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The Influence of Nanoparticles, Multicomponent Microelemental Fertiliser "Avatar-2 Zahyst" and Microbial Fertiliser "Azogran" on the Yield of Potato Variety "Suvenir Chernihivsky" in Polissya

Abstract. Improving traditional potato growing technology is of great scientific and practical importance for agriculture. Recently, nanoparticles (NPs) have been catching the attention of scientists as a promising means of increasing crop productivity. It has been established that NPs of such chemical elements as Fe, Zn, B, Si, Cu, Co, Se, and Ag can significantly increase the productivity of potatoes. It is known that Ag NPs show synergism with some microbial agents. However, the effect of NP of such elements as Zn and Se on potato yield and NPs combined with microbial agents for pre-sowing fertilisation has not been studied sufficiently. The influence of Ti and I NPs on potato yield, the influence of ELs on the yield of domestic potato varieties, and the influence of ELs on potato yield in Polissya are not yet studied. The purpose of the study was to investigate the effect of pre-sowing fertilisation of potatoes with Zn NPs, Ti NPs, Se + I NPs, Zn + Ti + Se + I NPs, multicomponent microelement fertiliser "Avatar-2 Zahyst", microbial fertiliser "Azogran" and a combination of microbial fertiliser "Azogran" with Se + I NPs on the yield of potato variety "Suvenir Chernihivsky" in Polissya. For three years in a row, small-scale experiments were set up on sod-podzolic soil and leached chernozem. The plots were located on the land of the Institute of Agricultural Microbiology and Agricultural Production of the National Academy of Agrarian Sciences in Chernihiv Oblast. The data obtained on the potato harvest was analysed in accordance with generally accepted methods of statistical analysis. It was found that among all variants of pre-sowing fertilisation, the composition of Se + I NPs, the microbial fertiliser Azogran and the combination of Azogran with the composition of Se + I NPs had the greatest effect on the yield

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of potatoes of the Suvenir Chernihivsky variety on sod-podzolic soil by 33.13, 38.34 and 45.35%, respectively, and on leached chernozem by 10.97, 17.98 and 37.27%. It was found that the composition of Se + I nanoparticles and Azogran exhibit synergism. The data obtained indicate high prospects for the use of NPs in combination with microbial fertilisers in potato cultivation

Keywords: potatoes, crop, nanotechnology, nanoparticles, microbial fertiliser, microelement fertiliser

RELEVANCE

Potatoes are one of the most important food, technical and fodder crops in Ukraine and around the world. Improving conventional potato growing methods is an important task for agricultural production. Among the latest methods of improving the technology of growing potatoes, nanotechnologies occupy an important place. Numerous studies have established the positive effect of nanoparticles (NPs) of various chemical elements and compounds on the productivity of plants, in particular, potatoes.

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

The study of the effect of NPs on the growth of plants, in particular potatoes, is an extremely relevant area of modern science. It is established that the NPs of many chemical elements, including metals, nonmetals, and semi-metals, can significantly increase potato yield, reduce plant disease, and increase the nutritional value of tubers.

Fe NFs have been shown to increase the mineral content of potato tubers, leaf growth rate, weight and uniformity of tuber size, ripening rate, potato yield, and a number of other important indicators (Davies, 2018). Zn, B, Si, and zeolite NPs have been proven to increase the yield of potato tubers (Mahmoud, 2020).

It was found that Fe, Cu, Co, and CuO have a positive effect on the area of leaf blades of potato plants, tuber yield, number of tubers per plant, the average weight of 1 tuber, and the content of starch, vitamin C, and vitamin PP in tubers (Samoylova *et al.*, 2017). Se NPs were found to increase the ability of potato leaves to retain moisture and resistance to elevated temperatures and increase potato yields (Cherniakova *et al.*, 20 19).

According to the results of research, Ag NPs in combination with the microbial fertiliser Nitroxin, which contains strains of nitrogen-fixing bacteria of the species *Enterobacter cloacae* and genera *Pseudomonas* and *Azotobacter*, increases the size of minitubers, the number of minitubers per plant, the average weight of 1 minituber and the yield of potato minitubers (Davod *et al.*, 2011). It was found that hybrid stabilized polyhexamethylene biguanide with Ag hydrochloride increases the yield and marketability of potato tubers (Krutyakov *et al.*, 2017). Under *in vitro* conditions, Ag NPs at certain concentrations reduced the length of potato stems but significantly increased the length of roots, leaf area, and dry weight of stems and roots. In addition, Ag NFs increased the total content of chlorophyll, anthocyanins, flavonoids, and phenols. The content of proline did not change. Ag NPs slightly increased H_2O_2 concentration in potato plant tissues and lipid peroxidation (Homaee & Ehsanpour, 2015).

It has been established that SiO_2 NPs at certain concentrations increase the weight of potato stems and leaves, the number and weight of tubers per plant, the content of chlorophyll and carotenoids, and do not affect the electrophoretic mobility of DNA, which indicates the absence of toxicity (Mushinskiy *et al.*, 2018).

It has been found that Na_2SiO_3 NPs increase the quantum yield of photosystem II, carotenoid content in potato tissues, the antioxidant activity of 1,1-diphenyl-2-picrylhydrazyl, number of tubers per plant, tuber yield, and dry matter content in tubers (Kafi *et al.*, 2019).

Therefore, the use of nanoparticles in potato growing technology has prospects. However, the effect of Zn, Ti, Se, I NPs, their compositions and preparations developed on the basis of a wide range of nanoparticles, and the simultaneous use of nanoparticles and microbial preparations have not been sufficiently studied.

The purpose of the study was to investigate the effect of pre-sowing fertilisation with Zn NPs, Ti NPs, Se + I NPs, Zn + Ti + Se + I NPs, "Avatar-2 Zahyst", microbial fertiliser "Azogran" and a combination of "Azogran" with Se + I NPs on the yield of potato variety "Suvenir Chernihivsky" in Polissya.

MATERIALS AND METHODS

The experiments used Zn NPs, Ti NPs, Se + I NPs composition and multicomponent microelement fertiliser "Avatar-2 Protection" developed by Doctor of Technical Sciences, Professor V. Kaplunenko, courtesy of V. Dimchev (Avatar Research and Production Company LLC), the microbial fertiliser "Azogran" courtesy of Doctor of Biological Sciences, Professor, Head of the Department of Microbiological Processes on Hard Surfaces of the D. K. Zabolotny Institute of Microbiology and Virology of the NAS of Ukraine, I. K. Kurdysh, for which the author expresses his sincere gratitude.

Multicomponent micronutrient fertiliser Avatar-2 Zahyst is designed to protect crops from fungal, bacterial and viral pathogens. The fertiliser contains NPS of at least 13 chemical elements and has fungicidal, bactericidal and insecticidal activity. Avatar-2 Zahyst is a stress protector and helps to increase plant resistance to drought, snowless frosts, and soil salinity (Kaplunenko *et al.*, 2017; Derevianko *et al.*, 2019).

"Azogran" is a complex bacterial fertiliser containing selected strains of nitrogen-fixing bacteria *Azotobacter vinelandii* IMB B-7076 and phosphate-mobilising bacteria *Bacillus subtilis* IMB B-7023. The fertiliser has growth-regulating and insecticidal effects, increases crop productivity and improves the germination of forest crop seedlings (Korniychuk *et al.*, 2018; Kurdysh *et al.*, 2021).

To study the effect of NPs and Avatar-2 Zahyst and Azogran on the yield of potatoes of the Suvenir Chernihivsky variety, two small-plot experiments were laid out on the land plots of the Institute of Agricultural Microbiology and Agroindustrial Production of the National Academy of Sciences of Ukraine (IAMAP NAS). The first plot has sod-podzolic soil, and the second has leached chernozem.

The soddy-podzolic soil had the following initial agrochemical characteristics of the arable layer: humus content (by Tyurin) – 1.1%; pH of the salt extract – 5.0; hydrolytic acidity (by Kappen) – 2.5 m-eq. per 100 g; P_2O_5 content (by Kirsanov) – 170.0; K_2O (by Maslova) – 62.0 mg per 1 kg of soil (Volkohon *et al.*, 2013).

The leached chernozem had the following initial agrochemical characteristics of the arable layer: humus content was 3.56%; pH_{KCl} was 5.2-5.5; the sum of absorbed bases was 12.5-14.0 mg-eq. per 100 g of soil; the content of easily hydrolyzed nitrogen (by Cornfield) was 95-100 mg; mobile phosphorus forms (by Kirsanov) were 108-111 mg K_2O per 1 kg of soil (Kopylov *et al.*, 2009).

Following generally accepted methods, a plot size of 9.8 m^2 was selected (Dospekhov, 1985). The total area of both experiments was 410 m^2 each. Both experiments were repeated four times. Agricultural techniques used on the plots are shown in Table 1.

Table 1. Agricultural techniques used in the experimental plots

Agrotechnics	Plot on sod-podzolic soil	Plot on leached chernozem
Tillage	Disking, cutting ridges	Disking, cutting ridges
Mineral fertiliser application (y/y)	$N_{96}P_{96}K_{96}$ (ANP fertilizer)	$N_{96}P_{96}K_{96}$ (ANP fertilizer)
Application of organic fertilisers	not applied	not applied
Seeding rate	41,000 tubers/ha	41,000 tubers/ha
Row spacing width	70 cm	70 cm

In different variants of the experiment, Zn NC, Ti NC, Se + I NPs composition, Zn + Ti + Se + I NPs composition, microbial fertiliser Azogran, and a combination of Azogran and Se + I NPs composition were used. To assess their performance, pre-sowing treatment of potato seeds with solutions of these compounds was used.

The placement of variants is systematic two-tier and systematic multi-tier. The pre-sowing fertilisation of potato seeds was carried out according to the scheme shown in Table 2.

The data on temperature and precipitation during the period of the experiment are shown in Table 3.

Table 2. Scheme of small plot experiments

Variant	**Load, l/t**	**Solution/fertiliser concentration**	**Concentration (per 1 tuber)**
Control (Running water)	1	-	-
Zn NPs	1	4000 mg/l	97.6 μg
Ti NPs	1	500 mg/l	12.2 μg
Se + I NPs	1	100 + 150 mg/l	2.4 + 3.7 μg
Zn + Ti + Se + I NPs	1	Zn NPs: 4000 mg/l Ti NPs: 500 mg/l Se + I NPs: 100 + 150 mg/l	Zn NPs: 97.6 μg Ti NPs: 12.2 μg Se + I NPs: 2.4 + 3.7 μg
Avatar-2 Zahyst fertiliser	1	-	24.4 μL
Azogran fertiliser	1	*B. subtilis*: 1x10^9 CFU/cm^3 *A. vinelandii*: 1x10^8 CFU/cm^3	*B. subtilis*: 2,4x10^7 CFU *A. vinelandii*: 2,4x10^6 CFU
Combination of the fertiliser "Azogran" with Se + I NPs	1	*B. subtilis*: 1x10^9 CFU/cm^3 *A. vinelandii*: 1x10^8 CFU/cm^3 Se + I: 100 + 150 mg/l	*B. subtilis*: 2,7x10^7 CFU *A. vinelandii*: 2,4x10^6 CFU Se + I: 2.4 + 3.7 μg

Table 3. Weather conditions in 2021

Month	Precipitation, mm		Average daily air temperature, t °C	
	Average data for 2019-2021 (M * ± Std.Err**)	Medium-long-term data	Average data for 2019-2021 (M ± Std.Err)	Medium-long-term data
April	8.4 ± 0.6	9.0	29 ± 5	36
May	14.2 ± 1.3	15.0	87 ± 13	63
June	21.6 ± 0.6	18.6	45 ± 22	62
July	20.7 ± 1.5	20.5	57 ± 5	74
August	19.4 ± 0.4	19.3	52 ± 8	54
September	14.2 ± 1.1	13.8	39 ± 2	53

Note: *M – arithmetic mean; **Std.Err – standard error of the arithmetic mean

To record the harvest, 10 separately located bushes were dug up from each plot (Dospiekhov, 1985; Bondarchuk *et al.*, 2019) and the total weight of tubers from each bush was weighed. The total weight of tubers from each bush was converted to t/ha using the formula:

$$x = \frac{(m \times 41000)}{1000000} \quad , (1)$$

Where *x* is the yield, t/ha, m is the weight of tubers per bush, g, 41,000 is the seeding rate, tubers/ha, 1,000,000 is the number of grams in 1 ton.

The obtained yield values were entered into spreadsheets for further statistical analysis.

The obtained data on the yield of potato variety Suvenir Chernihivskyi were analysed according to the generally accepted methods of statistical analysis (Rebrova, 2002) using Microsoft Office Excel 2016, StatSoft STATISTICA 10 and StatSoft STATISTICA 12. First, the data in all variants were analysed for compliance with the normal (Gaussian) distribution using the Kolmogorov-Smirnov, Lilliefors, and Shapiro-Wilk tests. It was found that in the vast majority of cases, the data distribution differs from the normal distribution in all tests, so nonparametric statistical methods were used for further analysis. The median was calculated to show the average yield in the variants. The significance of the difference between the experimental variants and the control (p) was calculated using the nonparametric Shapiro-Wilk U-test (Rebrova, 2002).

RESULTS AND DISCUSSION

It was found that the effect of the studied NFs and the microbial fertiliser Azogran on the potato yield varies according to the chemical composition of the NFs and differs slightly depending on the soil.

On soddy podzolic soil, most of the pre-sowing fertiliser variants contributed to the growth of the yield of potato tubers of the Suvenir Chernihivsky variety. However, when subjected to Zn and Ti NPs, there was a downward trend in yield in the last two years (Table 4).

The pre-sowing fertilisation with the composition of Se + I NPs resulted in a growing tendency of potato tubers yield of the variety Suvenir Chernihivsky. Thus, in the first year, the harvest grew significantly by 49.22%, in the second year it decreased by 8.85%, and in the third year, it grew by 8.35%. According to the average data of three years, after pre-sowing fertilisation with Se + I NPs composition the yield significantly increased by 33.13% (Table 4).

The variants with Azogran showed an increase in yield. During the first year, the yield after pre-sowing treatment with Azogran increased significantly by 23.39%, in the second year it decreased by 6.44%, and in the third year it increased by 6.09%.

According to the average data of three years, after pre-sowing fertilisation with Azogran the yield increased significantly by 38.34% (Table 4).

Table 4. The yield of Suvenir Chernihivsky potato variety after pre-sowing fertilisation with nanoparticles, multicomponent microelement fertiliser "Avatar-2 Zahyst" and microbial fertiliser "Azogran" on a plot with sod-podzolic soil, t/ha

Variant	Average yield, t/ha (median)			
	2019	2020	2021	Average for 2019-2021
Control	23.55	35.04	13.51	19.21
Zn NPs	26.65	32.67	11.58	23.12

Table 4, Continued

Variant	Average yield, t/ha (median)			
	2019	2020	2021	Average for 2019-2021
Ti NPs	25.57	24.51*	12.57	21.66
Se + I NPs	35.14*	31.94	14.64	25.57*
Zn + Ti + Se + I NPs	25.98	29.39	13.98	22.48
Avatar-2 Zahyst fertiliser	26.47*	29.73	15.46	23.71
Azogran fertiliser	29.06*	32.78	14.33	26.57*
Azogran + Se + I NPs composition	32.29*	44.65*	18.45*	27.92*

Note: The * sign within the same column indicates significant differences between the variants relative to the control at a significance level of $p < 0.05$ according to the Mann-Whitney U test

The highest yield was obtained with the simultaneous pre-sowing fertilisation of Suvenir Chernihivsky variety potato seeds using Azogran with the composition of Se + I NPs. The yield in this variant increased significantly throughout the observation period. In the first year, the yield was 37.09% higher than in the control, and in the second and third years, it was 27.43% and 36.57% higher, respectively. According to the average data of three years, with pre-sowing fertilisation with "Azogran" and Se + I NPs composition significantly increased by 45.35% (see table. 4).

The pre-sowing fertilization of potato seeds with Zn, LF Ti, LF Zn + Ti + Se + I NPs composition and "Avatar-2 Zahyst" fertiliser exhibited a tendency to increase the yield, but the results were not significant (see Table 4).

According to the results of statistical analysis, all variants of leached chernozem demonstrated a more distinct upward trend in yield (see Table 4).

As opposed to the sod-podzolic soil, a significant upward trend in yield was observed on the leached chernozem after pre-sowing fertilisation with Zn NPs. The yield in this variant increased significantly by 24.85 and 30.35% in the first and second years, and by 5.24% in the third year (Table 5).

Table 5. The yield of Suvenir Chernihivsky potato variety after pre-sowing fertilisation with nanoparticles, multicomponent microelement fertiliser "Avatar-2 Zahyst" and microbial fertiliser "Azogran" on a plot with leached chernozem, t/ha

Variant	Average yield, t/ha (median)			
	2019	2020	2021	Average for 2019-2021
Control	13.79	21.76	15.33	16.37
Zn NPs	17.23*	28.37*	16.32	17.23
Ti NPs	19.18*	21.29	14.72	17.38
Se + I NPs	20.29*	23.03	16.69	18.16*

Table 5, Continued

Variant	Average yield, t/ha (median)			
	2019	2020	2021	Average for 2019-2021
Zn + Ti + Se + I NPs	19.35*	26.51*	15.01	18.37
Azogran fertiliser	20.49*	27.82*	17.02	19.31*
Avatar-2 Zahyst fertiliser	18.69*	23.83*	16.29	17.96*
Azogran + Se + I NPs composition	23.51*	26.34*	19.80*	22.47*

Note: The * sign within the same column indicates significant differences between the variants relative to the control at a significance level of $p < 0.05$ according to the Mann-Whitney U test

The variant with pre-sowing fertilisation with Ti NPs showed a downward trend in yield. In the first year, the harvest in this variant increased by 39.05%, in the second year it decreased by 2.16%, and in the third year it decreased by 4.01%. According to the average data of three years, the harvest in this variant increased by 6.21% (see Table 5).

Under pre-sowing fertilization with Se + I NPs, a tendency towards yield increase was observed. Thus, in the first year, the harvest in this variant increased by 47.04%, in the second – by 5.83%, in the third – by 8.82%. According to the average data of three years, the yield in this variant is 10.97% higher than the control with a sufficient level of significance (see Table 5).

An upward trend in yield was also observed in the variants with pre-sowing fertilisation with the composition of Zn + Ti + Se + I NPs and fertiliser Avatar-2 Zahyst. According to the average data of three years, the yield in these variants increased by 12.21% and 9.71%, respectively (see Table 5).

In the variant with pre-sowing fertiliser with "Azogran", the yield was steadily increasing. Thus, in the first and second years, the yield in this variant was significantly higher than in the control by 48.52 and 27.86%, respectively, and in the third year – by 10.96%. According to the average data of three years, the yield in this variant is significantly higher than in the control by 17.98% (see Table 5).

The best results were obtained with pre-sowing fertilisation with a combination of Azogran and Se + I NPs composition, which was characterised by the greatest impact on the yield. The yield in this variant increased significantly by 70.41, 21.06, and 29.14%, respectively, for three consecutive years. According to the average data of three years, the yield in this variant is significantly higher than in the control by 37.27% (Table 5).

The difference in data obtained from the two sites is consistent with data from other researchers. It is known that the biological activity of NPs can vary depending on the type of soil. Thus, the same NPs can stimulate or inhibit the activity of dehydrogenase, urease, acid and alkaline phosphatase, depending on the type of soil (Jośko, 2014).

Consequently, the Ti NPs showed a tendency to reduce the yield on both soils, the Zn NPs – to reduce the yield on sod-podzolic soil and to increase on leached chernozem. The composition of the Zn + Ti + Se + I NPs exhibited a tendency to a slight increase in yield.

The composition of Se + I NPs, Avatar-2 Zahyst and Azogran had a greater impact on the yield of potatoes of the Suvenir Chernihivsky variety.

The combination of Azogran with the composition of Se + I NPs had the greatest effect on the yield, steadily increasing its growth in both plots throughout the entire observation period. The results obtained indicate a significant synergy between the composition of the SE + I NPs and the microbial fertiliser Azogran. S. Derevianko and A. Vasylchenko (2020) found that the composition of Se + I Nps significantly increases the titer of the bacterial strain *Bacillus subtilis* IMB B-7023, which is one of the bioagents of the fertiliser Azogran, which may explain the synergy (Derevianko & Vasylchenko, 2020). The authors believe that the use of NPs, in particular in combination with microbial preparations, can significantly increase the efficiency of potato cultivation.

CONCLUSIONS

It was found that the studied NPs influence the yield of potatoes of the Suvenir Chernihivsky variety in different ways. The effect of NPs on yields may differ slightly depending on the type of soil in which the experiment is conducted, but the overall trends are the same on both soils.

Pre-sowing fertilisation with Ti NPs results in a decrease in the yield of potatoes of the Suvenir Chernihivsky variety. In the last two years of observation, the yield decreased when fertilised with Zn NPs on sod-podzolic soil, but increased steadily on leached chernozem. The composition of Zn + Ti + Se + I NPs and the multicomponent micronutrient fertiliser "Avatar-2 Zahyst" increase the yield of potatoes of the variety Suvenir Chernihivsky, but not enough statistically significant data were obtained during the observation period.

The composition of Se+I NPs and the microbial fertiliser "Azogran" significantly increase the yield of potatoes of the Suvenir Chernihivsky variety. According to the average data of three years, pre-sowing fertilisation with the composition of Se + I NPs and the microbial fertiliser "Azogran" contributed to a significant increase in yield on sod-podzolic soil by 33.13 and 38.34%, respectively, and on leached chernozem by 10.97 and 17.98%, respectively.

According to the research, the best variant of pre-sowing fertilisation, which has the most significant effect on the yield of potatoes of the variety Suvenir Chernihivsky, is a combination of "Azogran" with the composition of Se + I NPs. This variant contributed to a statistically significant increase in yield throughout the entire monitoring period in both plots. According to the average data of three years, the yield in this variant is significantly higher than in the control by 45.35% on sod-podzolic soil and by 37.27% on leached chernozem.

The data obtained indicate a significant synergy between the composition of Se + I NPs and the microbial preparation "Azogran", which can be explained by the stimulating effect of Se + I NPs on the bioagent strains of the fertiliser.

The findings of the study suggest that the introduction of nanotechnology and its combined use with microbial preparations is promising for increasing potato yields.

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Аспірант

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Вплив наночастинок, багатокомпонентного мікроелементного добрива «Аватар-2 Захист» та мікробного добрива «Азогран» на врожайність картоплі сорту Сувенір Чернігівський в умовах Полісся

Анотація. Удосконалення традиційних технологій вирощування картоплі має велике наукове і практичне значення для сільського господарства. Останнім часом наночастинки (НЧ) привертають увагу вчених як перспективний засіб підвищення продуктивності сільськогосподарських культур. Встановлено, що НЧ таких хімічних елементів, як Fe, Zn, B, Si, Cu, Co, Se та Ag можуть значно підвищити врожайність картоплі. Відомо, що НП Ag проявляють синергізм з деякими мікробними агентами. Однак вплив на врожайність картоплі таких елементів, як Zn і Se, та їх поєднання з мікробіологічними препаратами для передпосівного удобрення вивчено недостатньо. Не вивчено вплив NP Ti та I на врожайність картоплі, вплив ЕМ на врожайність вітчизняних сортів картоплі, а також вплив ЕМ на врожайність картоплі в умовах Полісся. Метою роботи було дослідити вплив передпосівного підживлення картоплі NPK Zn, NPK Ti, Se+I NPK, Zn+Ti+Se+I NPK, багатокомпонентного мікроелементного добрива "Аватар-2 Захист", мікробного добрива "Азогран" та комбінації мікробного добрива "Азогран" з Se+I NPK на врожайність картоплі сорту "Сувенір Чернігівський" в умовах Полісся. Три роки поспіль на дерново-підзолистому ґрунті та чорноземі вилугуваному закладали невеликі досліди. Ділянки були розташовані на землях Інституту сільськогосподарської мікробіології та агропромислового виробництва Національної академії аграрних наук у Чернігівській області. Отримані дані про врожай картоплі аналізували відповідно до загальноприйнятих методів статистичного аналізу. Встановлено, що серед усіх варіантів передпосівного внесення добрив найбільший вплив на врожайність картоплі сорту Сувенір Чернігівський на дерново-підзолистому ґрунті мали композиція Se+I NP, мікробне добриво Азогран та поєднання Азограну з композицією Se+I NP на 33,13, 38,34 та 45,35% відповідно, а на чорноземі вилугуваному - на 10,97, 17,98 та 37,27%. Встановлено, що композиція наночастинок Se+I та азограну проявляє синергізм. Отримані дані свідчать про високу перспективність використання НЧ у поєднанні з мікробними добривами при вирощуванні картоплі

Ключові слова: картопля, культура, нанотехнології, наночастинки, мікробне добриво, мікроелементне добриво