

THE USING OF BIO PREPARATIONS AGAINST SUMMING PESTS (THRIPS AND APHIDS) IN GROWING WINTER WHEAT

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Summary. The results of using biopesticides on winter wheat against thrips and aphids are presented. It was determined that pre-sowing treatment of seeds with biological preparations does not lead to a change in the number of thrips and aphids. To control their number, it is advisable to use bioinsecticides: against aphids, the most effective was the triple use of a mixture of 3% solutions of Lincomycin BT + Bezimid BT (1:1), where the efficiency was 83.3%, and the effectiveness of biological preparations against thrips ranged from 40.6% to 55.8%. The combined use of biological and chemical insecticide increases the effectiveness of the biological preparation while reducing the chemical load. Early sowing of winter wheat contributes to increase in the population of imago plants and thrips larvae and, to a lesser extent, aphids.

Introduction

Wheat is the most common grain crop in temperate climates. Insect pests pose a significant threat to its production worldwide, resulting in significant economic losses and reduced yields. Particular damage is caused by sucking pests (thrips and aphids), which lead to the suppression of plants, the spread of diseases and a decrease in yield. Crop damage from insect pests is expected to increase in regions due to climate warming of 2°C. A change in the future reduction of wheat yield in Europe by 18% is predicted [1]. In connection with climate change, the widespread use of chemical means of pest control, it is urgent to constantly monitor the main pests of wheat and search for safe means of control and their place in the strategy of integrated pest management (IPM) in order to minimize dependence on pesticides and reduce the impact on the environment. The use of biopesticides in organic farming is especially relevant. The purpose of our research: to determine the effectiveness of using biopesticides produced by the Engineering and Technology Institute "Biotechnika" of NAAS against thrips and aphids when growing winter wheat in the South of Ukraine.

According to the types of the active base, biopesticides are divided into three main groups: bacterial, fungal, and viral, and according to the mechanisms of action: drugs of intestinal, contact, and combined action. Biological preparations against pests of agricultural crops are used for pre-sowing treatment of seeds and spraying of plants during the growing season. The effectiveness of biological preparations depends on weather conditions (precipitation, wind, temperature), number, development periods of pests [2], quality and frequency of treatments [3]. Various authors are conducting research on the study of the action and use of biological preparations in agricultural production, for example, against sucking phytophages [4], mites [5], a complex of pests [6] and others.

According to the results of research by the Department of Plant Protection of the NSC "Institute of Agriculture" to determine the effectiveness of biological preparations in the protection of winter wheat from pests during the spring-summer growing season, it was established that the

biological preparations Bitoxybacillin-BTU, Lepidocide, Naturgard and Haupsin showed high technical efficiency against the imago of the bread beetle – 81.3-83.7%, cereal aphids – 74.3-80.6 and cereal thrips – 72.5-78.8% [7]. Experiments conducted in the Dry Steppe zone on winter wheat crops under irrigation showed a significant dependence of the effectiveness of the biopreparation Bitoxibacillin-BTU on the date of cultivation, which was determined by the timing of sowing; technical efficiency ranged from 17.4 to 35.2% [8].

A significant number of experiments concern the study of the influence of biological preparations on the productivity of both winter wheat and other agricultural crops alone or in combination with growth-regulating drugs, poisons, various types of fertilizers, and so on. All authors note their positive effect, which, as a rule, fluctuated in a wide interval, which is due to both weather and climate and soil features of the growing zone [9-19]. But there is not enough data on the effectiveness of biological preparations in relation to sucking pests according to the phases of development of winter wheat, according to the features of zonal or regional weather conditions, in symbiosis with intensive or resource-limited elements of culture cultivation technology, which actualizes the conduct of research to determine the effectiveness of the use of biopesticides to protect winter wheat from thrips and aphids in the Southern steppe of Ukraine. In the specified region, the main developer and manufacturer of biological preparations for plant protection (biofungicides, bioinsecticides, biorodenticides, entomological preparations) and the coordinating scientific center for industrial biotechnologies is ITI "Biotechnique" of the National Academy of Sciences. The task of the study was to determine the effectiveness of biological preparations against sucking pests used for seed treatment and limiting the number of insects during the growing season.

Materials and methods

Field experiments were conducted at the experimental field of the Odesa State Agricultural Research Station of the National Academy of Sciences, which is located in the Odesa district, Odesa region. All records and surveys were carried out on experimental plots, where the influence of sowing dates, preparations of various origins when used for pre-sowing treatment and plant vegetation treatment on the phytosanitary condition of winter wheat are studied. In 2021-2022, observations were made on the plots where winter wheat was sown with various options for pre-sowing seed treatment: 1) Vitavax 200FF impregnant; 2) organo-mineral fertilizer based on fulvic acids and fullerene for pre-sowing treatment of seeds – Seed Treatment, improved Seed Treatment and Vitazym biological preparation. Plant protection was carried out with pesticides on the areas treated with chemical pesticides, on others - with biological preparations (Metarizyn BT, Actophyt BT). In 2022-2023 and 2023-2024 agricultural years, bioinsecticides Actophyt BT, Metarizyn BT and mixtures of bioinsecticides in a ratio of 1:1: Actophyt BT + Bitoxybacillin BT, Boverin BT + Metarizyn BT, Lycanicillin BT + Bezimid BT, and SmartGrow were used in experiments Defender. All bioinsecticides were used in the form of 3% solutions three times during the growing season of winter wheat from the beginning of emergence into the tube until milky maturity. The pure control variant was treated with water during the periods of drugs application, in the variant of chemical protection, contact and systemic insecticide of double action "Anticolorad" (0.25 l/ha).

When carrying out the pests accounting, generally accepted methods were used in the tillering phase (end of March), emergence into the tube (beginning of May), earing, beginning of pouring grain (end of May). Barber traps were used to collect herpetobiont mesofauna in the periods of germination, flowering and grain filling (duration 8 days). During flowering and the grain pouring beginning, hortobionts were also selected (mowing with an entomological net, counting on 100 swings). In order to determine the number of thrips and aphids, in addition to mowing, a count per spike was used at the end of pouring - at the beginning of the milky - waxy grain ripeness.

Results and discussion

The most dangerous pests in the conditions of the experimental field of the Odesa State Agricultural Research Station during 2020-2024 are a complex of sucking insects: thrips, aphids, leafhoppers, bugs, among which the wheat thrips *Haplothrips tritici* (Kurd.) (Derwesh, 1965) and

the large cereal aphid dominated *Sitobion avenae* (Fabricius, 1775). The number of larvae of *H. tritici* reached 28 samples/ spike, and according to the results of mowing (adults + larvae) – 164 samples /100 swings of the net, and aphids – 685 samples /100 swings of the net.

Differences in the sucking phytophages number were observed in grassy wheat when pouring grain in different areas. Thus, the number of aphids in the Seed Treatment variant was the same as in the control plots (chemical stain remover), and in the improved Seed Treatment variant it was twice as low as in the control plot; with the drug Vitazym - three times lower than in the control area. More drastic differences were observed for thrips. In the Seed Treatment variant, their number is almost 3-4 times lower than in the control; the drug Seed Treatment is improved - 10 times, with the drug Vitazym - 7 times lower. The abundance of predators (the young) is also much higher in the control and in the Seed Treatment option, that is, where the abundance of aphids is highest. Similar results were noted when counting thrips in spikes. Thus, in variants with Seed Treatment improved and Vitazym, their number was 43 and 40 samples / spike, that is, almost three times lower than in the control (115 samples / spike). It should also be taken into account that the crops where biological preparations were used for pre-sowing treatment during the growing season were treated with bioinsecticides Actophyt and Metarizyn and in these areas there is an increase in yield by 4.4% and 9.3%, respectively, compared to the pure control, which is the result of a decrease number of thrips and aphids.

Pre-sowing treatment of wheat seeds ensures the plants strengthening, especially this is important during the dry period, which was observed in the 2021/2022 agricultural year. Biological preparations were the most effective, where a smaller number of aphids and thrips was observed. On the contrary, a greater number of bugs and grain beetles (*Dolichosoma lineare* Rossi, Melyridae) were registered in the field treated with Seed Treatment. Based on the results of the 2021/2022 agricultural year, it can be concluded that the use of Vitavax 200FF and Seed Treatment for pre-sowing treatment did not significantly affect the species composition of entomocomplexes. When using the Seed Treatment biological complex, compared to Vitavax 200FF, a tendency to increase the number of bugs, grain beetles, sawflies and flies and decrease the number of aphids and thrips was observed.

Research in 2022-2023 agricultural year. The entomocomplex on winter wheat crops under the conditions of ODSDS was more diverse and consists of 101 species. The species diversity index (Fisher, Corbet, Williams) is 10. Coleoptera (58 species), Diptera (17), Hemiptera (8), Homoptera (6), Hymenoptera (6) dominated, and the rest are represented by a small number of species: Orthoptera (2), Thysanoptera (3), Lepidoptera (2): phytophages accounted for 54% of the species found. saprophages occupied an insignificant share (19% of species). Thrips and aphids were dominant.

In the period of flowering - the beginning of grain pouring, the maximum phytophages harmfulness is observed. The plants were examined for the presence of the main pests of thrips, aphids, and spikelets damaged by the shell bug. For wheat thrips, there was no difference in the number (examples/ spike) of the pre-sowing treatment options. The use of Metarizyn + chemical insecticide was effective: a decrease in the number (0.5 - 6.5) was observed more than 10 times compared to the control (10.5 - 18.3) and the variant Bitoxybacillin (3%) + Actophyt (1.0%) (17.6 – 27.8) (Table 1).

Table 1

Accounting of thrips (examples / spike) during the period of the beginning of flowering of winter wheat (25.5.2023)

Variants	Control	Vitazym	Seed Treatment	Vitavax
Control	18,3	16,2	11	14,8
Actophyt BT + Bitoxybacillin BT	22,2	17,6	22,5	18,7
Metarizyn BT + chemical insecticide (Anticolorad)	6,5	2	0,6	0,5

To regulate the number of aphids, the use of all three options, which can be arranged in a row, was positive: chemical insecticide; Metarizyn + chemical insecticide; Actophyt + Bitoxibacillin (Table 2). That is, a mixture of biological preparations (Aktophyt + Bitoxibacillin) showed almost the same effect on aphids as a chemical preparation.

Table 2

Accounting of aphids (examples/10 spikes) during the period of the beginning of flowering of winter wheat (25.5.2023)

Variants	Control	Vitazym	Seed Treatment	Vitavax
Control	21,5	15,6	10	9
Chemical insecticide	0	0	1	0
Actophyt BT + Bitoxybacillin BT	0,7	0	2	0,3
Metarizyn BT + Anticolorad (chemical insecticide)	0	0	0	0

Shell bugs were observed in greater numbers in 2023 compared to 2022 y., of course damage was also reported. The same low level of damage to spikelets by bugs was observed in the variants Metarizyn + chemical insecticide (0 - 5 ex/10 m²) and Actophyt + Bitoxibacillin (0 - 3 ex/10 m²) compared to the control (0 - 7 ex/10 m²).

In the 2023 weather conditions no significant influence of the type of pre-sowing treatment of winter wheat seeds on the entomocomplex of winter wheat was noted. Spraying growing plants of winter wheat with a mixture of bioinsecticide and chemical pesticide: Metarizyn + Anticolorad showed positive results regarding the regulation of the number of such pests as aphids, thrips, and damage by the bug-shell, but it had a negative effect on the entomocomplex in general - the dynamic density of insects decreased by half, the species diversity decreased, predators of Coccinellidae, Histeridae, Staphylinidae were not registered and the density of spiders (Aranei) decreased. The yield increase was 23%. The use of the mixture Actophyt + Bitoxybacillin was more environmentally friendly - the structure of the entomocomplex was preserved, the number of aphids and shell bug damage decreased significantly, but the number of thrips remained at a high level. 14% crop increase.

Research in 2023-2024 agricultural year. In the spikelets period, compared to 2023, the diversity of insects is significantly less; 20 species of insects from 8 orders, 16 families were registered. There were 12 species of pests, 6 species of predators and parasites. The most dangerous were the wheat thrips, the harmful turtle bug, the leech, and the common sawflies.

The use of the chemical preparation Anticolorad negatively affects the entire entomocomplex (diversity, number), but significantly reduces the number of such pests as thrips, bugs, grain beetles, leafhoppers, sawflies. Bioinsecticides did not significantly affect the diversity of insects, but their use led to a significant reduction in the number of sawflies and changes in the distribution of thrips species (Table 3).

Table 3

The number of aphids and thrips on winter wheat (period of milk ripeness, 05.14.2024) in different variants of the use of protection means

Processing options	Eexamples / 100 spikelets		Efficiency,%		Crop increase, %
	Aphid	Thrips	Aphid	Thrips	
Control, clean	30	1370	0	0	0
Control, Anticolorad	12,7	278	53,3	79,7	16,6
Actophyt BT + Bitoxybacillin BT	10	606,3	66,7	55,8	9,9
Boverin BT+ Metarizin BT	17,3	814	42,3	40,6	14,7
Lincomycin BT + Bezimid BT	5	757	83,3	44,7	12,8
Defender	15	726	50	47	14,9

LCD _{0.95}	14,3	333,6			-
F _{critical}	3,1		-		-
F _{factual}	6,8	21,7			
V, %	18,2-53,6	7,9-38,0			

The intensity of damage to plants by sucking insects depends on the state of plant development. A study of thrips and aphids of winter wheat of Dovira Odeska of different sowing dates showed that in a dry year, the most pests were registered in the early (25.09.) after almost simultaneous emergence of wheat. In the period of mass flight of thrips adults, which mostly occurs at an average daily temperature above 15°C, preference is given to wheat of earlier sowing periods (Table 4). This leads to a higher number of thrips larvae in these variants. The plants in the variant of the early sowing period were more developed and stronger. Research from previous years (1975) showed that thrips better colonize winter wheat in late sowing periods (October 30) than in early ones (September 5). These differences are explained by climatic changes. In 2024, the average monthly air temperatures of the spring months reached values that significantly exceeded the long-term average: March – 7.4 °C versus 4.6 °C; April – 15.7 °C versus 9.0 °C and May – 16.6°C versus 15.3°C. The calendar summer actually began on March 29, when average daily temperatures exceeded 15.0°C.

Table 4

Colonization of winter wheat of different sowing dates by thrips and aphids

Sowing terms	25.09.2023	5.10.2023	15.10.2023	25.10.2023
Thrips, larvae ex/100 spikelets 11.6.2024	590	250	85	55
Thrips, imago ex./100 swings of the net 16.5.2024	101	81	68	66
Aphids, ex/100, ex/100 swings of the net	76	65	61	56

Counts of aphids showed the absence of preferences in the settlement of wheat of different sowing periods, a tendency to increase in numbers was noted in the early (76 samples against 56 in the late). The low number of aphids in 2024 is explained by the fact that in late April - early May there were heavy rains, which negatively affect the condition of aphid colonies.

Conclusions

A three-year study showed pre-sowing treatments of winter wheat seeds with biological preparations do not lead to a change in the number of sucking pests (thrips and aphids) during the growing season. To control the number of thrips and aphids, it is advisable to use bioinsecticides: against aphids, the most effective was the triple use of a mixture of 3% solutions of Lincomycin BT + Bezimid BT (1:1), where the efficiency was 83.3%, and the effectiveness of biological preparations against thrips ranged from 40.6 % to 55.8%. The combined use of biological and chemical insecticide increases the effectiveness of the biological preparation while reducing the chemical load. Early sowing of winter wheat contributes to an increase in the population of imago plants and thrips larvae and, to a lesser extent, aphids.

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