

Effect of Preplanting Treatment with Biopreparations on Seed Potato's Yield Capacity and Quality

Tkebuchava Zaira¹; Uridia Rusudan²; Narimanishvili Tamar¹; Zubashvili Nana¹; Tsitashvili Lela¹; Lobjanidze Mzia¹

¹Faculty of Engineering, Agrarian and Natural Sciences. Samtskhe-Javakheti State University (in Georgia)

²Faculty of Veterinary Medicine. European University (in Georgia)

Publication Date: 2026/10/09

Abstract: The presented article deals with research results obtained from the educational scientific and research plot of the agronomy specialty of the Faculty of Engineering, Agrarian and Natural Sciences of the Samtskhe-Javakheti State University. Preliminary treatment of potato tubers with biopreparations stimulates plant growth and development. It has been established resulting from studies that preliminary treatment of potato tubers with Mycorrhiza 2% and Phytosporine aquatic solutions increases leaf surface area by 20,4-25,5% and extends vegetation. Application of these preparations has reduced potato phytophthora spread and has improved biological efficiency by 16,5–24,3%; plant height has been increased by 7.2-9,6% in average during two years. Potato yield has been increased by 2,6-3,25 t/he, potato sales productivity – by 8,4-14,3%, and tuber number per one bush – by 3.8-6,65 units.

Keywords: Potato, Tuber Treatment, Biopreparations, Yield Capacity, Quality.

How to Cite: Tkebuchava Zaira; Uridia Rusudan; Narimanishvili Tamar; Zubashvili Nana; Tsitashvili Lela; Lobjanidze Mzia (2026) Effect of Preplanting Treatment with Biopreparations on Seed Potato's Yield Capacity and Quality.

International Journal of Innovative Science and Research Technology, 11(10), 156-161.

<https://doi.org/10.38124/ijisrt/26oct047>

I. INTRODUCTION

Necessity of potato production increase faces the science with the problem of breeding of high-yield varieties of different economic purposes (Samadashvili 2009, 57-63). In order to accomplish this goal a particular importance has been attached in recent years to selection methods based on inheritance characteristics: disease resistance, maturing time, starch content etc. Key role in potato production efficiency enhancement is played by the system of properly planned fertilization and soil treatment, which improves soil physical-mechanical properties and in its turn is of great importance during crop harvesting (Samadashvili 2008, 56-60).

Microbial-based biopreparation is used as a way to protect plants against phytopathogens, enhancing their growth, and increasing water retention and soil and fruit quality. These biopreparations are considered to be one of the "green solutions" in various agricultural practices. (du Jardin, 2015; Pylak et al., 2019; Cybulska et al., 2022; Drobek, Cybulska, Frac, et al., 2024; Drobek, Cybulska, Zdunek, et al., 2024).

It is known that potato yield substantially depends on tuber quality. Among main reasons of yield reduction in all categories of farm enterprises of Republic of Georgia they name the following: insufficient use of organic and mineral fertilizers, disrespect for plant protection means, late start of works, bad seed quality and insufficient introduction of up-to-date technologies (Jashi, 2017).

Experience of the advanced farm enterprises of the Republic of Georgia clearly demonstrated high potential of potato. In the package of agrotechnical measures great importance is attached to preliminary seed treatment against pests and diseases, at that, it sets a goal of seed quality improvement, plant growth stimulation and yield increase (<https://bioagro.ge>, Kevkhishvili 1998, 365).

Preliminary treatment of seeds with biopreparations promotes strengthening of plant protection mechanisms and reduces bacterial disease risks.

In addition, biopreparations improve potato resistance to different stress conditions, which is of great importance for both yield capacity and long-term seed's storage (Antonova... 2015).

➤ **Research Goal:**

To determine the effect of preliminary treatment of potato tubers with biological preparations: Phytosporine and Mycorrhiza 2% aquatic solutions on fungous diseases and yield capacity under conditions of the Akhaltsikhe Municipality.

In both managed and natural ecosystem, beneficial plant associated bacteria play a key role in supporting and/or increasing plant health and growth (Compant and Sessitsch, 2010). Following rhizosphere and rhizoplane colonization, some soil borne microorganisms, can enter roots and establish subpopulations ranging from 10^5 to 10^7 CFU g⁻¹ FW. These endophytes are more likely to show plant growth promoting effects than bacteria exclusively colonizing the rhizosphere (G.E. Dawwam , A. Elbeltagy, H.M. Emara, I.H. Abbas, M.M. Hassan, (2013).

➤ **Research Objects and Technique**

Studies were conducted in 2022-2023, at the scientific-experimental plot of the Samtskhe-Javakheti State University. The potato average-late variety Arizona was used, and tubers were treated with biological preparations: Mycorrhiza 2% and Phytosporine aquatic solutions.

• **Test Variants:**

- ✓ Control (according to agricultural rules);
- ✓ Preliminary seed treatment with Mycorrhiza 2% solution;

- ✓ Preliminary seed treatment with Phytosporine.

The test was conducted in four repetitions, plot area to be accounted – 25 m², total area – 0,125 he. Predecessor – autumn wheat.

The test was made according to standard methods, and data were processed using mathematical and statistical analysis (Tchanishvili... 2017, 123-130).

Potato was planted in the middle of April, planting delth – 8 cm, seeding rate – 30 c/he.

During vegetation period, row spacings were treated twice by a cultivator and weeded with a hoe.

Against diseases there was used Phytosporine-M, which is a new-generation versatile industrial bacterial preparation featured by long-term and broad spectrum of action (<https://www.google.com/Bio Farmer>). It is aimed to protect potato and other crops from fungous and bacterial diseases. In addition to Phytosporine-M, Mycorrhiza 2% solution was tested as well, which is a symbiosis of plant's root system and fungi (<https://bioagro.ge>). This interaction plays crucial role for both plant and soil ecology. Mycorrhiza acts as a natural active component for improvement of plant nutrition, health and resistance. Aktara and Decis were used against Colorado potato beetle. Prior to crop harvesting, an aerial part of potato was cut.

II. RESULTS

Table 1 Effect of Mycorrhiza 2% Preparation on Potato Springing up Dynamics

Variant	2022					2023				
	11.05	14.05	17.05	20.05	23.05	11.05	14.05	17.05	20.05	23.05
Control	4	8	31	72	98	3	6	25	60	91
Mycorrhiza 2%	5	17	58	82	116	7	14	78	104	138
Phytosporine-M	6	12	54	80	114	5	9	72	94	130

Source: Authors' Calculations

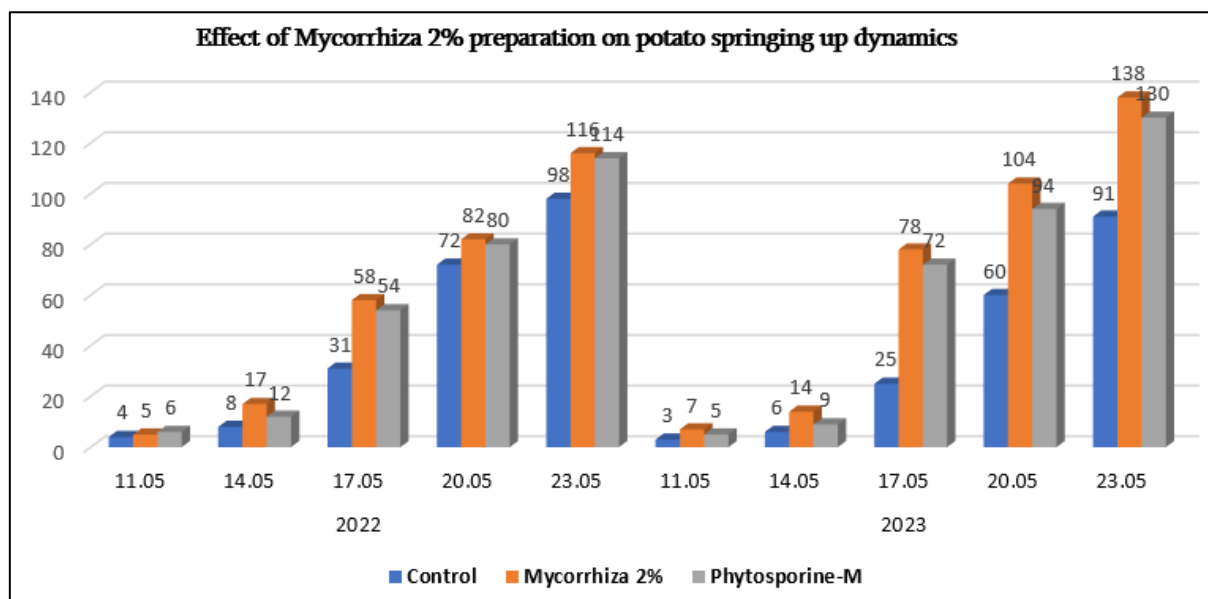


Fig 1 Effect of Mycorrhiza 2% Preparation on Potato Springing up Dynamics

Table 2 Effect of Phytosporine-M Preparation on Potato Blossoming Dynamics

Variant	2022				2023			
	21.07	26.07	01.08	04.05	21.07	26.07	01.08	04.05
Control	17	142	198	208	10	133	191	201
Mycorrhiza 2%	88	193	247	282	80	176	190	211
Phytosporine-M	6	12	254	280	78	184	198	220

Source: Authors' Calculations

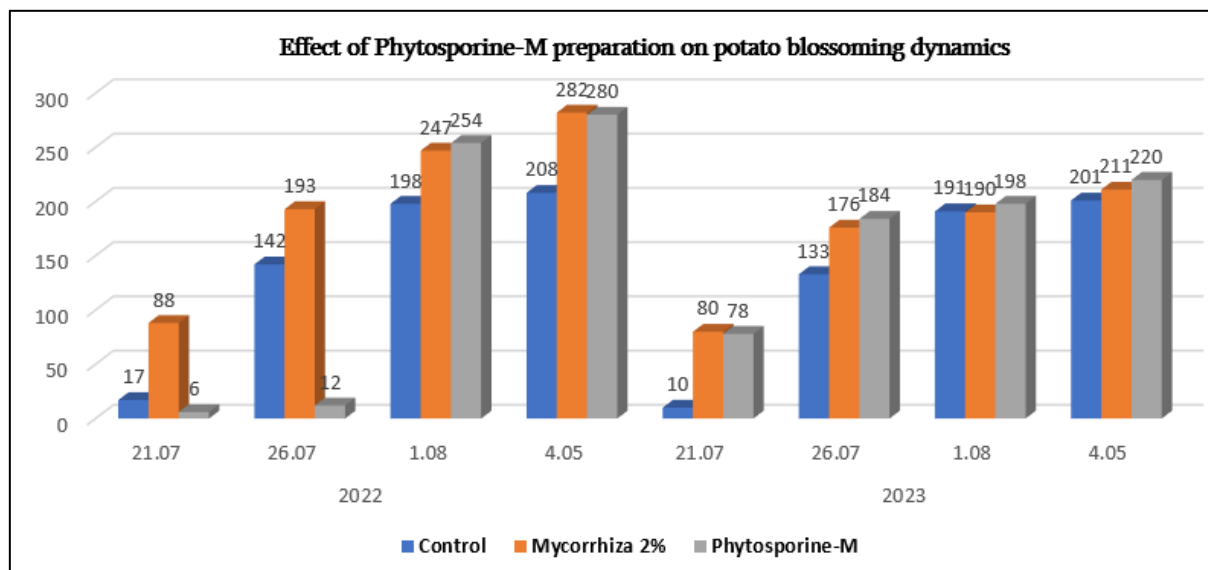


Fig 2 Effect of Phytosporine – M Preparation on Potato Blossoming Dynamics

Springing up was accounted starting from 10th of May to 22nd of May, once in every third day. Treatment with Mycorrhiza 2% solution had a positive effect on the springing up dynamics and substantially accelerated the process compared to the control one.

In order to study the plant growth, phases of springing up, early blossom and full blossom were registered. It turned out that the effect of Mycorrhiza 2% preparation on springing up dynamics was positive in tested variants, and on 23rd of May there was 51,6% more springing up achieved in this variant, while in case of Phytosporine-M it was equal to 42,8%. Through analysis of previous registration details one can see that the variants treated with Mycorrhiza 2% are

better than those treated with Phytosporine-M. As for blossom, Table 2 data show that records of 04.05.2023 were better in comparison to the control group data obtained on 04.05.2022.

There were registered plant biometric data (for Mycorrhiza 2%) (Table 3). Phytosporine-M provided the highest plant height growth +5,7 cm (or +12,1%) in average, while Mycorrhiza 2% had the less effect.

Phytosporine-M increased the leaf surface area by 8,15 thou sq.m. (or 25,5%) in average, and Mycorrhiza 2% - by 5,5 thou sq.m. (or 20,4%).

Table 3 Effect of Biopreparations on Potato Biometric Data

Variant	Plant height		Number of stolom		Number of leafs		Leaf surface area	
	cm	%	piece	deviation from control %	piece	deviation from control %	thou. sq.m. per he	deviation from control %
2022								
Control	48,0	100,0	3,5	100,0	45,7	100,0	40,4	100,0
Mycorrhiza 2%	51,6	107,5	3,6	102,8	51,3	112,4	51,4	128,4
Phytosporine-M	56,7	118,1	3,7	105,7	54,0	116,5	52,7	128,6
UMAS ₀₅	1,01		0,4		2,22		4,96	
2023								
Control	45,1	100,0	3,2	100,0	43,4	100,0	41,5	100,0
Mycorrhiza 2%	46,4	102,6	3,5	111,1	50,0	112,1	47,2	112,4
Phytosporine-M	47,6	113,4	3,6	114,1	50,0	112,9	51,2	122,4

UMAS ₀₅	0,48		0,4		1,12		1,2	
2-year average								
Control	47,2	100	3,5	100	44,55	100	43,8	100
Mycorrhiza 2%	49,6	105,1	3,6	106,95	47,65	112 25	49,3	120,4
Phytosporine-M	52,15	112,75	3,65	109,9	52	1 14,7	51,95	125,5

Source: Authors' Calculations

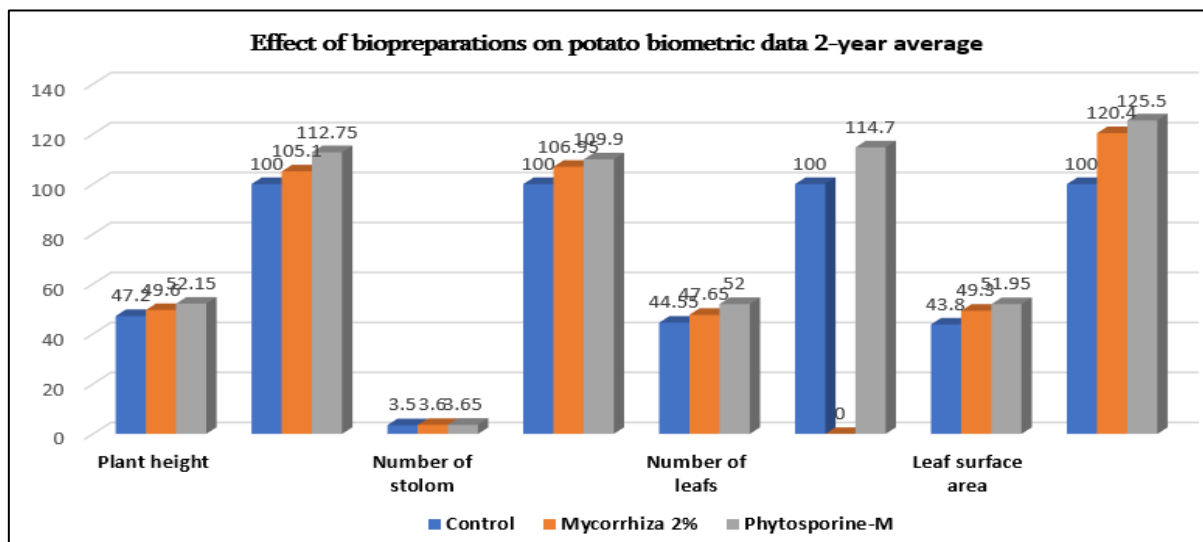


Fig 3 Effect of Biopreparations on Potato Biometric Data 2 – Year Agerage

One of the most important problems is phytophthora spread, which reduces the yield. For instance, Table 4 shows

how the potato late blight was developed and expanded according to preliminary tuber treatment.

Table 4 Phytophthora Development, Spread and Biological Efficiency

Variant	Disease progression and spreading				Biological efficiency %
	during blooming stage		during crop harvesting		
	2022	2023	2022	2023	
Control	22,3	18,3	61,0	67,8	-
Mycorrhiza 2%	20,2	11,2	35,9	23,7	63,3
Phytosporine-M	13,6	9,9	29,2	15,4	74,6

Source: Authors' Calculations

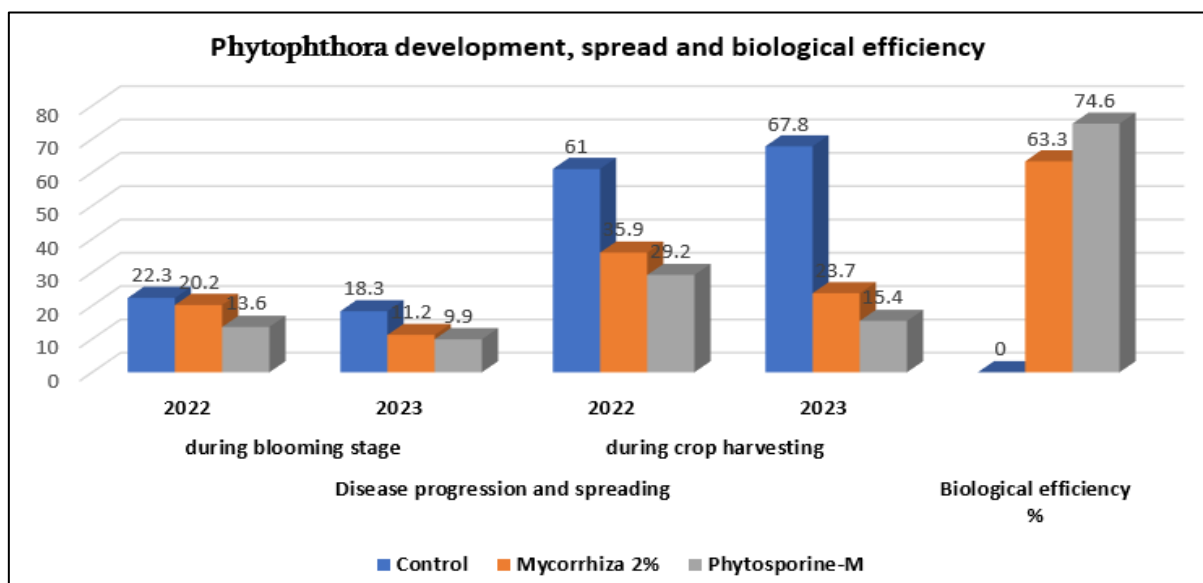


Fig 4 Phytophthora Development, Spread and Biological Efficiency

Phytophthora development in the blooming stage was equal to 22,3% in the control one. Mycorrhiza 2% reduced the disease rate by 2,1% in 2022, and by 7,1% in 2023.

Phytosporine-M reduced the disease spread by 8,7% in 2022, and by 8,4% in 2023. During crop harvesting, phytophthora spread comprised 67,8% in the control group, in case of Phytosporine-M – 15,4%, and for Mycorrhiza 2% - 23,7%. Biological efficiency was as follows: Phytosporine-M – 74,6%, Mycorrhiza 2% – 63,3%.

According to 2-year average, the biggest yield gain (Table 5) was registered for the variant, where Phytosporine-M was used and it comprised 15,25 t/he, which is 27,08% higher compared to the control variant. In the event of Mycorrhiza 2% use, the yield gain was 20,2 t/he, so it was 2.6 t/he (21,7%) higher than in the control.

Review of the two-year average fraction composition in terms of full weight shows that in case of Phytosporine-M use, the fraction higher than 80g was obtained in amount of 73,55 g, while in the event of Mycorrhiza 2% it comprised 71,95 g. Difference in comparison to the control was equal to 6,1 g in case of Phytosporine-M, and 4,5 g – for Mycorrhiza 2%.

An average fraction – 50-80 g, in case of Phytosporine-M use, was obtained in amount of 20,25 g, and the difference compared to the control is 1,95 g, while for Mycorrhiza 2% it was obtained in amount of 20,75 g, so the difference comprised 1,45 g compared to the control.

As for the fine fraction (< 50 g), as is seen from Table 5, there was obtained in amount of 8,9 g for the control. Compared to all three variants, according to two-year average value, in case of Phytosporine-M use it was obtained in amount of 2,75 g, while for Mycorrhiza 2% – 6,9 g.

Table 5 Effect of Biopreparations on Potato Yield Structure.

Variant	Crop capacity		Fraction composition in terms of full weight			Realization %	Number of tubers per one bush, pieces
	t/he	deviation from control %	coarse (>80 g)	average (50-80 g)	fine (<50 g)		
2022							
Control	12,1	100	69,8	23, 9	4,6	84,4	5,7
Mycorrhiza 2%	14,5	119,8	76,1	18	4,5	92,5	9,6
Phytosporine-M	15,2	125,6	79,3	20	2,6	99,2	12,0
UAS ₀₅ = 2,42							
2023							
Control	11,9	100	65,1	20,5	13,2	84,3	5,9
Mycorrhiza 2%	14,7	123,5	67,8	23,5	9,3	93,0	9,7
Phytosporine-M	15,3	128,6	71,2	23.6	2,9	95,55	12,,9
UAS ₀₅ = 1,33							
2-year average							
Control	12	100	67,45	22,2	8,9	84,35	5.8
Mycorrhiza 2%	14,6	121,65	71,95	20,75	6,9	92,75	9,65
Phytosporine-M	15.25	127.1	73.55	20.25	2.75	98.3	12.45

Source: Authors' Calculations

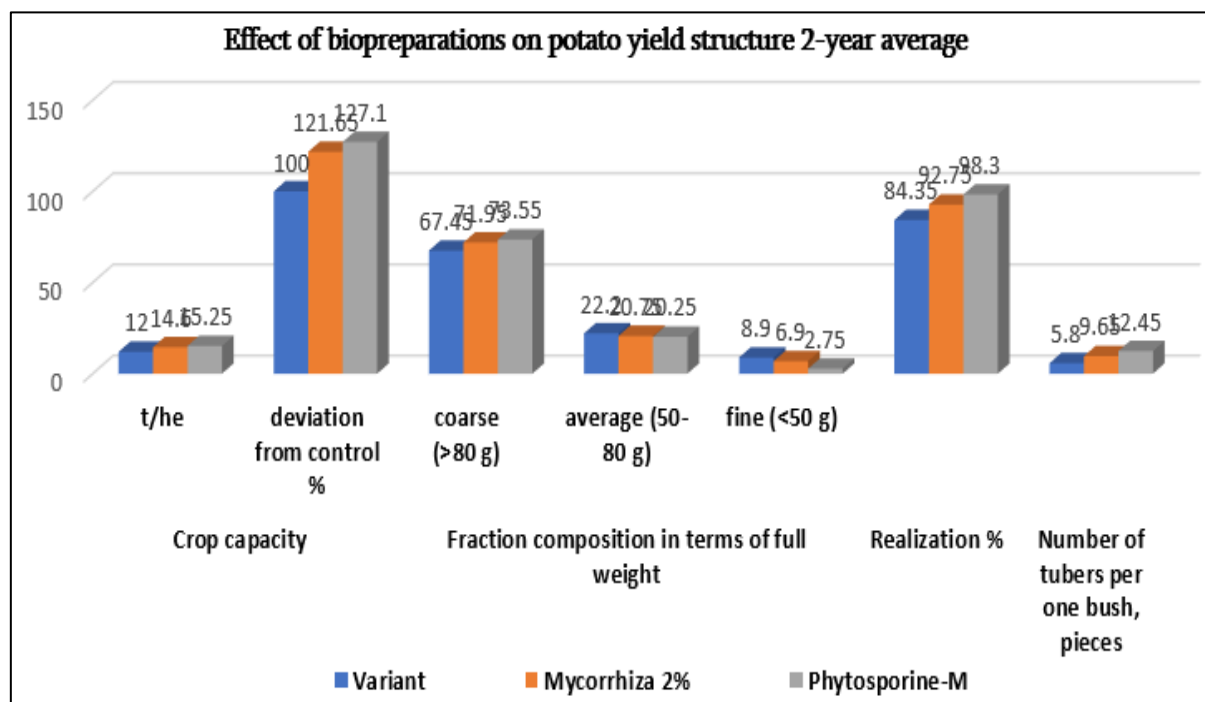


Fig 5 Effect of Biopreparations on Potato Yeld Structure 2_Year Average

III. CONCLUSIONS

According to average data obtained during tests, the largest gain of potato tubers has been registered in case of the variant treated with Phytosporine-M – 15,25 t/he, which exceeded the control one by 27,31%.

Potato yield for the variant treated with Mycorrhiza 2% was equal to 14,6 t/he, which is 21,65% higher compared to the control one.

The highest realization quality for potato was registered in case of Phytosporine-M use – 98,3%, which exceeded the control one by 16,5%, while in the event of treatment with Mycorrhiza 2%, 92,75% of realization quality was recorded, which is 9,95% higher than the control one.

This difference is caused by reduction in small tubers' number, when using Phytosporine-M and Mycorrhiza 2%.

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