

soybean plants. Plant survival during the growing season was significantly influenced by both the soybean cultivar and the applied preparation, with the highest average values recorded under the use of Antistress 03.

Among the studied cultivars, 'Zlatopil'ska' showed the most favorable response to anti-stress treatments, ensuring optimal stand density, improved yield structure components, and the highest grain yield. The application of Antistress 03 and Organic Balance Monophosphorus contributed to an

increase in the number of pods and seeds per plant, seed weight per plant, and overall yield.

The maximum soybean yield was obtained in the 'Zlatopil'ska' cultivar with the double application of Antistress 03, which provided a considerable increase compared to the control treatment. Therefore, the use of anti-stress growth regulators, particularly Antistress 03, can be recommended as an effective element of soybean cultivation technology to enhance yield stability under specific soil and climatic conditions.

UDK 635.655:661

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EFFECTS OF PRE-SOWING BIOLOGICAL SEED TREATMENT AND AMINO ACID FOLIAR APPLICATION ON BUCKWHEAT PRODUCTIVITY

Buckwheat is among the most important cereal and melliferous crops cultivated in Ukraine. The development of niche crops, particularly the production of buckwheat groats, represents a highly promising approach to strengthening national food security, decreasing reliance on imported agricultural products, enhancing the resilience of the agricultural sector, and supporting its sustainable development under current challenges. Buckwheat fully complies with the principles of organic farming, as its cultivation considerably reduces anthropogenic pressure on soil biota and contributes to the conservation of soil fertility.

Organic agriculture should not be viewed merely as a compromise between intensive and resource-saving land use systems. Instead, it is a comprehensive transformation of priorities, balancing economic viability with soil protection and restoration. The focus shifts from short-term profitability to the enhancement of natural soil fertility, responsible land management, and strict adherence to food quality and safety standards, which are especially relevant under modern conditions.

The relevance of this study is determined by the growing importance of buckwheat as a strategic food and melliferous crop, as well as by the need to increase its productivity under conditions of sustainable and environmentally friendly agriculture. In Ukraine and worldwide, there is increasing interest in niche crops that contribute to food security, reduce dependence on imported products, and ensure stable agricultural production under changing climatic conditions.

The use of biological preparations for seed treatment and foliar nutrition is a promising approach that meets the principles of organic farming, as it allows yield improvement while reducing anthropogenic pressure on agroecosystems. Buckwheat is characterized by high ecological plasticity and a low demand for mineral fertilizers, making it an ideal crop for the application of biological technologies.

At the same time, scientific data on the response of different buckwheat varieties to biological seed treatments remain limited. Therefore, studying the effectiveness of pre-sowing biological seed treatment and foliar application, as well as identifying varietal differences in yield response, is highly relevant. The obtained results can be used to improve cultivation technologies, enhance the phytoremediation potential of buckwheat, and increase the efficiency of its use in sustainable and organic farming systems.

The migration behavior of heavy metals is determined by their ability to adsorb onto organo-mineral soil complexes. Therefore, investigating the adsorption properties of soil minerals is essential for understanding phytoremediation mechanisms. Adsorption onto the soil matrix leads to the accumulation of heavy metals, whereas the formation of stable complexes with non-adsorbed organic matter enhances metal mobility and facilitates their transfer into plant root systems. Consequently, the evaluation of soils using plant-based test systems remains an important research direction requiring further investigation.

The aim of the study was to evaluate the effectiveness of pre-sowing seed treatment with biological preparations and foliar application in increasing buckwheat productivity and improving seed quality.

Field experiments were conducted during 2023–2025 at the facilities of the Educational and Scientific Laboratory «Demonstration Collection Plot of Agricultural Crops» in accordance with generally accepted field research methodologies. Four buckwheat varieties were selected for the study: 'Dykul', 'Syn 3/02', 'Kamianchanka', and 'Volodar'. Pre-sowing seed treatment was carried out using the preparations Bionorma Nitrogen and Bionorma Phosphorus at a rate of 1 L per tonne of seed.

The greatest increase in yield was observed in the 'Volodar' variety, where grain yield reached 2.02–2.25 t/ha following treatment with Bionorma Phosphorus and Bionorma Nitrogen preparations. In the 'Kamianchanka' variety, yield ranged from

1.68 to 1.88 t/ha, depending on the applied preparation. Favorable weather conditions during the years of the study ensured effective pollination and optimal crop formation.

It was established that pre-sowing seed treatment with Bionorma Nitrogen and Bionorma Phosphorus had a positive effect on yield levels, with the most pronounced response recorded in the 'Volodar' variety, where yield increases amounted to 26.1–31.6%. The results obtained will be used in further studies aimed at enhancing the phytoremediation potential of buckwheat and improving the efficiency of its utilization.

The results of the study demonstrated that pre-sowing seed treatment with the biological preparations Bionorma Nitrogen and Bionorma Phosphorus had a positive effect on buckwheat productivity across the studied varieties. The most pronounced

response was observed in the 'Volodar' variety, which showed the highest yield levels and the greatest yield increase compared with the control.

Yield performance varied depending on the variety and the applied biological preparation, indicating varietal specificity in response to biological seed treatments. Favorable weather conditions during the years of research contributed to effective pollination, proper crop development, and optimal yield formation.

Overall, the use of biological pre-sowing seed treatments can be considered an effective and environmentally friendly approach to increasing buckwheat productivity. The obtained results provide a scientific basis for further research aimed at enhancing the phytoremediation potential of buckwheat and improving the efficiency of its use in sustainable and organic farming systems.

UDC: 634.8: 581.143.6

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IN VITRO INTRODUCTION OF SELECTED GRAPEVINE (*VITIS VINIFERA* L.) GENOTYPES FOR GERMPLASM CONSERVATION AND RAPID PROPAGATION

Grapevine (*Vitis vinifera* L.) represents one of the most economically and culturally important perennial crops worldwide. Modern viticulture faces increasing challenges associated with climate change, emerging pathogens, genetic erosion of traditional cultivars, and the need for sustainable production systems. The preservation of valuable genotypes, including both wine varieties and rootstocks with specific adaptive traits, is therefore of critical importance. Conventional field conservation is often limited by environmental risks, pathogen pressure, and high maintenance costs. In this context, plant tissue culture techniques, particularly *in vitro* cultivation, offer a reliable alternative for the safe conservation, rapid propagation, and distribution of high-quality, pathogen-free planting material.

In vitro methods enable not only clonal propagation but also the establishment of genetic resource collections under controlled conditions, minimizing the risk of genotype loss due to abiotic stress or disease outbreaks. Furthermore, these techniques are essential for supporting breeding programs, facilitating the exchange of plant material, and enabling long-term conservation strategies such as slow-growth storage or cryopreservation. Despite its advantages, successful *in vitro* establishment of grapevine remains genotype-dependent and technically demanding, particularly in the stages of explant sterilization and initial culture establishment.

The aim of this study was to optimize a protocol for an effective introduction, sterilization, and subsequent multiplication of selected grapevine genotypes under *in vitro* conditions. The work focused on both wine cultivars and interspecific rootstocks, representing a diverse genetic background and varying physiological responses to *in vitro* culture.

The experimental plant material included economically important cultivars of *Vitis vinifera*, namely 'Riesling', 'Kerner', 'Dornfelder', and 'Grüner Veltliner', as well as a range of interspecific rootstocks such as '1103 Paulsen', '5C' (Teleki 5C), 'SO4' (Sélection Oppenheim 4), '125 AA' (Kober 125 AA), '110 Richter', '3309 Couderc', 'Kober 5BB', 'Börner', 'Fercal', 'Binova', and 'LE-K/1'. All listed genotypes were successfully introduced into *in vitro* culture, demonstrating the robustness of the developed methodology across genetically diverse material.

Dormant canes were collected during winter pruning, representing a physiologically stable and contamination-reduced source of explants. Nodal segments were prepared and subjected to a multi-step surface sterilization procedure based on sodium hypochlorite solution combined with a surfactant to enhance disinfection efficiency. Following sterilization, explants were rinsed repeatedly with sterile distilled water to eliminate residual disinfectants and reduce phytotoxic effects.

The explants were cultivated on a nutrient medium derived from the formulation of Quoirin and