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Impact of biopreparations on the phytopathological state of potato plants

Abstract. Given the frequent use of chemical agents for the control of potato diseases, it is crucial to explore protective measures that consider agroecological aspects. This study aimed to determine the impact of biological preparations on the development of late blight and alternariosis in potatoes. Research on the effects of biopreparations on the main diseases of potatoes was conducted over three years under field conditions at the Volyn State Agricultural Research Station of the Institute of Potato Growing of the National Academy of Agrarian Sciences of Ukraine. The experimental design, disease diagnosis, and assessment of the technical efficacy of biological preparations against potato diseases were performed according to established methodologies. The experiments revealed that the application of biopreparations under various conditions leads to a reduction in the intensity of late blight and alternariosis in potatoes, as well as contributing to the preservation of yield. Lower disease development and higher efficacy of biopreparations were observed

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in the context where the biodestructor Ekostern (1.2 L/ha) and the biopreparation MycoHelp (2.0 L/ha) were applied, alongside three rounds of plant spraying with various biological preparations – Agat-25K, Regoplant, PhytoHelp, and Stimpo. Among these, PhytoHelp, with an application rate of 1.0 L/ha, exhibited the highest technical efficacy. The use of biological preparations in different contexts increased potato tuber yield. Specifically, with the application of MycoHelp at 2.0 L/ha and the spraying of plants with various biological agents, the preserved yield ranged from 1.71 to 2.02 t/ha. The application of biopreparations alongside the use of Ekostern at 1.2 L/ha and MycoHelp at 2.0 L/ha contributed to yield increases across various treatments, ranging from 1.6 to 2.21 t/ha. The obtained results are deemed useful for enhancing the effectiveness of the integrated protection system for potatoes against specific diseases and for developing organic cultivation technologies for table potatoes on sod-podzolic soils

Keywords: potato blight; alternariosis; disease development; technical efficacy; potato tuber yield

INTRODUCTION

Biopreparations can provide a more environmentally safe and effective means of protecting plants from diseases due to their natural active components, which exert a lesser impact on the environment compared to chemical agents. Their application can help reduce the risk of soil and water resource contamination, as well as minimise the negative effects on beneficial organisms essential for maintaining ecological balance. Furthermore, biopreparations can decrease the risk of pathogen resistance development, a common occurrence with prolonged use of chemical treatments. In addition to their ecological benefits, biopreparations can significantly enhance crop yields and improve plant quality owing to their growth-promoting properties and ability to strengthen plant immunity. This is critically important for ensuring food security, as high yields and quality produce meet the population's needs and enhance economic stability within the agricultural sector. The study and implementation of biopreparations could be vital steps towards the development of sustainable agriculture and the introduction of new, more effective methods for combating phytopathogens.

M. Koch *et al.* (2020) highlighted the significance of potatoes (*Solanum tuberosum* L.) in agriculture due to their high yield potential and valuable nutritional properties, including minerals, vitamins, antioxidants, protein, and fibre. T. Deguchi *et al.* (2016) reported that global potato consumption is approximately 35 kg per person per year. They also found that optimal growing

conditions for potatoes are in regions with average daily temperatures between 10 and 20°C. In Japan, as noted by the authors, plastic mulching is often used to accelerate planting and warm the soil more quickly. This practice is employed to achieve higher prices for early harvests, free up land for rice cultivation, and reduce the risk of late blight under conditions of heavy rainfall.

At the same time, according to T. Artyukh *et al.* (2022), the use of polyethylene film mulching in Ukraine is infrequent, despite the strategic importance of potatoes for the country's food security. As of 2021, Ukraine ranked fourth globally in potato production and second in per capita consumption at 139 kg. However, the authors highlighted that diseases affecting potatoes during growth and storage are among the key limiting factors for yield and quality.

According to M. Berhan (2021), late blight (caused by *Phytophthora infestans* (Mont.) de Bary) and alternariosis (caused by *Alternaria solani* (Ell. et Mart.) Sor.) are among the most prevalent potato diseases worldwide. S.K. Bomok & M.Y. Pikovskiy (2019) found that during storage, table potatoes often develop fungal rots such as dry fusarium, phoma, white, grey, and verticillium rots, as well as common scab and black scurf. These diseases reduce the quality of tubers, decreasing their dry matter and starch content. Research by S.K. Bomok *et al.* (2020) identified late blight and alternariosis as the most dangerous potato diseases in Ukraine. M.M. Kyryk *et al.* (2012) highlighted that late blight affects the above-ground parts of the potato plant and can

also spread to tubers, while alternariosis causes leaf spot and stem necrosis.

R. Sharma *et al.* (2020) investigated the widespread use of chemical pesticides for potato disease control, highlighting the increasing pesticide load on the biosphere. They identified a lack of high-yielding varieties and the prevalence of diseases, particularly alternariosis, as major factors limiting potato yield. J. Yuen (2021) also emphasised the significant impact of *Phytophthora infestans* on food security. Due to the prolonged use of fungicides for disease control, many potato varieties require continuous chemical treatments or possess disease-resistance genes.

Given the challenges posed by chemical pesticides and the prevalence of potato diseases, there is a pressing need to explore more sustainable disease management strategies. Biological control, utilising beneficial microorganisms, offers a promising alternative. Z. Gao *et al.* (2017) demonstrated the efficacy of soil microorganisms in producing volatile organic compounds that can influence plant growth and enhance resistance to pathogens, including grey mould and late blight.

Numerous scientific studies have demonstrated the efficacy of biological control agents in managing potato diseases. Notably, isolates of *Bacillus amyloliquefaciens* and *Bacillus subtilis* have exhibited antifungal activity exceeding 50% against a broad spectrum of phytopathogenic fungi, including *Alternaria alternata*, *Rhizoctonia solani*, *Fusarium oxysporum* and *Fusarium verticillioides*, while simultaneously promoting plant growth (Azeem *et al.*, 2022).

J. Zhang *et al.* (2023) investigated the efficacy of the strain of *Bacillus subtilis* H17-16, isolated from healthy potato roots, in controlling potato late blight caused by *Phytophthora infestans*. The study found that strain H17-16 inhibited the growth of *P. infestans* mycelium and sporangia, induced disease resistance in potatoes, and promoted plant growth. Furthermore, field and post-harvest applications of H17-16 effectively reduced the incidence of potato late blight, and its combination with chitosan or chemical fungicides yielded better results than H17-16 alone. Additionally, another strain of *Bacillus subtilis*, EG21, demonstrated antagonistic activity

against both *Phytophthora infestans* and *Rhizoctonia solani* *in vitro*.

The research aims to establish the impact of biological preparations on the development of late blight and alternariosis in potatoes.

MATERIALS AND METHODS

Research on the impact of biopreparations on the development of late blight and alternariosis in potatoes was conducted from 2021 to 2023 at the Volyn State Agricultural Research Station of the Institute of Potato Growing of the National Academy of Agrarian Sciences of Ukraine (NAAS). The soil at the experimental site is characterised as sod-podzolic loamy sand. The potato variety Partner was cultivated.

The experimental design, disease diagnostics, and determination of the technical efficacy of biological preparations against potato diseases were carried out according to accepted methodologies (Kononuchenko, 2002; Kyryk *et al.*, 2012). The following biopreparations were used in the studies:

1. Ekostern Classic (bacteria of the genera *Bacillus*, *Paenibacillus*, *Azotobacter*, *Enterobacter*, *Enterococcus*, *Agrobacterium*, and fungi of the genus *Trichoderma*; total viable effective microorganisms not less than $2.5-5.0 \times 10^9$ CFU/cm³);
2. MycoHelp (a mixture of cells from *Bacillus subtilis*, *Azotobacter*, *Enterobacter*, *Enterococcus*, and fungi of the genus *Trichoderma*; total viable effective microorganisms not less than 1.0×10^9 CFU/g);
3. PhytoHelp (a concentrated mixture of live natural bacteria *Bacillus subtilis* – not less than 4×10^9 CFU/cm³);
4. Agat-25K (based on soil bacteria *Pseudomonas aureofaciens* H-16; cultural substance of inactivated bacteria, titre $5-8 \times 10^{10}$ before inactivation, bioactive substances from plant sprouts, containing macro- and micronutrients, flavonoids, as well as active fractions of pine extract);
5. Regoplant (contains metabolites of microfungi, which are biologically active substances at a concentration of 0.3 g/L, saturated and unsaturated fatty acids (C14-C28), polysaccharides, includes 15 amino acids, as well as analogues of phytohormones of cytokinin and auxin nature, micronutrients at a concentration of

1.75 g/L, potassium salt of alpha-naphthyl acetic acid – 1 mg/L, and Aversectin C);

6. Stimpo (metabolites of micromycetes, which are biologically active substances – 1 g/L, saturated and unsaturated fatty acids (C14-C28), polysaccharides, 15 amino acids, analogues of phytohormones of cytokinin and auxin nature,

micronutrients at a concentration of 0.014 g/L, and Aversectin C).

In this study, mustard was used as a green manure crop, followed by incorporation into the soil either without a biodestructor or after spraying with the biodestructor Ecostern at a rate of 1.2 L/ha (Table 1).

Table 1. Experimental design for studying the impact of biological preparations on the development of potato diseases

| Factor A | Factor B |
|---|---|
| Background 1. No biodestructor. Incorporation into the soil of MycoHelp, 2.0 L/ha | 1. Control (no foliar application of biological preparations) |
| | 2. Agat-25K, 100 mL/ha |
| | 3. Regoplant, 50 mL/ha |
| | 4. PhytoHelp, 1.0 L/ha |
| | 5. Stimpo, 15 mL/ha |
| Background 2. Ecostern 1.2 L/ha. Incorporation into the soil of MycoHelp, 2.0 L/ha | 1. Control (no foliar application of biological preparations) |
| | 2. Agat-25K, 100 mL/ha |
| | 3. Regoplant, 50 mL/ha |
| | 4. PhytoHelp, 1.0 L/ha |
| | 5. Stimpo, 15 mL/ha |

Source: developed by the authors

Subsequently, the impact of biopesticides was studied following a soil application of MycoHelp at a rate of 2.0 L/ha (in spring, before cultivation) and three foliar spray applications of Agat-25K, Regoplant, PhytoHelp, and Stimpo on potato plant development, late blight, and alternariosis. The study adhered to the ethical guidelines outlined in the Convention on Biological Diversity (1992).

Potato plants were sprayed at the following growth stages: when the canopy closed, at budding, and after flowering.

RESULTS AND DISCUSSION

Analysis of the results revealed that in Background 1 (soil application of MycoHelp, 2.0 L/ha, and three foliar spray applications with various biological agents), late blight development on the treated plots ranged from 6.8% to 9.2%, which was 5.0-7.4% lower compared to the

control (Table 2). The lowest disease incidence was observed in treatments with PhytoHelp, 1.0 L/ha (6.8%), and Agat-25K, 100 mL/ha (7.9%). The development of late blight was also reduced with the use of Stimpo, 15 mL/ha, and Regoplant, 50 mL/ha, where it was 8.9% and 9.2%, respectively. In the study, the reduction in alternariosis development was 6.6-9.4% with a control disease incidence of 17.5%. The highest value was observed when using PhytoHelp at a rate of 1.0 L/ha. The development of alternariosis was practically the same with the application of Regoplant, Stimpo, and Agat-25K, with values of 10.9%, 10.8%, and 10.5%, respectively. The technical efficacy of the tested biopreparations against late blight was 35.2-52.1%. This figure against alternariosis reached 37.7-53.7%. The most effective protection of potato plants from diseases was provided by spraying with PhytoHelp at a rate of 1.0 L/ha.

Table 2. Efficacy of biological preparations against potato diseases (average for 2021-2023)

| No. | Experimental variant | Disease development, % | | Technical efficacy, % | |
|---|--|------------------------|---------------|-----------------------|---------------|
| | | Late blight | Alternariosis | Late blight | Alternariosis |
| Background 1. Incorporation into the soil of MycoHelp, 2.0 L/ha | | | | | |
| 1. | Control (no foliar application of biological preparations) | 14.2 | 17.5 | - | - |

Table 2, Continued

| No. | Experimental variant | Disease development, % | | Technical efficacy, % | |
|---|--|------------------------|---------------|-----------------------|---------------|
| | | Late blight | Alternariosis | Late blight | Alternariosis |
| | | | | | |
| 3. | Regoplant, 50 mL/ha | 9.2 | 10.9 | 35.2 | 37.7 |
| 4. | PhytoHelp, 1.0 L/ha | 6.8 | 8.1 | 52.1 | 53.7 |
| 5. | Stimpo, 15 mL/ha | 8.9 | 10.8 | 37.3 | 38.3 |
| | LSD ₀₅ | 0.31 | 0.24 | | |
| Background 2. Ecosteron 1.2 L/ha. Incorporation into the soil of MycoHelp, 2.0 L/ha | | | | | |
| 1. | Control (no foliar application of biological preparations) | 12.8 | 14.1 | - | - |
| 2. | Agat-25K, 100 mL/ha | 6.5 | 8.1 | 49.2 | 42.5 |
| 3. | Regoplant, 50 mL/ha | 7.9 | 8.5 | 38.3 | 39.7 |
| 4. | PhytoHelp, 1.0 L/ha | 5.5 | 5.8 | 54.7 | 58.8 |
| 5. | Stimpo, 15 mL/ha | 7.8 | 8.4 | 39.0 | 40.0 |
| | LSD ₀₅ | 0.21 | 0.26 | | |

Source: developed by the authors

In treatment, variants in Background 2, where Ecosteron (1.2 L/ha) was applied to the soil along with MycoHelp (2.0 L/ha) and foliar sprays of biopreparations during the potato growing season, late blight development decreased to 5.5-7.9% compared to the control, where the disease incidence was 12.8% (Table 2). The trend observed in Background 1 was also evident in Background 2, namely the ability of PhytoHelp (1.0 L/ha) and Agat-25K (100 mL/ha) to provide the maximum reduction in late blight development. In the variants in Background 2, the lowest alternariosis development was also observed in Variant 4 with PhytoHelp treatment, where the value was 5.8%, while in variants treated with Agat, Stimpo, and Regoplant, the value was 8.1%, 8.4%, and 8.5%, respectively.

The technical efficacy of biopesticides against late blight in Background 1 ranged from 35.2% to 52.1%, while against alternariosis, this figure was 37.7-53.7% (Table 2). For both diseases, PhytoHelp at a rate of 1.0 L/ha was the most effective. Meanwhile, in Background 2, with the application of Ecosteron (1.2 L/ha), an increase

in technical efficacy was observed when using biological treatments. Specifically, this figure against late blight was 38.3-54.7%, and against alternariosis – 39.7-58.8%. The highest efficacy was observed in variants with foliar application of PhytoHelp.

The application of biological preparations on different backgrounds increased potato tuber yield (Table 3). In the control, the potato tuber yield was 10.62 t/ha in Background 1 with a soil application of MycoHelp at 2.0 L/ha, while in the control of Background 2 with the use of Ecosteron at 1.2 L/ha and MycoHelp at 2.0 L/ha, the yield was 11.46 t/ha. In Background 1, with a soil application of MycoHelp at 2.0 L/ha and foliar application of various biological agents, the harvested yield was 1.71-2.02 t/ha. Comparing the variants of foliar treatment of potato plants with biopreparations in Background 1, it should be noted that they differed little in potato tuber yield, which was 12.33-12.64 t/ha. The highest yield was established in Variant 4 with a soil application of MycoHelp (2.0 L/ha) and three-time treatment with PhytoHelp (1.0 L/ha).

Table 3. Potato tuber yields under the application of biological preparations (average for 2021-2023)

| Experimental variant | Yield, t/ha |
|---|-------------|
| Background 1. Incorporation into the soil of MycoHelp, 2.0 L/ha | |
| 1. Control (no foliar application of biological preparations) | 10.62 |
| 2. Incorporation into the soil of MycoHelp at 2.0 L/ha + three foliar applications of Agat-25K at 100 mL/ha during the growing season | 12.35 |
| 3. Incorporation into the soil of MycoHelp at 2.0 L/ha + three foliar applications of Regoplant at 50 mL/ha during the growing season | 12.33 |

Table 3, Continued

| Experimental variant | Yield, t/ha |
|---|-------------|
| 4. Incorporation into the soil of MycoHelp at 2.0 L/ha + three foliar applications of PhytoHelp at 1.0 L/ha during the growing season | 12.64 |
| 5. Incorporation into the soil of MycoHelp at 2.0 L/ha + three foliar applications of Stimpot at 15 mL/ha during the growing season | 12.42 |
| Background 2. Ecostern 1.2 L/ha. Incorporation into the soil of MycoHelp, 2.0 L/ha | |
| 1. Control (no foliar application of biological preparations) | 11.46 |
| 2. Incorporation into the soil of MycoHelp at 2.0 L/ha + three foliar applications of Agat-25K at 100 mL/ha during the growing season | 13.08 |
| 3. Incorporation into the soil of MycoHelp at 2.0 L/ha + three foliar applications of Regoplant at 50 mL/ha during the growing season | 13.39 |
| 4. Incorporation into the soil of MycoHelp at 2.0 L/ha + three foliar applications of PhytoHelp at 1.0 L/ha during the growing season | 13.67 |
| 5. Incorporation into the soil of MycoHelp at 2.0 L/ha + three foliar applications of Stimpot at 15 mL/ha during the growing season | 13.06 |
| LSD ₀₅ Factor A | 0.07 |
| Factor B | 0.11 |
| AB | 0.15 |

Source: developed by the authors

The application of biological preparations on a background of Ecostern at 1.2 L/ha and MycoHelp at 2.0 L/ha contributed to a yield increase of 1.6–2.21 t/ha in various variants.

In Background 2, tuber yields for variants with foliar applications of biopreparations ranged from 13.06 to 13.67 t/ha. Similar to Background 1, the highest yield was obtained in Variant 4 (soil application of MycoHelp at 2.0 L/ha + three foliar applications of PhytoHelp at 1.0 L/ha during the growing season). Variant 3, with a soil application of MycoHelp at 2.0 L/ha and three foliar applications of Regoplant at 1.0 L/ha, had a slightly lower tuber yield of 13.39 t/ha. Meanwhile, Variants 1 (MycoHelp at 2.0 L/ha and Agat-25K at 100 mL/ha) and 5 (MycoHelp at 2.0 L/ha and Stimpot at 15 mL/ha) showed virtually no difference in tuber yield, with values of 13.08 and 13.06 t/ha, respectively.

In general, scientific literature presents findings on the varying potential of biological products in enhancing plant productivity and limiting the development of potato diseases, which depend on numerous factors requiring further study (Osei et al., 2022). The current research has demonstrated the effectiveness of both biological products applied to sod-podzolic soil and those applied as foliar treatments.

The results presented indicate that the application of biopreparations under various conditions leads to a reduction in the severity of late blight and alternariosis in potatoes and

contributes to increased yield. Lower disease incidence and higher efficacy of biological products were observed when a biodestructor, Ecostern (1.2 L/ha), and a biopreparation, MycoHelp (2.0 L/ha), were applied to the soil, followed by three foliar sprays of different biological agents – Agat-25K, Regoplant, PhytoHelp, and Stimpot. Among these, PhytoHelp (based on *B. subtilis* bacteria) at a rate of 1.0 L/ha exhibited the highest technical efficacy. The findings of A. Saba et al. (2022) confirm the effectiveness of biological control agents against potato diseases using various microorganisms. Specifically, isolates of *Bacillus amyloliquefaciens* and *Bacillus subtilis* demonstrated antifungal activity (over 50%) against a broad spectrum of phytopathogenic fungi, including *Alternaria alternata*, *Rhizoctonia solani*, *Fusarium oxysporum*, and *Fusarium verticillioides*, and also promoted plant growth.

In a study conducted by L. Stridh et al. (2022) under both greenhouse and field conditions, the impact of various biocontrol agents, such as *Pythium oligandrum*, *Bacillus subtilis*, and the biopreparations *Polygandron* and *Serenade*, was evaluated for the control of early blight in potatoes. These agents were used individually, in combination with each other, or conjunction with synthetic fungicides. In greenhouse conditions, the application of biocontrol agents led to a significant reduction in infection by *A. solani*, achieving efficacy rates of 50% to 95%. However, in field conditions, this effect was much less

pronounced, indicating the difficulty of achieving similar results in open fields due to the influence of various external factors. In light of these results, the authors of this article conducted their own field trials, which confirmed the effectiveness of bioproducts not only in controlling common potato diseases but also in increasing overall tuber yield. This approach highlights the potential of integrating biological agents with other control methods for a comprehensive approach to improving crop productivity.

A. Alfiky *et al.* (2022) reported that EG21 metabolites exhibited a strong zoosporecidal effect on *P. infestans*. The inhibitory effect against *P. infestans* and *R. solani* infections was confirmed on potato leaves and tubers, respectively. The antagonistic potential of *Trichoderma* spp. strains against *P. infestans* were evaluated *in vitro* by A. Alfiky *et al.* (2023). In dual culture, *P. infestans* growth was suppressed by 53% to 95%.

Overall, *Pseudomonas* spp. strains exhibited varying levels of biocontrol activity against *P. infestans* in potato tuber bioassays. For instance, a study by G. Léger *et al.* (2021) demonstrated that strains of *P. orientalis* and *P. yamanorum* significantly reduced the level of late blight, exhibiting a high level of biocontrol properties. Conversely, strains of *P. synxantha* were ineffective in inhibiting pathogen growth, highlighting the need for careful strain selection for the control of *P. infestans*. These results also indicate potential variations among strains of the same genus, requiring further research to identify the most effective biocontrol agents. Moreover, in addition to the individual characteristics of strains, environmental conditions can also influence their ability to effectively protect plants from pathogens.

S. Kumar *et al.* (2023) conducted pot experiments to evaluate the efficacy of three biocontrol agents – *Trichoderma viride*, *Bacillus subtilis* and *Pseudomonas fluorescens* – individually and in a consortium, for promoting potato growth and activating defence mechanisms against *A. solani*. Results indicated that the application of a consortium of the three microorganisms significantly enhanced plant growth compared to other treatment methods. Potato plants treated with the triple-microbe consortium exhibited a substantial reduction in disease incidence

compared to control plants inoculated with *A. solani* but left untreated.

N. Metz & H. Hausladen (2021) investigated the potential of *Trichoderma* spp. against *A. solani* under laboratory, greenhouse, and field conditions. They found that the choice of a specific *Trichoderma* strain can significantly influence the outcome, as even strains of the same species demonstrated varying levels of efficacy. However, a significant reduction in alternariosis in the field was recorded in only one of the four years of field trials. Furthermore, the authors were unable to find a significant correlation between *in vitro*, *in vivo*, and field data within a single year, highlighting the need for field trials to assess real-world efficacy.

Thus, both in the present research and in studies conducted by other researchers, a positive effect of biopreparations on reducing the incidence of diseases affecting table potatoes has been established. In particular, a decrease in the infectious load on plants and an increase in their resistance to pathogens have been observed. This not only improves the quality of the yield but also reduces the reliance on chemical protection agents.

CONCLUSIONS

The results of the research indicate that the use of biopreparations has a positive impact on the development of both late blight and alternariosis in potatoes. The greatest efficacy was demonstrated by the product PhytoHelp at a dosage of 1.0 L/ha, which reduced the level of late blight infestation to 5.5% and alternariosis to 5.8%, in conjunction with the application of Ekostern at 1.2 L/ha. Overall, the technical efficacy of the investigated products against late blight reached 54.7%, while against alternariosis, it reached 58.8%. Other biopreparations also contributed to the reduction of disease development, although their effectiveness was somewhat lower.

The application of biopreparations also contributed to increased potato yields. When using MycoHelp at a rate of 2.0 L/ha in combination with PhytoHelp at 1.0 L/ha, yields reached 13.67 t/ha, which is 2.21 t/ha higher than the control. Similarly high yield results were obtained with other biopreparations such as Agat-25K

and Stimp, however, PhytoHelp demonstrated the most consistent results.

The lowest disease development was observed in treatments where the biodestructor Ecoster (1.2 L/ha) and the biopreparation MycoHelp (2.0 L/ha) were applied, followed by foliar sprays with Agat-25K, Regoplan, PhytoHelp, and Stimp at various growth stages. PhytoHelp, at a rate of 1.0 L/ha, demonstrated the highest technical efficacy, resulting in a yield increase of 2.21 t/ha. Thus, the research confirmed the high efficacy of biopreparations in controlling major potato diseases, as well as their positive impact on yield. This indicates the feasibility of their use in potato production. The results obtained suggest the need for further studies on the effects of biopreparations on different potato varieties and other crops.

Additionally, the long-term effects of biopreparations on the preservation of agroecosystems should be investigated. It is also important to study the impact of these products on other pathogenic organisms that may affect potatoes. Research into the efficacy of biopreparations in other soil and climatic zones is promising.

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CONFLICT OF INTEREST

None.

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Вплив біопрепаратів на фітопатологічний стан рослин картоплі

Анотація. З огляду на часте застосування хімічних засобів для контролю хвороб картоплі, важливо шукати можливості захисту з урахуванням агроекологічних аспектів. Метою роботи було визначення впливу біологічних препаратів на розвиток фітофторозу та альтернاریозу картоплі. Дослідження впливу біопрепаратів на розвиток основних хвороб картоплі проводили протягом трьох років у польових умовах Волинської державної сільськогосподарської дослідної станції Інституту картоплярства Національної академії аграрних наук. Постановку експериментів, діагностику хвороб, визначення технічної ефективності біологічних препаратів проти захворювань картоплі проводили за загальноприйнятими методиками. Експериментами встановлено, що застосування біопрепаратів на різних фонах призводить до зниження інтенсивності розвитку фітофторозу та альтернاریозу картоплі, а також сприяє збереженню врожаю. Нижчий розвиток хвороб і вищу ефективність біопрепаратів відмічено на фоні, де вносили біодеструктор Екостерн (1,2 л/га), біопрепарат Мікохелп (2,0 л/га) та здійснювали трьох разові обприскування рослин різними біологічними препаратами – Агат-25К, Регоплант, Фітохелп і Стимпо. При цьому найвищою технічною ефективністю характеризувався Фітохелп з нормою витрати 1,0 л/га. Використання біологічних препаратів на різних фонах забезпечувало зростання врожайності бульб картоплі. Зокрема за застосування Мікохелп 2,0 л/га та обприскуванням рослин різними біологічними засобами збережених урожай становив 1,71-2,02 т/га. Внесення біопрепаратів на фоні використання Екостерн 1,2 л/га та Мікохелп, 2,0 л/га сприяло зростанню врожайності у різних варіантах від 1,6 до 2,21 т/га. Отримані результати доцільно використовувати для підвищення ефективності інтегрованої системи захисту картоплі від окремих хвороб і розробки органічних технологій вирощування картоплі столової на дерново-підзолистих ґрунтах

Ключові слова: фітофтороз картоплі; альтернاریоз; розвиток хвороб; технічна ефективність; урожайність бульб картоплі