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Research Article

Influence of the Multifunctional Biological Product Phytop 26.82 on the Growth and Development of Seed Potatoes

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The study aimed to test a multifunctional technology for potatoes' biological protection using Phytop 26.82 against black scurf (*Rhizoctonia solani Kuhn*) and Colorado potato beetle in Western Siberia. The experiment was conducted with the medium-maturing variety "Kemerovchanin." The product tested was Phytop 26.82. The research methodology was carried out both in laboratory conditions and in the field. In the laboratory, the biological product was used on potato leaves and Colorado potato beetle larvae. The authors revealed the degree of influence of the natural effect Phytop 26.82 on the Colorado potato beetle's larvae of different ages. The larvae were counted on the 5th, 7th, and 10th days of the experiment. In the field, the authors also revealed the level of the immunogenic effect of the bioagent Phytop 26.82 on the Rhizoctonia stem canker (*Rhizoctonia solani Kuhn*). The morphological parameters of the Kemerovchanin potato variety were observed during the course of this study. The results of the study showed that the microbial mixture Phytop 26.82 made it possible to increase the biomass of plants by 1.5–1.8 times due to an increase in the length of the aerial part (by 10%), the number of stems (1.2–1.7 times), and the number of stolons (1.5–1.6 times) compared to control. Under the bioagent, Phytop 26.82, Rhizoctonia stem canker on the stems decreased by 45% overall counting weeks. The effectiveness of the bioagent Phytop 26.82 reached 100% in two aspects. One of them was the effectiveness of a biological product in the Colorado potato beetle's obliteration (*Leptinotarsa decemlineata*). The second direction of significance was the fight against the black scurf. The use of a mixture of bioagents of the Phytop 26.82 preparation can simultaneously have an insecticidal, fungicidal, and growth-stimulating effect on potatoes.

1. Introduction

Plant protection from pests and diseases remains an urgent problem in both small farms and modern greenhouses and in the fields of agricultural holdings. It is difficult to grow plants that would not be affected or susceptible to various diseases in current conditions. Today, land protection and improving agriculture's safety from harmful organisms is an urgent topic in agronomy. In particular, ensuring the environmental safety of potatoes (*Solanum tuberosum*) implies the maximum possible replacement of chemical pesticides with biological preparations based on biological agents taken from the environment. Their goal is the natural regulation of the action of several pests and plant pathogens. It is most advisable to use physical products in Siberia, especially in personal subsidiary plots, where 95% of all potatoes are grown [1]. It is equally important to replace chemical pesticides in the protection of potatoes to suppress diseases, among which pests are the most significant. All this requires long-term and comprehensive studies to evaluate new biological agents and biological products.

Scientists are looking for environmentally friendly remedies with complex effects around the world.

This study aimed to test a multifunctional potato biological protection technology using Phytop 26.82 control—*Rhizoctonia Solani* and the Colorado potato beetle *(Leptinotarsa decemlineata)* in Western Siberia.

For any agricultural crop, its protection measures depend on the species composition of pest and plant pathogens. The more various pests are destroyed by biological methods, the more significant the contribution of natural plant protection to the economy of agriculture and food systems.

In Siberia, biological methods are still used on a relatively narrow range of crops (wheat, peppers, tomatoes, cucumbers, strawberries, raspberries, and currants) [2]. In Siberia's climatic conditions, agronomists actively use natural protection for vegetable crops in the open and closed grounds [3]. Less attention is paid to the problem of the biological safety of potatoes, the relevance of which is beyond doubt.

Potato growing in Siberia is an essential branch of agricultural production. This culture has high plasticity and can grow and produce good crops in unstable weather and climatic conditions [4]. Potato yield, among other factors, is highly dependent on disease damage and damage by pests. The spread and harmfulness of pests in different years can vary significantly depending on the weather conditions of a particular growing season, agricultural technology, the quality of seeds, and cultivated varieties' composition.

The most dangerous pest of potatoes in Western Siberia is the Colorado beetle (*Leptinotarsa decemlineata).* The crop losses from its activities are high in almost all Russian regions [5]. In most cases, the chemical pyrethroid insecticides are used against this phytophagy [5]. In the structure of potato production, a significant share is taken by the private sector (individual subsidiary farms, including vegetable gardens, cottages, and country houses), so the role of environmental protection measures is increasing.

Until now, own production of potatoes on a farm plot or dacha is the key to food security for many segments of the population, allowing them to survive adverse years. The shortage of potato crops in Russia is due to damage to plants by the Colorado beetle (*Leptinotarsa decemlineata* L.). In recent years, this problem has also occurred in the Siberian region. On various varieties, losses reach from 12 to 50%. In years where the pest becomes severe and in the absence of protective measures, potato losses reach 100%.

The beetle has adapted to the local climatic conditions of the West Siberian region [6]. Its abundance and severity are consistently high. Thus, at present, the territory of the forest-steppe of the Novosibirsk region belongs to the zone of distribution and habitation of this phytophagy [7].

Among potato diseases under local conditions, the most dangerous black scurf species is *Rhizoctonia solani Kuhn* [8]. It affects tubers, stems, stolons, and roots of adult potato plants, as well as sprouts and seedlings, causing their death. In addition to potatoes, it affects many vegetables, flower plants, and weeds (*Sonchus oleraceus, Sonchus arvensis, Equisétum arvénse, Chenopōdium quīnoa*, etc.).

The disease can manifest as scurf, deep (ulcerated) spots, reticulated necrosis of tubers, rotting of eyes and shoots, death of stolons and roots, and the form of a "white leg" of stems. The scurf appears as black sclerotia of various sizes, located on the tubers' surface, similar to clumps of soil stuck to them. Sclerotia do not cause much damage to the tuber.

2. Materials and Methods

2.1. Experimental Procedure. The experiment was carried out with the medium-maturing variety "Kemerovchanin" (it is a ware variety potato of potatoes). The product tested was Phytop 26.82. The microbial mixture Phytop 26.82 consists of nematophagous fungi—*Arthrobotrys oligospora* and *Duddingtonia flagrans*, bacteria—*Bacillus amyloliquefaciens* (BS) RCIM B 10642, *Bacillus licheniformis* (Bl) RCIM B 10562, and *Bacillus subtilis* (B8) RCIM B 10641, and an entomopathogenic fungus *Beauveria bassiana* (B15). The authors used the biological product Bactofit SP (1 g per 500 ml of water) as a reference. The product Bactofit is a biological fungicide based on the microbial activity—bacteria *Bacillus subtilis* (strain IPM 215) ("haystack"—an aerobic microorganism).

The field experiments were carried out in the fields of the training and production farm "Michurintsev Garden" of the Novosibirsk State Agrarian University following the method of field research. The field experiment (method of field research) is that cultivated plants are studied together with the entire complex of soil-climatic and agrotechnical factors near-production conditions or directly in production conditions. The soil cover of the areas of the educational and production farm "Michurintsev Garden" is typical for the region leached medium loamy chernozem with an agrochemical property (characteristics) of the arable soil layer (0–30 cm): humus (according to Tyurin) was 4–6%, nitrogen was 0.30 g (according to Kjeldahl), and phosphorus and potassium were (according to Chirikov) 25.0 mg per 100 g of soil, respectively. The soil's P is weakly acidic and neutral (pH 5.9–6.3) [9, 10]. The main elements of potato cultivation technology correspond to those generally accepted in the Novosibirsk region.

The experiments were carried out from the end of September 2018 to September 2019.

The following assessments were conducted:

(i) Infestation of potatoes with the causative agent of *Rhizoctonia solani J.G. Kuhn*

(ii) Influence on growth-stimulating processes (morphological indicators and yield).

2.2. Experimental Treatment

(1) Control (treatment of tubers with water)

(2) Bactofit (treatment of tubers, the rate of application of 200 L/ha)

(3) Phytop 26.82 (treatment of tubers, the rate of application of 200 L/ha)

The total area of the plot was 25 m^2. The placement of schemes was systematic. The authors carried out the tests according to the standard (4 rows per plot); therefore, the experiments' repeatability was fourfold in two-row plots.

Agrotechnical measures included fall ploughing in late September to early October 2018, spring ploughing, and cultivation (15–20 cm). Sowing was carried out manually on May 25, 2019. Planting maintenance consisted of mechanical weeding, interrow cultivation, and hilling.

Agronomic practices included the application of potato fertilizer Kemira (30–40 g per m^2 of soil), weeding, and hilling. Kemira's preparations have several different directions, developed specifically for feeding specific crops. Fertilizer "Kemira" for potato contains granules for spring tillage before planting tubers. It could be applied during the growing season. It contains 16% potassium. Sulfur (2.7%) is an excellent assistant in the fight against various diseases. The composition also includes 11% nitrogen, 9% phosphorus, and 2.7% magnesium. Weeding was done by hand. The predecessor is steam. Planting density was 40.8 thousand/ha, the planting site was 0.7×0.35 m. All treatments were performed with 4 replications.

The experimental design included testing a new mixture, used in two versions: treating tubers before planting potatoes to reduce Rhizoctonia disease prevalence (Bactofit used as a reference option) and spraying during the growing season against the Colorado potato beetle.

(1) Control (treatment of tubers with water)

(2) Bactofit (treatment of tubers)

(3) Biological product Phytop 26.82: nematophagous fungi *Arthrobotrys oligospora* and *Duddingtonia flagrans* (BS (treatment of tubers) + Bl (treatment of tubers) + B8 (treatment of tubers) + B15 (treatment of tubers)).

A microbial mixture Phytop 26.82 was used at a concentration of 10^6 CFU/ml. The incidence of shoots and stems of Rhizoctonia stem canker 4, 6, and 10 weeks after planting was registered. The percentage of damaged and fallen stolons concerning their total number was noted. The plants were dug, the soil was shaken off, and the underground part was assessed with respect to damage. A five-point scale according to Frank [11] was used for the assessment.

0: no lesion

1: strokes and ulcers on a sprout (stem) up to 25 mm long

2: lesion on the sprout (stem) up to 50 mm long

3: lesion on the sprout (stem) more than 50 mm long, but do not completely ring the sprout (stem)

4: extensive ulcers ringing the sprout (stem)

5: the sprout (stem) has rotted or broken

The degree of damage to new tubers by black scurf disease was determined by the ratio of the mass fraction of healthy tubers and tubers affected by various disease forms. The biological yield and the new crop's tubers' state were determined by weighing the crop from the site and calculating it per hectare.

Prevalence (P) was determined using the following formula:

$$P = \frac{A_p \times 100}{R_p}, \quad (1)$$

where A_p is the number of affected plants and R_p is the total number of registered plants.

A more accurate assessment of the state of tubers was carried out using the sclerotiorum (S.i.) index [12]:

$$\text{S.i.} = \frac{1 \times h + 3,5 \times m + k + 6 \times l}{c + h + m + k + l}, \quad (2)$$

where c is the weight of healthy tubers; h is the mass of tubers affected by reticular necrosis and a deep spot; m is the mass of tubers with single sclerotia and sclerotia on 1/10 of the surface; k is the mass of tubers with sclerotia, occupying 1/4 of the surface; and l is the mass of tubers with sclerotiorum, occupying 1/2 of the surface.

Additional experiments in the laboratory were carried out. The effect of the new biological product Phytop 26.82 was evaluated on the Colorado potato beetle (*Leptinotarsa decemlineata*) in plastic containers (volume 250 ml). The box with forage plant potato leaves was treated with a suspension of a biological preparation (at a concentration of $1'10^6$ CFU/ml), and ten larvae of all ages of the Colorado beetle (*Leptinotarsa decemlineata*) were placed, previously caught on potato planting.

In the control version, leaves wetted with water were used. Live and dead individuals were counted on the 5th, 7th, and 10th days of the experiment. In each treatment, four repetitions were tested, each with ten individuals of the pest. The authors calculated the biological effectiveness of the drugs using the Abbott formula:

$$C = 1 - \frac{100\left(AK_1\right)}{BK_2}, \quad (3)$$

where A is the number of pest individuals in the experimental version before treatment; B is the number of live pest specimens in the experimental version after treatment; K_1 is the number of live individuals in control in the preliminary counting (before treatment); and K_2 is the number of live individuals in control in the subsequent counting (after treatment).

Field tests were conducted of a multifunctional microbial mixture (Phytop 26.82) and its effect on potatoes was evaluated:

(1) Potato infestation with the black scurf (*Rhizoctonia solani Kuhn*)

(2) Biological effectiveness of the microbial mixture Phytop 26.82 on the Colorado beetle

(3) Influence on plant morphological indicators and yield

The treatment included testing a new mixture, which was used in two versions:

(i) The treatment of tubers before planting potatoes to reduce the prevalence of black scurf (as a reference variant, Bactofit was used (this drug has the maximum distribution, and therefore, it is taken as a control comparison))

(ii) Spraying during the growing season on the Colorado beetle (*Leptinotarsa decemlineata*)

All treatments were performed with 4-fold repetitions using the microbial mixture Phytop 26.82 at a concentration of 10^6 CFU/ml.

Statistical processing of the data was performed by the method of analysis of variance using the SNEDECOR software package for Windows and using Google and Excel tables [13]. The energy efficiency of elements of early potato cultivation technology is evaluated according to the "Union Academy of Agricultural Sciences named after V.I. Lenin (UAAS, named after V.I. Lenin) Guidelines" (1998). Economic efficiency is determined by the Russian Academy of Agricultural Sciences (RAAS) (2001).

3. Results and Discussion

The new mixture's effectiveness in the laboratory experiment was high (see Table 1 and Figure 1). Almost half of the larvae of the 1st age died on the 5th day. On the 7th day, the biological efficiency (BE) was 73.9%; and on the 10th day, it was at the level of 100%. However, with each subsequent age, the biological efficiency decreased, and Phytop 26.82 did not have an excellent insecticidal effect on larvae of 3-4 ages. On average, for all ages, the drug controlled phytophage at the level of 26.4–42.9% (on the 5th–7th day) and 65.9% (on the 10th day) (see Table 1, Figure 1).

Application of the new bioagent mixture in the field also showed significantly higher efficiency concerning larvae of the 1st age, which reached 88.5%. Besides, the drug provided a relatively high death rate of larvae of the 2nd age (61.5%). On average, for all ages, the biological effectiveness of Phytop 26.82 on the 7th day did not exceed 50% (due to the high resistance of older larvae). Thus, the biological product should be more effective for larvae of 1-2 ages.

Table 1: The biological efficacy of the drug Phytop 26.82 at a dose of 1×10^6 CFU/ml by phase and age of larvae (from L1 to L4) in laboratory experiments on days 5, 7, and 10. The arithmetic mean of the biological effectiveness was calculated as a percentage for the reporting day.

Microbial mixture	Larval age	Biological efficiency in days (%)		
		5	7	10
Phytop 26.82, 1×10^6 CFU/ml	L1	47.8	73.9	100.0
	L2	34.6	67.3	90.5
	L3	23.1	23.7	45.7
	L4	0.0	6.7	27.6
	Average	26.4	42.9	65.9

3.1. Antifungal Effect of the Drug

Under the influence of bioagents, the damage to the stems of *Rhizoctonia solani Kuhn* decreased. The prevalence of Rhizoctonia stem canker decreased relative to the control: at the 4th week by 1.6 times, at the 6th week by 1.9 times, and at the 10th week by 1.3 times (see Table 2).

It is logical that the biofungicide Bactofit, whose mechanism of action is based on the work of a microorganism—the bacterium *Bacillus subtilis* (strain IPM 215), was more effective and provided 100% suppression of pathogen for 4–6 weeks compared to the tested drug. The disease's prevalence is a quantitative indicator of the number of plants affected but does not reflect the degree of illness. In that case, the intensity of disease development or just the development of the disease is a quality value determined by the area of the affected body's surface or the power of the other symptoms of the disease. Therefore, it is a more precise criterion.

The development of potato Rhizoctonia stem canker in the variant with the Phytop 26.82 natural preparation 2.5 months after planting statistically significantly decreased by 3.4 times compared to the control and was at the reference drug level (Bactofit).

Thus, the studied biological preparation had a growth-stimulating and healing effect on potato plants, which allowed obtaining higher quality and high yield compared to the control variants. Preplanting treatment of tubers with a new mixture (Phytop 26.82) provided the production of larger tubers (see Table 3 and Figure 2) and a 10% increase in yield (360 kg/ha).

The sclerotiorum index and the prevalence of scurf when using Phytop 26.82 on tubers of the new crop decreased by 1.8 times compared to the control variant and were at the standard level.

3.2. Growth-Stimulating Effect

The use of a mixed biological preparation Phytop 26.82 for preplanting treatment of tubers provided an increase in plant biomass by 1.5–1.8 times due to the rise in the length of the aboveground part (by 1.2 times), the number of stems (by 1.2 times—for the 6th counting weeks), and the number of stolons (by 1.5–1.6 times) compared to the control variant (see Table 4 and Figures 3–5).

Besides, the benefits of the new drug over the standard were found. Therefore, at the 6th week in the experimental version, the tubers' mass was 1.8 times greater than in the version with Bactofit. And the height of plants increased by 1.2 times. On the 10th week after planting, the number of stolons increased by 1.7 times, and plants' weight increased by 1.3 times.

3.3. The Effect of the Drug Phytop 26.82 on the Phytopathogenic Microflora of the Soil

The authors analyzed the effect of the Phytop 26.82 bioproduct on the soil microbiota during the preplanting treatment of tubers (June 2019). This biopreparation reduces the activity of pathogenic fungi of *R. Fusarium* by 1.5 times (Czapek's medium), as well as when grown on a selective nutrient medium by 1.3 times (see Table 5).

Under the influence of the microbial complex, which is part of the drug Phytop 26.82, the number of fungi genus *Penicillium* (Czapek's medium) decreases 2.6 times, and the number of actinomycetes in the soil (starch-ammonia agar

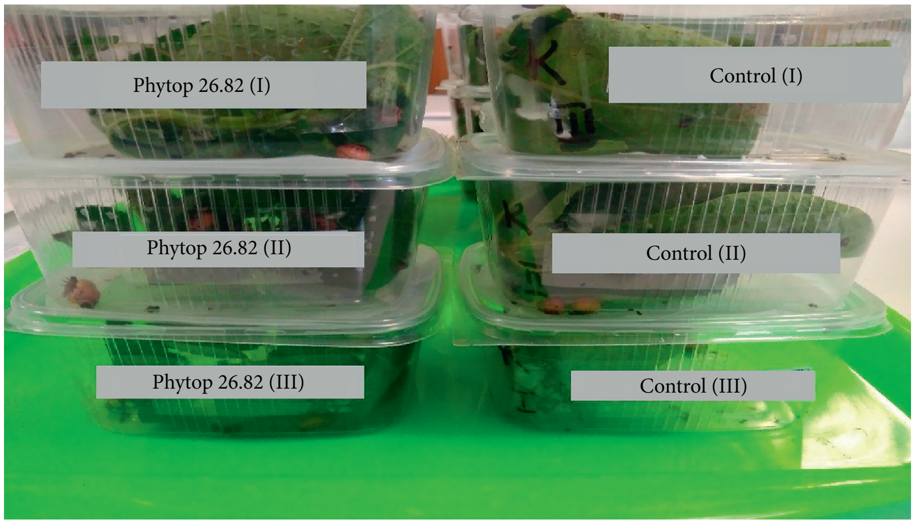

Figure 1: Laboratory experience in evaluating the insecticidal activity of Phytop 26.82.

Table 2: The fungicidal effect of bioagents on potatoes of the "Kemerovchanin" variety by the counting week.

Experience variants	Counting weeks	The prevalence of the disease (%)	Biological efficiency (%)	Development index (%)
Control	4	28.57	—	5.71
	6	29.27	—	6.45
	10	68.75	—	45.00
Bactofit	4	0.00	100.00	0.00
	6	0.00	100.00	0.00
	10	41.67	62.96	16.67
Phytop 26.82	4	18.18	36.36	3.64
	6	15.38	15.38	4.62
	10	53.33	70.37	13.33
SSD*05 of the variants		—	—	12.34
SSD*05 counting date		—	—	21.38

*SSD: the smallest significant difference. The smallest significant difference in the development index is also presented. The highest biological efficiency is presented in the Phytop 26.82 variant.

Table 3: The impact of the biopreparation Phytop 26.82 on the indicators of the development of black scurf on the root potato with a new yield of three variants.

Variant	Yield (ton/ha)	S.i. (sclerotiorum index)	The prevalence of black scurf (%)
Control	30.2	0.25	5.6
Bactofit	30.2	0.15	3.4
Phytop 26.82	33.6	0.14	3.1
SSD_{05}	11.46	0.39	—

Potatoes treated with the biological product Phytop 26.82 show the highest outcome in tons per hectare, 33.6 tons/ha. Moreover, also the lowest sclerotiorum index in potatoes treated with Phytop 26.82 was found.

(SAA)) decreases 1.4 times. Simultaneously, the number of bacteria assimilating organic nitrogen (1.6 times) and insignificantly embodying mineral nitrogen increases. However, microbial agents reduce the number of oligonitrophilic bacteria by 1.1 times, which play an essential role in fixing atmospheric nitrogen and supplying available nitrogen forms to plants. Simultaneously, the number of cellulose-based bacteria increases 1.4 times, which is vital for the natural destructive process (carbon cycle in the biosphere), providing a fixed carbon return to 1.1 times in the photosynthesis process in the atmosphere as CO_2. The global role of microorganisms is to degrade cellulose, one of the plant residues' main components. No animals, either the plants themselves, can do this. The cellulose content ranges from 15% to 60% of the plant mass. And the cellulose content in cotton and flax reaches up to 80–95%. Also, microorganisms are involved in soil processes and the formation of their properties.

In summary, the presented results are in line with current trends in the use of a mixture of bioagents for plant protection from harmful organisms to improve the effectiveness of biological plant protection, including inducing systemic resistance to the pathogen [14].

Figure 2: The yield of "Kemerovchanin" potato variety: in the left is control and in the right is Phytop 26.82.

Table 4: The effect of bacterial strains on the morphological parameters of the "Kemerovchanin" potato by the counting week.

Experience variants	Counting week	Weight of 1 plant gram	The length of the stems (cm)	Number, pieces	
				Stems	Stolons
Control	4	89.3	17.6	2.3	13.7
	6	219.3	38.7	3.7	14.3
	10	500.7	47.7	5.3	31.3
Bactofit	4	111.0	14.4	4.0	20.3
	6	180.0	36.7	4.0	25.3
	10	694.7	59.0	4.3	30.7
Phytop 26.82	4	85.3	16.0	3.7	16.0
	6	325.7	43.7	4.3	23.0
	10	903.7	59.0	5.0	48.0
$SSD^*_{05 \text{ of the variants}}$		113.4	3.348	1.279	7.300
$SSD^*_{05 \text{ counting date}}$		196.4	5.798	2.215	12.64

*SSD: the smallest significant difference. The smallest significant difference by counting date and variants is also presented. The largest morphological values for the plant's weight and length and the number of stolons and stems are presented in the Phytop 26.82 variant. The less significant values are shown in the Bactofit variant. The smallest values are presented in the control variant.

Figure 3: The stems of the "Kemerovchanin" potato variety at the 4th counting week according to three variants (control, Phytop 26.82, and Bactofit). As we can see in the photo, the most extended potato stem is 46 cm (the branch of the biological product Phytop 26.82).

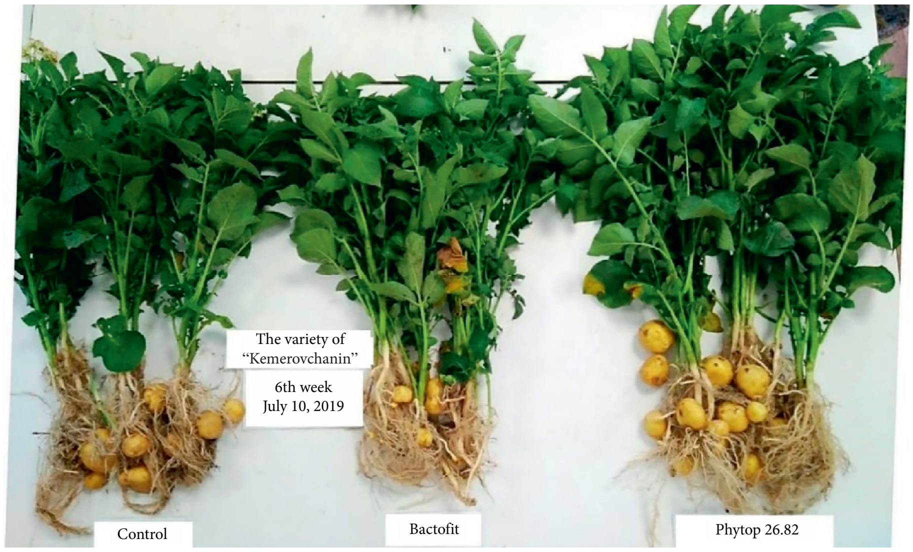

Figure 4: The formation of stolons and potato tubers under the influence of biological products (at the 6th counting week)—the largest number of tubers on potatoes treated with the microbial mixture Phytop 26.82.

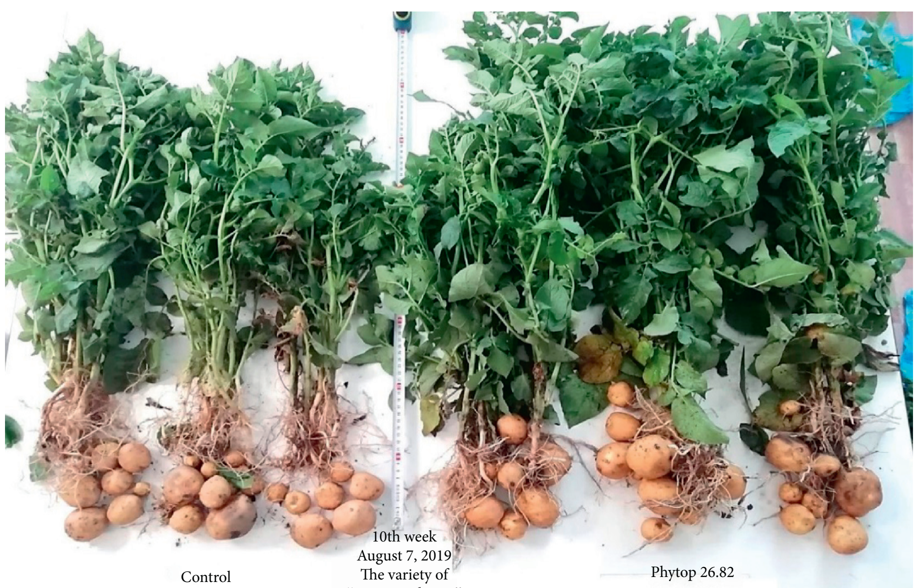

Figure 5: The influence of microbial agents on forming the aboveground and underground parts of potatoes 2.5 months after planting, i.e., on the 10th counting week. Potato treated with the biological product Phytop 26.82 looks persistent and robust. The stems are tall, the leaf surface is vast, and there are many tubers compared to the other two variants.

Table 5: The influence of the biological product Phytop 26.82 on soil microflora indicators for the two variants.

Indicators	Experimental variants	
	Control	Phytop 26.82
Soil moisture (%)	11.8	12.6
The total number of soil microflora, CFU/1 g of absolutely dry soil	6.383×10^4	11.861×10^4
The ratio of microorganisms in the soil (soil agar medium) (%) Fungi; bacteria; actinomycetes	48.4 : 46.3 : 5.3	45.4 : 51.8 : 2.8
The number of saprotrophic soil fungi (Czapek's medium), CFU/1 g of absolutely dry soil	1821	1653
The number of genus *Fusarium* (Czapek's medium), CFU/1 g of absolutely dry soil	597.7	405.7
The number of genus *Penicillium* (Czapek's medium), CFU/1 g of absolutely dry soil	280.0	106.3
Soil population with fungi of the genus *Fusarium* on selective nutrient medium (SDA starch dextrose agar), CFU/1 g of absolutely dry soil	344.0	266.7

Table 5: Continued.

Indicators	Experimental variants	
	Control	Phytop 26.82
Number of actinomycetes in the soil (starch-ammonia agar medium), CFU/1 g of absolutely dry soil	0.417×10^5	0.304×10^5
The number of bacteria assimilating organic nitrogen (meat-peptone agar medium), CFU/1 g of absolutely dry soil	20.5×10^5	32.6×10^5
The number of bacteria assimilating mineral nitrogen (starch-ammonia agar medium), CFU/1 g of absolutely dry soil	6.8×10^5	7.0×10^5
The number of oligonitrophilic bacteria- (medium hungry agar), CFU/1 g of absolutely dry soil	6.2×10^5	5.6×10^5
The number of cellulose-destroying bacteria (Hutchinson's medium), CFU/1 g of absolutely dry soil	7.6×10^5	10.5×10^5
Mineralization coefficient	0.3	0.21

4. Conclusions

The use of a microbial mixture Phytop 26.82 consisting of antagonistic bacilli, an entomopathogenic fungus, and two nematophagous fungi by pretreatment of potato tubers resulted in a significant reduction in the lesion stems with the fungus *R. solani* compared to the control. The prevalence of black scurf decreased in 6 weeks after pretreatment of tubers by 1.9 times, and after ten weeks, it fell by 4.5 times relative to the rule.

The use of a microbial mixture for preplanting treatment of potato tubers provided an increase in plant biomass by 1.5–1.8 times due to an increase in their height (1.2 times), the number of stems (1.2 times at the 6th week), and the number of stolons (1.5–1.6 times) compared to the control variant. The authors observed a 1.8-fold decrease in the incidence of sclerotic and other forms of *R. solani* in daughter tubers. Potato yield under the influence of a mixture of bioagents increased by 3.4 t/ha compared to the control variant. The authors established the new microbial variety's high biological efficiency against larvae of 1-2 ages of the Colorado beetle in laboratory experiments (90.5–100%).

Thus, the use of new mixtures of the bioagent drug Phytop 26.82 can simultaneously have insecticidal, fungicidal, and growth-stimulating action on potatoes, which allows its use for population control of potato Colorado beetle (*Leptinotarsa decemlineata*) and Rhizoctonia disease potato to produce a clean and quality product.

5. Values of the Research

(i) The development of Phytop 26.82 biological products is the innovative natural protection of potatoes for breeding and seed production of domestic varieties throughout the country, including various agroclimatic conditions.

(ii) Statistical data processing was carried out using dispersion analysis to identify the effect of the drug Phytop 26.82 on the morphological indicators of potato norms and the development of scurf on new crop potato tubers and soil microflora.

(iii) According to research, the drug has high biological effectiveness of a new microbial mixture directed against larvae of 1-2 ages of the Colorado beetle (*Leptinotarsa decemlineata*). There is an assumption that the data obtained abroad and other varieties of potatoes may differ from the authors' data.

Data Availability

The data used to support the findings of this study are available at https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/9NSYVK.

Disclosure

This article is a continuation of the research studies on "Polyfunctional Properties of the Entomopathogenic Bacteria in Protecting Potatoes in Western Siberia by" V.P. Tsvetkova, M.V. Shternshis, and E.I. Shatalova (Biosciences Biotechnology Research Asia, 2016) (http://pdfs.semanticscholar.org/cc39/b4bdfc94a2e4714e6677bcd1fa0899c167c0.pdf) "Biologics based on bacteria of the genus *Bacillus* for plant health management" M.V. Sternshis, A.A. Belyaev, and V.P. Tsvetkova (Ministry of Agriculture of the Russian Federation, Novosibirsk State Agrarian University, 2016) (https://vetom.ru/images/content_images/17-nauka/39-monografii/NGAU2016.pdf).

Conflicts of Interest

The authors declare no conflicts of interest.

Authors' Contributions

A.P. conceptualized and supervised the study and was responsible for project supervision; A.P. and V.T. were responsible for data curation; V.M. and K.K. performed formal analysis; A.P., M.S., N.G., and S.R. were responsible for funding acquisition; A.P., R.G., M.S., N.G., V.M., A.S., E.R., and K.K. investigated the study; A.P., V.T., and R.G. were responsible for methodology and prepared the original draft; V.T., R.G., M.S., N.G., S.R., V.M., A.S., E.R., and K.K. were responsible for resources; A.S. and E.R. were responsible for software; A.P., S.R., and I.R. validated the study and reviewed and edited the manuscript; S.T. was responsible for visualization. All authors have read and agreed to the published version of the manuscript.

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Supplementary Materials

The raw data files of the article are provided in the supplementary material. (*Supplementary Materials*)

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