Article Type: Research

J Name: Modern Phytomorphology

Short name: MP

ISSN: ISSN 2226-3063/eISSN 2227-9555

Year: 2025

Volume: 19

Page numbers: 402-405

DOI: 10.5281/zenodo.200402
(10.5281/zenodo.2025-19)

Short Title: Productivity of winter wheat varieties depending on biological and chemical plant protection systems against diseases and pests

RESEARCH ARTICLE

Productivity of winter wheat varieties depending on biological and chemical plant protection systems against diseases and pests

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Received: 12.05.2025, Manuscript No. mp-25-165407 | **Editor Assigned:** 14.05.2025, Pre-QC No. mp-25-165407 (PQ) | **Reviewed:** 28.06.2025, QC No. mp-25-165407 (Q) | **Revised:** 04.06.2025, Manuscript No. mp-25-165407 (R) | **Published:** 11.06.2025

Abstract

The effectiveness of the use of both biological and chemical means of protection of innovative varieties of winter soft wheat in the Left Bank Forest-Steppe of Ukraine has been proven. Without protection means, on average, the grain yield was 6.16 t/ha, with biological protection it increased by 6.6% (up to 6.58 t/ha), and the maximum value was reached with a chemical protection system, increasing by 12.0% (up to 6.86 t/ha). The difference between biological and chemical plant protection was minimal and amounted to 0.33 t/ha or 5.0%. Plant protection contributed to a significant increase in the mass of 1000 grains with the use of biological and chemical preparations. In the variant without protection, this indicator was on average 41.16 g, and in the variants with biological and chemical plant protection from harmful organisms, its increase was recorded by 2.2 and 3.2 g, respectively.

Keywords: Winter wheat varieties, Protection systems, Variety, 1000-seed weight, Yield

Introduction

The main grain crop in Ukraine is soft winter wheat. In terms of the size of the sown areas and the volume of the gross grain harvest, it significantly exceeds other grain crops. Existing varieties are capable of providing a yield of 8-9 t/ha and more, but the imperfection of its cultivation technologies, adverse climatic conditions, and various stress phenomena do not allow the full potential of the crop to be realized. With modern cultivation technology, an important issue is reliable protection of winter grain crops from harmful organisms, which in the future determines the level of crop yield (Hadzalo, et al. 2023).

An important place in increasing the yield and improving the quality of grain belongs to the improvement of winter wheat growing technology. Success in obtaining high yields of high-quality grain is possible with the help of varietal resources and integrated systems of plant protection against harmful organisms (Zayets et al. 2024, Kurmanbayeva, et al. 2021, Kuznetsov et al. 2021).

Therefore, obtaining high productivity of wheat agrophytocenoses is possible by using innovative varieties with high genetic

potential for productivity and taking into account their biological characteristics of reaction to soil and climatic conditions (Li, et al. 2022, Wang, et al. 2021, Lavrynenko, et al. 2021).

The aim of the research was to determine the productivity of innovative winter wheat varieties depending on plant protection methods in the conditions of the Left-Bank Forest-Steppe of Ukraine.

Materials and Methods

Field experiments and evaluation of winter wheat varietal samples were carried out during 2021–2023 at the experimental field of the Institute of Bast Crops of the NAAS, the city of Hlukhiv, which is territorially located in the Left Bank Forest-Steppe of Ukraine. Winter wheat varieties were grown in crop rotation with a typical crop rotation for the zone and a predecessor–flax (long flax). The area of the accounting plot is 10 m2, four-fold repetition. The seed sowing rate is 5.5 million similar seeds per hectare. Innovative varieties of winter wheat of soft selection of the Institute of Climate-Smart Agriculture of the NAAS were studied: Soborna, Ledya, Rosinka. The biological preparation Trichopsin BT was used, as well as chemical pesticides: fungicide–Lamardor PRO, and insecticide–Fastak. Field studies were carried out according to generally accepted methods (Rozhkov, 2016).

Results and Discussion

According to the results of the analysis of the experimental data obtained, it was established that on average over the years of research, the maximum grain yield of over 7 t/ha was formed by the Rosinka variety under biological and chemical plant protection (Tab. 1).

Table 1. Grain yield of wheat varieties depending on the plant protection system, t/ha.

Plant Protection (Factor A)	Grade (factor B)	A year of research			A	B
		2021	2022	2023		
Control (water treatment)	Cathedral	5.85	6.11	6.18	6.05	6.43
	Ledya	5.90	6.24	6.34	6.16	
	Rosinka	5.99	6.31	6.47	6.26	
	Medium	5.91	6.22	6.33	6.16	
Biosecurity	Cathedral	6.17	6.58	6.65	6.47	6.52
	Ledya	6.22	6.61	6.78	6.54	
	Rosinka	6.37	6.78	7.01	6.72	
	Medium	6.25	6.66	6.80	6.58	
Chemical protection	Cathedral	6.63	6.82	6.94	6.80	6.65
	Ledya	6.77	6.85	6.99	6.87	
	Rosinka	6.91	6.98	7.06	6.98	
	Medium	6.77	6.89	7.02	6.86	
	Medium	6.31	6.59	6.71		

LSD_{05}, t/ha: partial differences: A-0.18; B-0.20; main effects: A-0.13; B-0.15

The minimum grain yield (5.85 t/ha) was formed in 2021 in the control variant of the Soborna variety, and the maximum was obtained in the Rosinka variety under chemical protection in 2023 (7.06 t/ha). In terms of varietal composition, the Rosyanka variety had the advantage in terms of winter wheat grain yield, which formed an average of 6.65 t/ha by factors. In the variant with the Ledya variety, the studied indicator decreased by 1.53% (to 6.52 t/ha). The minimum average factorial yield value (6.43 t/ha) was noted on plots with the Soborna variety, which is 2.56% less than the Rosyanka variety.

For factor A (plant protection), the effectiveness of both biological and chemical plant protection products has been proven. In the control variant (without protection products), the average grain yield of the studied crop was 6.16 t/ha, with biological protection it increased by 6.6% (to 6.58 t/ha), and reached its maximum value with the chemical protection system-to 6.86 t/ha, which is 12.0% more than the control. The difference between biological and chemical plant protection was minimal and amounted to 0.33 t/ha or 5.0%. Chemical plant protection on the Soborna variety provided maximum efficiency–yield increase was 0.75 t/ha (12.4%). Chemical plant protection on the Ledya variety showed yield increase of 0.71 t/ha (11.5%). Chemical plant protection on the Rosinka variety provided yield increase of 0.72 t/ha (11.5%). Biological plant protection on the Soborna variety provided a yield increase of 0.42 t/ha (6.94%). Bi-

ological plant protection on the Ledya variety showed a yield increase of 0.38 t/ha (6.17%), and on the Rosinka variety provided a yield increase of 0.46 t/ha (7.35%).

It should be noted that biological protection of plants from diseases and pests, in addition to the additional grain harvest, contributed to obtaining environmentally safe products and preserved the environment. This indicates the prospects for the use of biological preparations in growing winter wheat on irrigated lands of the Southern Steppe of Ukraine.

Research on the structural element of productivity–the weight of 1000 grains significantly depends on the variety and protection system (Tab. 2).

Table 2. Weight of 1000 grains of wheat varieties depending on the plant protection system, g.

Plant Protection (Factor A)	Grade (factor B)	A year of research			A	B
		2021	2022	2023		
Control (water treatment)	Cathedral	39.0	39.3	39.5	39.27	41.72
	Ledya	40.5	41.1	41.8	41.13	
	Rosinka	42.7	43.1	43.4	43.07	
	Medium	40.7	41.2	41.6	41.16	
Biosecurity	Cathedral	41.9	41.9	42.5	42.10	43.94
	Ledya	45.3	45.6	45.9	45.60	
	Rosinka	46.3	46.6	47.8	46.90	
	Medium	44.5	44.7	45.4	44.87	
Chemical protection	Cathedral	43.1	44.2	44.1	43.80	45.79
	Ledya	45.2	45.0	45.1	45.10	
	Rosinka	46.9	47.3	48.0	47.40	
	Medium	45.1	45.5	45.7	45.43	
	Medium	43.4	43.8	44.2		

LSD_{05}, t/ha: partial differences: A-1.25; B-1.02; main effects: A-1.13; B-0.93

The maximum weight of 1000 grains at the level of 46.9–48.0 g was recorded in the Rosinka variety against the background of chemical plant protection against harmful organisms. The minimum values of this indicator within 39.0–39.5 g were obtained in the Soborna variety in the control variant. When comparing the mass of 1000 grains, the advantage of the Rosinka variety was mathematically proven, in which this indicator increased on average by a factor of 4.2–9.7% compared to the Soborna and Ledya varieties.

Conclusion

Plant protection contributed to a significant increase in the mass of 1000 grains when using biological and chemical plant protection products. In the control variant, this indicator averaged 41.16 g, and in variants with biological and chemical plant protection from harmful organisms, its increase was recorded by 2.2 and 3.2 g, respectively. The effectiveness of the use of both biological and chemical plant protection products for wheat has been proven. In the control variant (without protection products), on average, the grain yield of the studied crop was 6.16 t/ha, with biological protection it increased by 6.6% (to 6.58 t/ha), and reached its maximum value with the chemical protection system–up to 6.86 t/ha, which is 12.0% more than the control. The difference between biological and chemical plant protection was minimal and amounted to 0.33 t/ha or 5.0%. The maximum grain yield was obtained in the Rosinka variety with chemical protection (7.06 t/ha).

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