and Peak 75 %, water-soluble granules, the effectiveness of protection was practically the same (95.2-97.2 %).

During autumn vegetation of spike cereals, phytophags (cereal flies, cicadas, aphids) did not have economic importance. The numbers of spring generation of cereal flies were lower than the economic threshold of harmfulness (ETH). The greatest threat to winter wheat crops in the years of research was created by chinch bugs and wheat thrips. In the phase of milky ripeness of wheat, the number of their larvae was 7.8-8.5 specimens/m^2 and 11.7-15.2 specimens per ear, respectively. The population of greenbugs (common and barley aphids) on plants varied from 3.2 to 9.0 specimens/stem.

The protection of experimental plots from a complex of suctorial pests was carried out at the beginning of the milky ripeness of grain. Spraying winter wheat with insecticides Fastak, 10 % emulsion concentrate, Enzhio, 24.7 % suspension concentrate, and Detsis Profi, 25 %, water-soluble granules, following the recommended application rates, reduced the number of bugs by 93.8-98.7 %, that of wheat thrips and cereal aphids by 94.6-98.9 and 92.5-98,3 %, respectively (Fig. 1).

The research results show that Enzhio, 24.7 %, suspension concentrate, applied at a rate of 0.18 l/ha displayed higher efficacy against all species of suctorial phytophages.

Throughout the years of research, autumn occurrence of fungal diseases in irrigated winter wheat had no economic significance. In the spring-summer period, powdery mildew, septoriosis and orange leaf rust were a threat, which caused a need for fungicides applica-

2. Effect of herbicides on a decrease in the weediness of winter wheat (Khersonska Awnless variety, average for 2008-2010)

No.	Variant	weediness, pcs/m2			% of decrease compared to control
		before chemical treatment	30 days after treatment	before harvesting	
1.	Control (no herbicide)	39.8	42.3	42.0	–
2.	Granstar 75 %, water-soluble granules, 0.02 kg/ha	40.3	6.5	1.5	96.3
3.		38.7	5.2	1.4	95.2
4.	Peak 75 %, water-soluble granules, 0.02 kg/ha	40.8	4.5	0.9	96.7
5.		38.5	3.8	0.9	97.2
6.	Grodil Maxi 37.5 %, oil dispersion, 0.1 l/ha	39.3	8.1	0.6	98.5
7.		37.9	8.2	0.5	99.0
Least significant difference (LSD) 05, pcs / m2		3.12	3.82	2.95	

	chinch bugs	wheat thrips	cereal aphids
Fastak, 10% e.c.	93,8	95,2	92,5
Fastak, 10% e.c.	94,5	94,6	93,6
Enzhio, 24.7% s.c.	98,7	98	97,7
Enzhio, 24.7% s.c.	98	98,9	98,3
Detsis Profi, 25%, w.g.	95,2	96,7	96,5
Detsis Profi, 25%, w.g.	94,9	94,8	97

Fig. 1. Effectiveness of insecticides against suctorial pests of winter wheat (Khersonska Awnless variety, average for 2008–2010).

3. Effectiveness of fungicides against fungal diseases of winter wheat (Khersonska Awnless variety, average for 2008-2010)

No.	Fungicide	Application rate, l; kg/ ha	Development stage of the crop	Effectiveness, %		
				powdery mildew	leaf septoriosis	orange leaf rust
1.	Control (no protection)	–	–	–	–	–
2.	Bileton, 25 % wettable powder	0.5	stem elongation	85.0	64.9	70.2
3.	Bileton, 25 % wettable powder	0.5	stem elongation	93.2	86.0	93.8
	Impact, 25 % emulsion concentrate	0.5	beginning of flowering			
4.	Alto super 330 EC, emulsion concentrate	0.45	stem elongation	87.0	86.2	84.0
5.	Alto super 330 EC, emulsion concentrate Amistar Extra 280 SC, suspension concentrate	0.45	stem elongation	97.9	98.3	98.3
		0.5	beginning of flowering			
6.	Falcon, 46 % suspension concentrate	0.6	stem elongation	85.9	83.5	84.9
7.	Falcon, 46 % suspension concentrate	0.6	stem elongation	97.2	98.0	97.0
	Amistar Extra 280 SC, suspension concentrate	0.5	beginning of flowering			

tion. The first treatment with fungicides was carried out at the stem elongation stage, together with herbicides; the second one was provided at the beginning of flowering.

The fungicides applied contributed to a significant improvement in the phytosanitary state of winter wheat throughout the entire growing season. Of the studied fungicides, the best were Amistar Extra 280 ЗС, suspension concentrate, Falcon, 46 % suspension concentrate, Impact, 25 % emulsion concentrate (Table 3).

Peak effectiveness of protection against the complex of fungal diseases was reached in variants of double application of fungicides - in the phase of stem elongation and at the beginning of flowering of winter wheat, which reduced the development of powdery mildew by 93.2-97.9 %, that of septoriosis by 89.0-98.0; and that of orange leaf rust by 93.8-98.3 %.

It was established that the agrotechnical factors investigated (plant protection and microfertilizers) significantly influenced seed productivity in Khersonska 99 and Konka varieties (Table 4).

The study proves that Konka variety formed an average yield of seeds at the level of 3.59 t / ha, and in Khersonska 99 this indicator was 3.32 t / ha, i.e. 8.2 % less.

The use of chemical and biological protection had a varying effect on seed yield of the test crop. Here, we got an average of 3.27 t / ha of winter wheat seeds by factor B under traditional fungicidal protection.

The application of Gaupsin allowed increasing this indicator by 6.7 %, while the combined use of biopreparations Trichodermin and Gaupsin helped to form the maximum seed yield of (3.65 t/ha), which is 6.7-11.6 % more than in other variants studied.

The application of microelements resulted in an increase in seed productivity of the studied crop from 3.08 t/ha in the control to 3.35-3.82 t/ha on the plots treated with Riverm, Nanovit Micro and Avatar. So, the use of these preparations contributed to a significant increase in seed yield - by 8.7-24.1 %. Avatar had an advantage over other micronutrients under study: it allowed obtaining 7.3-14.2 % more seeds than under the application of Riverm and Nanovit Micro.

Dispersion analysis has shown that on the average, over three years of research, the influence of varietal composition, application of plant protection products and microfertilizers manifested itself unevenly (Figure 2).

4. Seed yield of winter wheat depending on varietal composition, plant protection and microelements, t/ha (average for 2014-2016)

Variety (factor A)	Plant protection (factor B)	Microelements (factor C)					Average by factors	
		control (without treatment)	Riverm	Nanovit Micro	Avatar	average	A	B
Khersonska 99	Fungicide	2.81	3.02	3.24	3.56	3.16	3.32	3.27
	Gaupsin	2.89	3.21	3.38	3.60	3.27		3.42
	Trichodermin+ Gaupsin	3.13	3.40	3.67	3.87	3.52		3.65
Konka	Fungicide	3.01	3.25	3.48	3.82	3.39	3.59	
	Gaupsin	3.21	3.50	3.68	3.93	3.58		
	Trichodermin + Gaupsin	3.42	3.69	3.90	4.14	3.79		
Average by factorC		3.08	3.35	3.56	3.82	3.45		
Least significant difference 05 for partial differences by factors: A – 0.09; B – 0.03; C – 0.05								

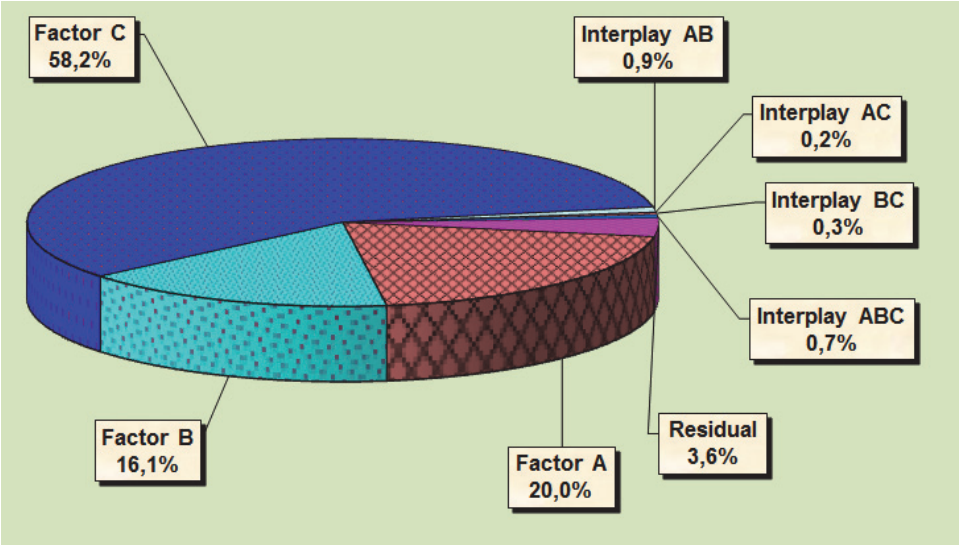

Fig. 2. Share of the impact of varietal composition (factor A), plant protection (factor B) and microfertilizers (factor C) on grain yield formation in winter wheat,% (average for 2014–2016).

Calculations testify that microfertilizers (factor C) had the greatest impact on the seed yield of the investigated crop (58.2 %). Varietal composition (factor A) was the second (20.0 %).

Chemical and biological means of plant protection (factor B) also significantly influenced the productivity of plants (16.1 %). The interaction of the factors was low, which could be explained by different reactions of plants to the investigated plant protection agents and microfertilizers; the residual effect of unrecognized factors, mainly weather conditions and differences in cultivation technology elements, was 3.6 %.

Conclusion and prospects for further research. The research findings show that the application of seed disinfectant Serticor 050 FS (1 l/t), fungicide Alto Super 330 EC, emulsion concentrate, together with herbicide Peak 75 % water-soluble granules (0.45 l/ha + 0.020 kg/ha) in the stem elongation phase, and fungicide Amistar Extra 280 SC, suspension concentrate (0.5 l/ha) at the beginning of flowering, as well as the use of insecticide Enzhio, 24.7 % suspension concentrate (0.18 l/ha) at the beginning of milky ripeness of grain have provided the highest effectiveness in irrigated winter wheat protection against harmful organisms. Winter wheat variety Konka formed a seed yield of 3.59 t/ha, which is 8.2 % more than in Khersonska 99. The use of chemical and biological protection unevenly affected the seed productivity of the examined crop, the combined application of biopreparations Trichodermin and Gaupsin being the most effective. Avatar had an advantage over other micronutrients under study: it allowed obtaining 7.3-14.2 % more seeds than under the application of other preparations. Dispersion analysis determined that microfertilizers take up the greatest proportion (58.2 %) in the impact on winter wheat yield formation.

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АНОТАЦІЯ

О. Є. Марковська, М. Й. Піковський, О. О. Нікішов. *Оптимізація системи захисту пшениці озимої від шкідливих організмів на зрошенні в умовах півдня України. Біоресурси і природокористування. 2018.* ***10****, № 5–6. P. 122–128. https://doi.org/10.31548/bio2018.05.015*

За результатами досліджень встановлено, що найвищу ефективність дії у захисті пшениці озимої від шкідливих організмів за умов зрошення забезпечило застосування протруйника Сертікор 050 FS (1л/т), фунгіциду Альто Супер 330 ЕС, к.е. разом із гербіцидом Пік 75 % в.г. (0,45 л/га +0,020 кг/га) у фазу виходу в трубку, а також фунгіциду Амістар Екстра 280 SC к.с. (0,5 л/га) на початку цвітіння культури та інсектициду Енжіо, 24,7 % к.с. (0,18 л/га) – на початку молочної стиглості зерна. Визначено, що сорт Конка мав врожайність насіння на рівні 3,59 т/га, що на 8,2 % більше за сорт Херсонська 99. Із біопрепаратів ефективним виявилося сумісне застосування Триходерміну та Гаупсину. Серед досліджуваних мікроелементів перевагу мав препарат Аватар, який забезпечував прибавку насіння в межах 7,3-14,2 %. Дисперсійним аналізом доведено, що найбільша частка впливу формування врожаю пшениці озимої належить мікродобривам (58,2 %). Також високим був вплив сортового складу (20,0 %) та захисту рослин (16,1 %).

Ключові слова: *пшениця озима, хвороби, шкідники, бур'яни, препарати, ефективність дії*

АННОТАЦИЯ

Е. Е. Марковская, М. И. Пиковский, А. А. Никишов. *Оптимизация системы защиты пшеницы озимой от вредных организмов на орошении в условиях юга Украины. Биоресурсы и природопользование. 2018.* ***10****, № 5–6. P. 122–128. https://doi.org/10.31548/bio2018.05.015*

По результатам исследований установлено, что наибольшую эффективность действия в защите пшеницы озимой от вредных организмов в условиях орошения обеспечило использование протравителя Сертикор 050 FS (1л/т), фунгицида Альто Супер 330 ЕС, к.э. вместе с гербицидом Пик 75 % в.г. (0,45 л/га +0,020 кг/га) в фазу выхода в трубку, а также фунгицида Амистар Экстра 280 SC к.с. (0,5 л/га) в начале цветения культуры и инсектицида Энжио, 24,7 % к.с. (0,18 л/га) – в начале молочной спелости зерна. Определено, что сорт Конка имел урожайность зерна на уровне 3,59 т/га, что на 8,2 % больше, чем у сорта Херсонская 99. Из биопрепаратов эффективным оказалось совместное применение Триходермина и Гаупсина. Среди исследуемых микроэлементов преимущество имел препарат Аватар, который обеспечил прибавку урожая зерна в пределах 7,3-14,2 %. Дисперсионным анализом доказано, что наибольшая часть влияния на формирование урожая пшеницы озимой принадлежит микроудобрениям (58,2 %). Также высоким было влияние сортового состава (20 %) и защиты растений (16,1 %).

Ключевые слова: *пшеница озимая, болезни, вредители, сорняки, препараты, эффективность действия*