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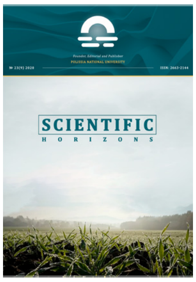

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Reaction of potato varieties to treatment with nitrogen-fixing bacteria and mycorrhizal biopreparations

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Abstract. The commercial value of potato plants for tuber production is substantial enough to explore ways to reduce the cost of the final product by optimising large-scale cultivation systems. Treating tubers with biological products makes it possible to reduce the use of phosphorus fertilisers and shorten the growing season. Furthermore, high-quality and commercially viable plant material can be produced by introducing beneficial microbiota. The objectives of this study were to determine the level of genetic

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potential realisation in early potato varieties when biologically active substances are used in tuber treatment, to identify the maximum achievable potential of the varieties examined, and to diagnose early potato forms. Regarding plant mineral nutrition, mycorrhizal fungi biological preparations represent one of the most important groups of soil microflora and could be applied in agricultural inoculation practices. The results obtained for starch content in the examined potato varieties indicated that treatment with biological preparations had no significant influence on its levels in tubers. However, a positive trend was observed in the dry matter content in almost all tuber treatment variants using biopreparations. The reaction of varieties to the average weight of marketable and individual tubers demonstrated the effectiveness of the preparations in enhancing key marketability indicators across all experimental variants. Treatment with biological preparations does not address the issue of providing all microelements during the potato vegetation period. Therefore, elements like boron should be incorporated into planning an optimal nutrition system

Keywords: starch; soil microflora; biochemical composition of tubers; microelements; productivity

INTRODUCTION

In response to steadily rising costs, a transformative shift in the potato industry can be achieved by developing an adaptive farming system that employs energy-efficient, environmentally friendly, and biologically based technologies. One promising aspect of these technologies is the use of biological products. According to research by N. Fumia *et al.* (2022) and N. Pysarenko *et al.* (2022), biological products can enhance plant resistance to phytopathogens, boost productivity, and improve product quality while simultaneously mitigating the harmful effects of pesticides on agrocenoses. Biological products offer an eco-friendly alternative for plant protection by reducing the prevalence of phytopathogens. Specific agricultural measures, such as pre-planting seed tuber treatments and spraying plants during the growing season with biological products, help reduce the density of pathogen populations in the soil and on new tubers, thereby enhancing plant resistance against these threats.

In addition to achieving high productivity levels, it is equally crucial to ensure consistent expression of desirable traits under specific growing conditions. Therefore, a key challenge in increasing potato tuber production is to determine the adaptive potential of different potato varieties in specific environments, which will help stabilise productivity and other desired traits. Studies by O. Tsyuk *et al.* (2022), J. Goffart *et al.* (2022), and P. von Gehren *et al.* (2023) indicate that earlymaturing potato varieties (with a growing season of 55-60 days) exhibit varietal differences, economically valuable traits, and varied biochemical compositions of tubers. The biological characteristics of these varieties vary in terms of tuber formation, leaf assimilation surface size and activity, photosynthetic efficiency, and the rate of growth and vegetative mass development (Eid *et al.,* 2021; Taktaiev *et al.,* 2023). Currently, and likely in the near future, the primary objective will be to increase the productivity potential and maximise the genetic resources of early-maturing potato varieties, even those with moderate agronomic performance, as highlighted by S. Kokovikhin *et al.* (2020) and S. Tanchyk *et al.* (2021).

The development of adaptive potato varieties remains challenging due to the absence of a unified approach to defining the norm of a genotype's response. Recent research by Y. Kang *et al.* (2020) and O. Karpenko *et al.* (2022) suggests that this concept should be considered through the lens of the ecological-genetic organisation of quantitative traits. This perspective considers the role of heredity during ontogenesis, which interacts with limiting factors in the external environment.

The study aimed to determine the extent of genetic resource utilisation in early potato varieties when biologically active substances are used in tuber processing, to identify the maximum achievable potential of the varieties involved in the research, and to diagnose early-maturing forms of potatoes.

MATERIALS AND METHODS

The research was conducted at the educational, scientific, and industrial complex of Sumy National Agrarian University during 2022-2023. The experimental field is located in the Sumy district of the Sumy region, Ukraine, with geographic coordinates of 50°52.742 N latitude and 34°46.159 E longitude, at an altitude of 137.7 m above sea level (50°52'46.6"N 34°46'07.8"E, map data ©2023 Google). The research area is characterised by long-term average indicators, with an annual mean daily air temperature of +7.4°C and annual precipitation of 593 mm. Average daily temperatures cross the +10°C threshold in the third decade of September (as they decrease) and in the second decade of April (as they increase). The cumulative active temperatures (>+10°C) for the April-September period reach 2,768°C.

The overall climatic characterisation of the study period (2021-2023) indicated lower temperatures and increased spring precipitation compared to the long-term average. The soil at the experimental field is classified as typical chernozem, with the arable layer featuring the following main characteristics: humus content of 4.1%, pH of 6.3, an absorbed base quantity of 31 mg-eq., mobile phosphorus content of 11.3 mg/100 g of soil, exchangeable potassium content of 9.2 mg/100 g of soil, and easily hydrolyzed nitrogen content of 11.2 mg/100 g of soil (measured by the Kornfield method). Field and laboratory research followed the methodological recommendations provided by V. Kononuchenko (2002). Starch determination was conducted using the Parow method, which measures the density difference between the tubers and water (Kononuchenko, 2002; Podgaetskyi *et al.*, 2002; Abby, 2016). The analysis was performed using the "Field Kit for Dry Matter" device manufactured by Martin Lishman. Additionally, the response of different varieties to the average weight of marketable and individual tubers was analysed to evaluate their impact on marketability. To characterise crop structure, tuber samples collected from the plots were classified into fractions: small (less than 25 g), medium-small (26 to 50 g), medium (51 to 80 g), and large (over 80 g). The number and mass of tubers in each fraction were recorded. Crop marketability was determined by weighing all tubers exceeding 25 g, expressed as a percentage of the total harvest (Bondarchuk *et al.,* 2019).

The study involved early-maturing potato varieties from different breeding institutions, including Arizona, Tornado, and Riviera (Netherlands), as well as Bellarosa (Germany), Slauta, and Tiras (Ukraine). The following biological preparations were used for pre-planting tuber treatment: Binoc TK, a complex dry inoculant produced by Enzim Agro (Ukraine); Kartoplex, a complex biotechnological preparation also produced by Enzim Agro (Ukraine); and Mycofriend, a mycorrhizal bio-preparation. Experimental plots were established by planting 33 tubers per row for each variety, with four replicates. Tubers within the same row were spaced 35 cm apart, with a row spacing of 70 cm. After harvest, productivity indicators for the dietary potato varieties were determined, including marketability (%), the number of tubers (pcs./plant), yield (g/plant), dry matter content (%), and starch content (%).

The experimental scheme involved the following methods of tuber treatment:

1. Control (no treatment).
2. Binoc TK treatment using the dry method, applied directly to the tubers in a bag immediately before planting, at a rate of 100 g per 50 kg.
3. Kartoplex treatment using the spraying method, evenly applied to the spread-out tubers with a backpack sprayer at a rate of 100 g per 50 kg.
4. Mycofriend treatment using the dry method, applied similarly to Binoc TK, at a rate of 150 g per 50 kg.

Kartoplex is a long-acting, complex biotechnological formulation that stimulates growth, increases potato yields, and has insecticidal properties. The use of this agent reduces the spread of diseases caused by phytopathogenic microorganisms. Active colony formation in the root system by fungal producers of this agent aids in plant protection against root rot and fungal and bacterial complexes. Colony formation and synthesis of bioactive substances in plant tissues enhance immunity and reduce susceptibility to phloem-complex diseases. The composition of Kartoplex includes mycelia and spores of soil-endophytic fungi *Beauveria bassiana* and *Metarhizium robertsii*, along with bacteria such as *Bacillus megaterium* and *Bacillus azotofixans*, as well as their metabolites (plant hormones and organic substance complexes).

Binoc TK is a complex inoculant formulated as a graphite-talc mixture for seed treatment before planting. Its composition includes microbial cultures that are antagonists of root rot pathogens, nitrogen fixers, phosphorus-solubilising cultures, potassium mobilisers, phytohormones, antibiotics, vitamins, amino acids, growth regulators, and trace elements.

Mycofriend is a bioproduct based on the mycorrhizal fungi *Glomus* and *Trichoderma harzianum*. Its active components include agriculturally valuable microorganisms such as mycorrhizal fungi *Glomus sp.*, rhizosphere microorganisms (e.g., *Trichoderma harzianum*, *Pseudomonas fluorescens*, and *Streptomyces sp.*), phosphate-fixing bacteria, and fungicidal and bactericidal bacteria (e.g., *Bacillus subtilis*, *Bacillus megaterium* var. *phosphaticum*, *Bacillus mucilaginosus*, and *Enterobacter sp.*).

Experimental studies of plants (both cultivated and wild), including the collection of plant material, followed institutional, national, or international guidelines. The authors adhered to the standards of the Convention on the Conservation of Biological Diversity (1992) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (1979).

RESULTS AND DISCUSSION

Mycorrhiza offers numerous benefits to various plants: mycorrhizal seeds exhibit improved germination rates and greater resistance to root rot. Seedlings of fruit plants establish more successfully in new locations and develop more vigorously (Chifetete & Dames, 2020). During the growing season, mycorrhizal plants develop more extensive root systems, enabling them to absorb greater amounts of nutrients and moisture than non-mycorrhizal plants. Mycorrhiza supplies plants with essential vitamins, minerals, enzymes, and hormones. Through the mycelium, plant root systems expand their absorption area for key elements such as phosphorus, potassium, and other growthstimulating substances (Adavi *et al.,* 2020). Fungi forming mycorrhizal associations with plant roots also act as protective agents against certain diseases, such as late blight.

The analysis of tuber treatment effects with biological preparations on early potato variety performance indicators is presented in Table 1. From the data provided, it can be concluded that the response of potato varieties to the application of bio-preparations differed significantly in terms of productivity. The maximum productivity was observed in four varieties – Tiras, Bellarosa, Slauta, and Riviera – when treated with the

Kartoplex preparation. Meanwhile, two varieties, Tornado and Arizona, exhibited the highest productivity when treated with Binoc TK. The average productivity of the six potato varieties showed the following results: Kartoplex ranked first with a yield of 710.9 g/plant, followed by Binoc TK with 697.9 g/plant, Mycofriend with 547.5 g/plant, and the control group in last place with 540.9 g/plant.

***Table 1**. Influence of tuber treatment with bio-preparations on productivity indicators of early potato varieties (average 2022-2023)*

Variety	Yield (g/plant)			
	Control	Binoc TK	Kartoplex	Mycofriend
Tiras	495.5	695.0	800.0	695.5
Bellarosa	595.5	713.6	718.2	600.0
Slauta	700.0	768.2	827.3	685.0
Tornado	604.5	675.0	620.0	520.0
Arizona	318.2	745.5	686.4	338.9
Riviera	531.8	590.0	613.6	445.5
Average	540.9	697.9	710.9	547.5

***Source:** field studies conducted at the experimental field of Sumy National Agrarian University*

The results of laboratory analyses on the response of potato varieties to the content of 14 microelements during tuber formation are shown in Figure 1. These results offer insights into the yield indicators of the studied varieties. The findings indicate that potato varieties responded variably to tuber treatments with bio-preparations. Figure 1 highlights significant deficiencies in nitrogen, boron, and cobalt content, which corresponded to reduced productivity in the experimental variants. One critical indicator of potato nutritional value is starch, which constitutes 70-80% of the dry matter in tubers. However, its content primarily depends on the potato variety, with higher starch levels typically observed in mid- to late-maturing varieties. This study focused on early-maturing potato varieties (Navarre *et al.,* 2016; Bondarchuk *et al.,* 2021; Radchenko *et al.,* 2023). The research aimed to establish correlations between tuber treatments with biological preparations and starch and dry matter content in the studied varieties.

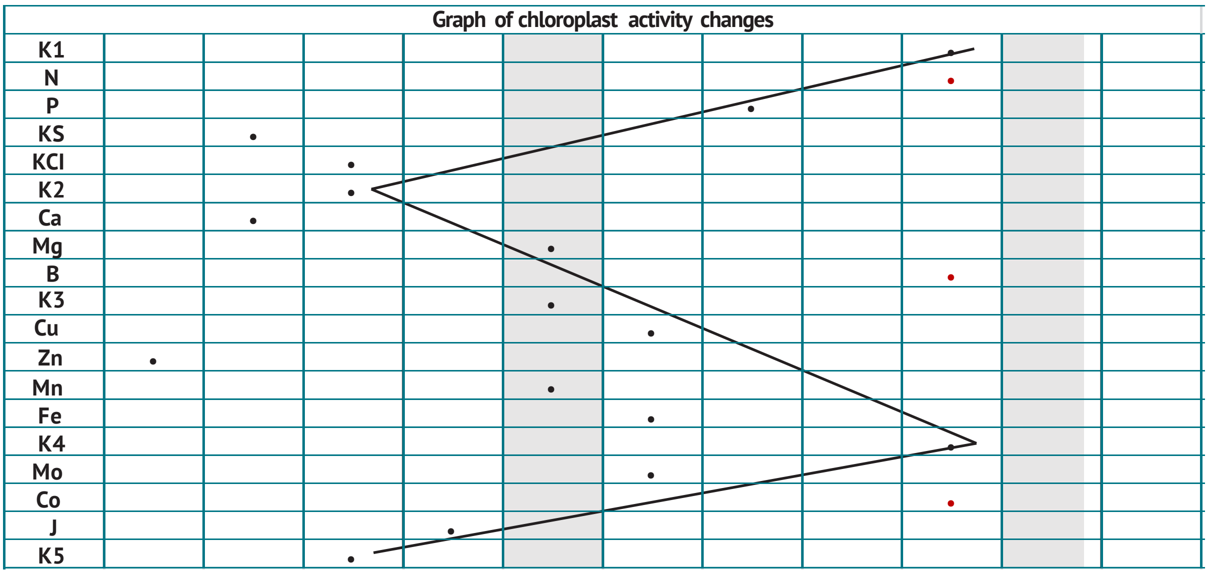

***Figure 1**. Trace element content in potato varieties during tuber formation*
***Source:** laboratory studies conducted at the Centre for Collective Use of Scientific Equipment, Sumy National Agrarian University*

The research results demonstrated that all potato varieties exhibited acceptable starch levels. The starch and dry matter content values for the different experimental conditions are presented in Table 2. The data suggest a minimal but noticeable response of the varieties to tuber treatments. Differences between the control and treatment methods were observed in most varieties.

***Table 2**. Starch and dry matter content values depending on experimental conditions (average 2022-2023)*

Variety/Treatment	Starch	Dry matter
Tiras/Control	12.1	16.05
Tiras/Binoc TK	10.7	19.80
Tiras/Kartoplex	12.2	19.80
Tiras/Mycofriend	13.5	22.30
Bellarosa/Control	12.0	15.30
Bellarosa/Binoc TK	10.3	16.05
Bellarosa/Kartoplex	10.1	16.55
Bellarosa/Mycofriend	10.1	14.55
Slauta/Control	10.0	14.05
Slauta/Binoc TK	12.3	16.55
Slauta/Kartoplex	11.2	16.05
Slauta/Mycofriend	10.7	15.30
Tornado/Control	10.6	14.05
Tornado/Binoc TK	10.0	14.55
Tornado/Kartoplex	10.0	15.30
Tornado/Mycofriend	10.0	14.55
Arizona/Control	10.0	13.80
Arizona/Binoc TK	10.0	14.05
Arizona/Kartoplex	10.9	14.05
Arizona/Mycofriend	10.0	14.55
Riviera/Control	10.0	16.55
Riviera/Binoc TK	9.9	18.80
Riviera/Kartoplex	9.9	18.05
Riviera/Mycofriend	9.9	15.30

***Source:** laboratory studies conducted at the Centre for Collective Use of Scientific Equipment, Sumy National Agrarian University*

As practical experience indicates, the dry matter content of a specific variety may also vary across growing seasons in the same field. The effectiveness of tuber treatments was assessed based on dry matter content. Compared to the control group, the highest dry matter content was observed when treating tubers with the Mycofriend preparation in the Tiras variety (22.30%) and Arizona (14.55%), while Binoc TK treatment resulted in the highest values for Riviera (18.80%) and Slauta (16.55%). The Kartoplex preparation produced the best results in Bellarosa (16.55%) and Tornado (15.30%). Conversely, lower values were recorded for most varieties in the control group. Thus, it can be concluded that tuber treatments with specific bio-preparations have a positive and measurable impact on dry matter content. The favourable response of early-maturing potato varieties to tuber treatments underscores the practicality of employing such methods to improve dry matter content.

The best marketability indicators were achieved with Kartoplex-treated varieties: Bellarosa (166 g), Tiras (111 g), and Arizona (108 g). Additionally, Mycofriend-treated Slauta (128 g) and Binoc TK-treated Arizona (110 g) displayed promising outcomes (Table 3). Conversely, the highest average marketable tuber weight was observed in the control group for Riviera (120 g). No significant differences were observed among treatment variants for the Tornado variety. The observed trends in the average marketable tuber weight directly impacted the size of individual tubers per plant.

***Table 3**. Influence of bio-preparations on marketability indicators (average 2022-2023)*

Variety/Treatment	Average tuber weight, g		Marketability, %
	Product	One	
Tiras/Control	95	75	95
Tiras/Binoc TK	100	83	95
Tiras/Kartoplex	111	97	95
Tiras/Mycofriend	97	85	97
Bellarosa/Control	118	81	90
Bellarosa/Binoc TK	127	86	94
Bellarosa/Kartoplex	166	136	97
Bellarosa/Mycofriend	116	80	95

Table 3. Continued

Variety/Treatment	Average tuber weight, g		Marketability, %
	Product	One	
Slauta/Control	117	93	91
Slauta/Binoc TK	113	97	96
Slauta/Kartoplex	111	88	94
Slauta/Mycofriend	128	112	97
Tornado/Control	81	67	92
Tornado/Binoc TK	89	68	92
Tornado/Kartoplex	83	71	94
Tornado/Mycofriend	83	68	92
Arizona/Control	79	64	81
Arizona/Binoc TK	110	94	96
Arizona/Kartoplex	108	80	91
Arizona/Mycofriend	82	62	92
Riviera/Control	120	90	92
Riviera/Binoc TK	97	79	97
Riviera/Kartoplex	113	95	96
Riviera/Mycofriend	76	65	93

Source: *laboratory studies conducted at the Centre for Collective Use of Scientific Equipment, Sumy National Agrarian University*

An analysis of the data regarding tuber marketability indicates differences among the varieties depending on the experimental conditions, with the lowest marketability index recorded in the Arizona variety under control conditions at 81%. Research has demonstrated that organic crops tend to be richer in phenolics and other antioxidants compared to conventional crops, while also containing lower levels of undesirable pesticide residues and nitrates. Conventional tubers exhibited higher concentrations of nitrates and lutein, whereas organic potatoes generally contained greater amounts of phenolic compounds (Kazimierczak *et al.,* 2019). These compounds are notable for their physiological and ecological roles, which arise from interactions between the plant and its environment.

Therefore, trait improvement, including quality traits, may be achieved by cultivating existing varieties under conditions that enhance or positively influence their expression. Organic cultivation, in particular, is anticipated to have a favourable effect on the antioxidant quality of potato tubers. Micronutrients play essential roles in both plants and humans, and their deficiencies can lead to significant health issues in humans or result in yield and quality losses in plants. The bioactive compounds often found in higher concentrations in organically grown crops not only provide nutritional and health benefits but also contribute to their distinctive taste and flavour profiles. As a result, variations in the concentrations of these compounds may influence the sensory characteristics of plant products (Wijesinha-Bettoni & Mouillé, 2019; Hussain *et al.,* 2021). More than half of the global potato production originates from developing countries, where micronutrient malnutrition is a widespread issue. This underscores the critical importance of micronutrient biofortification in potatoes for human health, as potatoes are widely consumed by a large proportion of the global population (Pysarenko *et al.,* 2022; Hryhoriv *et al.,* 2022). The dietary potato varieties examined in this study are distinguished by varietal differences, economic value, and the biochemical composition of their tubers. Assessing the potential of these varieties under organic farming conditions, without the use of chemicals, enables researchers to evaluate their maximum productivity potential and the extent to which key agronomic traits are expressed.

CONCLUSIONS

An analysis of the obtained results reveals substantial differences in productivity indicators compared to the control. Most varieties exhibited a positive response to tuber treatments with the biopreparations included in the study. A significant increase in productivity was observed in the Slauta variety with the application of the Kartoplex preparation, where productivity was 1.2 times higher compared to the control. In the Tiras variety, productivity was 1.6 times higher. Similar positive responses were recorded in some varieties following the application of the Binoc TK biopreparation. The highest values were recorded in the Arizona and Tornado varieties, with productivity differences of 427.3 g/plant and 70.5 g/plant, respectively, compared to the control. Therefore, the use of the biopreparations Binoc TK and Kartoplex during tuber treatment is recommended as an effective method for enhancing key economic traits in the cultivation of earlymaturing potato varieties. This approach allows for a substantial yield increase of 20-30%.

Global trends in healthy nutrition encourage the development of dietary products rich in antioxidants, contributing to disease prevention. The cultivation of specialised potato varieties in Ukraine and globally represents a critical area for enhancing food security. Future research will focus on increasing the yield of dietary potato varieties by producing *in vitro* potato seed material and evaluating the biochemical composition of their tubers.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Abby, S. (2016). *Production guide for organic potato*. Geneva: New York State Department of Agriculture.
[2] Adavi, Z., Tadayon, M.R., Razmjoo, J., & Ghaffari, H. (2020). Antioxidant enzyme responses in potato (*Solanum tuberosum*) cultivars colonized with Arbuscular Mycorrhizas. *Potato Research*, 63, 291-301. doi: 10.1007/s11540-019-09440-1.
[3] Bondarchuk, A.A., Koltunov, V.A., Oliynyk, T.M., Borodai, V.V., Zakharchuk, N.A., Vishnevska, O.V., & Furdyga, M.M. (2021). *Potato growing: Quality assessment methods*. Vinnytsia: Nilan LTD.
[4] Bondarchuk, A.A., Koltunov, V.A., Oliynyk, T.M., Furdyga, M.M., Vishnevska, O.V., Osypchuk, A.A., Kupriyanova, T.M., & Zakharchuk, N.A. (2019). *Potato growing: Methodology of the research case*. Vinnytsia: TVORY LLC.
[5] Chifetete, V.W, & Dames, J.F. (2020). Mycorrhizal interventions for sustainable potato production in Africa. *Frontiers in Sustainable Food Systems,* 4, article number 593053. doi: 10.3389/fsufs.2020.593053.
[6] Convention on Biological Diversity. (1992, June). Retrieved from https://zakon.rada.gov.ua/laws/show/995_030#Text.
[7] Convention on International Trade in Endangered Species of Wild Fauna and Flora. (1979, June). Retrieved from https://zakon.rada.gov.ua/laws/show/995_129#Text.
[8] Eid, E.M., Shaltout, K.H., Alamri, S.A.M., Alrumm, S.A., Hussain, A.A., Sewelam, N., & Ragab, G.A. (2021). Sewage sludge enhances tomato growth and improves fruit-yield quality by restoring soil fertility. *Plant Soil Environment*, 67(9), 514-523. doi: 10.17221/205/2021-PSE.
[9] Fumia, N., Pironon, S., Rubinoff, D., Khoury, C.K., Gore, M.A., & Kanta, M.B. (2022). Wild relatives of potato may bolster its adaptation to new niches under future climate scenarios. *Food Energy Secur*, 11(2), article number e360. doi: 10.1002/fes3.360.
[10] Goffart, J.P., Haverkort, A., Storey, M., Haase, N., Martin, M., Lebrun, P., Ryckmans, D., Florins, D., & Demeulemeester, K. (2022). Potato production in North-western Europe (Germany, France, the Netherlands, United Kingdom, Belgium): Characteristics, *Issues, Challenges and Opportunities*. *Potato Research*, 65, 503-547. doi: 10.1007/s11540-021-09535-8.
[11] Hryhoriv, Y., Butenko, A., Kozak, M., Tatarynova, V., Bondarenko, O., Nozdrina, N., Stavytskyi, A., & Bordun, R. (2022). Structure components and yielding capacity of Camelina sativa in Ukraine. *Agriculture and Forestry*, 68(3), 93-102. doi: 10.17707/AgricultForest.68.3.07.
[12] Hussain, M., Qayum, A., Xiuxiu, Z., Liu, L., Hussain, K., Yue, P., Yue, S., Koko, Y.F.M., Hussain, A., & Li, X. (2021). Potato protein: An emerging source of high quality and allergy free protein, and its possible future based products. *Food Research International*, 148, article number 110583. doi: 10.1016/j.foodres.2021.110583.
[13] Kang, Y., Zhang, W., Yang, X., Liu, Y., Fan, Y., Shi, M., Yao, K., & Qin, S. (2020). Furrow-ridge mulching managements affect the yield, tuber quality and storage of continuous cropping potatoes. *Plant, Soil and Environment*, 66(11), 576-583. doi: 10.17221/316/2020–PSE.
[14] Karpenko, O., Butenko, Y., Rozhko, V., Sykalo, O., Chernega, T., Kustovska, A., Onychko, V., Tymchuk, D.S., Filon, V., & Novikova, A. (2022). Influence of agricultural systems on microbiological transformation of organic matter in wheat winter crops on typical black soils. *Journal of Ecological Engineering*, 23(9), 181-186. doi: 10.12911/22998993/151885.
[15] Kazimierczak, R., Srednicka-Tober, D., Hallmann, E., Kopczynska, K., & Zarzynska, K. (2019). The impact of organic vs. Conventional agricultural practices on selected quality features of eight potato cultivars. *Agronomy*, 9(12), article number 799. doi: 10.3390/agronomy9120799.
[16] Kokovikhin, S.V., Kovalenko, V.P., Slepchenko, A.A., Tonkha, O.L., Kovalenko, N.O., Butenko, A.O., & Ushkarenko, V.O. (2020). Regularities of sowing alfalfa productivity formation while using different types of nitrogen fertilizers in cultivation technology. *Modern Phytomorphology*, 14, 35-39.
[17] Kononuchenko, V.V. (2002). *Methodological recommendations for conducting research with potatoes*. Nemishaevo: Institute of Potato Growing.

[18] Navarre, D.A., Shakya, R., & Hellmann, H. (2016). Vitamins, phytonutrients, and minerals in potato. In *Advances in potato chemistry and technology* (pp. 117-166). London: Academic Press. doi: 10.1016/B978-0-12-800002-1.00006-6.
[19] Podgaetskyi, A.A., Kononuchenko, V.V., & Molotskyi, M.Ya. (2002). *Potato gene pool, its components, characteristics and strategy of use*. Kyiv.
[20] Pysarenko, N., Sydorchuk, V., & Zakharchuk, N. (2022). Study of adaptive ability of potato varieties by the "yield" feature in the conditions of Central Polissia. *Foothill and Mountain Agriculture and Stockbreeding*, 71(1), 123-140. doi: 10.32636/01308521.2022-(71)-1-8.
[21] Radchenko, M., Trotsenko, V., Butenko, A., Masyk, I., Bakumenko, O., Butenko, S., Dubovyk, O., & Mikulina, M. (2023). Peculiarities of forming productivity and quality of soft spring wheat varieties. *Agriculture and Forestry*, 69(4), 19-30. doi: 10.17707/AgricultForest.69.4.02.
[22] Taktaiev, B.A., Furdyga, M.M., Oliinyk, T.M., Podberezko, I.M., Podhaietskyi, A.A., & Cherednychenko, L.M. (2023). Creation of disease-resistant potato breeding material with a complex of main economic and valuable characters. *Bulletin of Sumy National Agrarian University. The Series: Agronomy and Biology*, 53(3), 91-98. doi: 10.32782/agrobio.2023.3.13.
[23] Tanchyk, S., Litvinov, D., Butenko, A., Litvinova, O., Pavlov, O., Babenko, A., Shpyrka, N., Onychko, V., Masyk, I., & Onychko, T. (2021). Fixed nitrogen in agriculture and its role in agrocenoses. *Agronomy Research*, 19(2), 601-611. doi: 10.15159/ AR.21.086.
[24] Tsyuk, O., Tkachenko, M., Butenko, A., Mishchenko, Y., Kondratiuk, I., Litvinov, D., Tsiuk, Y., & Sleptsov, Y. (2022). Changes in the nitrogen compound transformation processes of typical chernozem depending on the tillage systems and fertilizers. *Agraarteadus*, 33(1), 192-198. doi: 10.15159/jas.22.23.
[25] von Gehren, Ph., Bomers, S., Tripolt, T., Söllinger, J., Prat, N., Redondo, B., Vorss, R., Teige, M., Kamptner, A., & Ribarits, A. (2023). Farmers feel the climate change: Variety choice as an adaptation strategy of European potato farmers. *Climate* 11(9), article number 189. doi: 10.3390/cli11090189.
[26] Wijesinha-Bettoni, R., & Mouillé, B. (2019). The contribution of potatoes to global food security, nutrition and healthy diets. *American Journal of Potato Research*, 96(2), 139-149. doi: 10.1007/s12230–018–09697–1.

Реакція сортів картоплі на обробку азотфіксуючими бактеріями та біопрепаратами з мікоризою

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Анотація. Комерційна цінність рослин картоплі для виробництва бульб є досить значною, щоб дослідити шляхи зниження собівартості кінцевого продукту шляхом оптимізації великомасштабних систем вирощування. Обробка бульб біопрепаратами дозволяє зменшити використання фосфорних добрив і скоротити вегетаційний період. Крім того, за допомогою інтродукції корисної мікробіоти можна отримати високоякісний та комерційно життєздатний рослинний матеріал. Метою даного дослідження було визначення рівня реалізації генетичного потенціалу ранніх сортів картоплі при застосуванні біологічно активних речовин для обробки бульб, виявлення максимально досяжного потенціалу досліджуваних сортів, а також діагностика ранніх форм картоплі. Що стосується мінерального живлення рослин, то біопрепарати мікоризних грибів є однією з найважливіших груп ґрунтової мікрофлори і можуть бути застосовані в практиці сільськогосподарської інокуляції. Отримані результати щодо вмісту крохмалю в досліджуваних сортах картоплі свідчать про те, що обробка біопрепаратами не мала суттєвого впливу на його рівень у бульбах. Проте за вмістом сухої речовини спостерігалася позитивна тенденція майже у всіх варіантах обробки бульб біопрепаратами. Реакція сортів на середню масу товарних та індивідуальних бульб продемонструвала ефективність препаратів у підвищенні основних товарних показників на всіх варіантах досліду. Обробка біопрепаратами не вирішує питання забезпечення всіма мікроелементами протягом вегетації картоплі. Тому такі елементи, як бор, слід враховувати при плануванні оптимальної системи живлення

Ключові слова: крохмаль; мікрофлора ґрунту; біохімічний склад бульб; мікроелементи; продуктивність