

Influence of the microbiological fertilizer Slavol on the formation of early harvest of potatoes in the conditions of the Moscow region

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Abstract. The article presents the results of a study of obtaining early potato production using a microbiological fertilizer in the conditions of the Moscow region. Early potato varieties were used for the study: Udacha, Bryansk delicacy, Red Scarlett, Zhukovsky early, Meteor, Riviera. All varieties of table appointment with high palatability are recommended for cultivation in the Nonchernozem zone of the Russian Federation. The purpose of the research is to study the effect of the microbiological fertilizer Slavol on the growth, development of early potato plants and productivity. The experiment was carried out in 2020-2021. Observations and records in the experiment were carried out according to generally accepted methods when conducting field and laboratory studies on potato crops. Mass seedlings were noted in the variants with the treatment of tubers with the microbiological fertilizer Slavol in the following sequence: variety Zhukovsky, Meteor, Riviera, Udacha, Bryansk delicacy. The maximum total period from germination to harvesting on July 15 was longer in the variant with treatment in the Zhukovsky early variety (56 days), which further affected the increase in yield. The use of the microbiological fertilizer Slavol contributed to an increase in yield for all the studied varieties from 22.2 to 42.8% in relation to the control variant. Thus, in the experiment, the positive effect of microbiological fertilizer Slavol on the growth, development and yield of early potato varieties in the conditions of the Moscow region was established.

1 Introduction

In the modern world, potatoes are grown everywhere, which is very popular among people with different income levels [1]. To increase the life expectancy of the population, it is important to have a varied and safe diet, which is very difficult to provide with the constant deterioration of the environment. Breeders are constantly working on breeding varieties that meet modern requirements; however, in the production of potatoes, pests and diseases are increasingly showing themselves aggressively, due to resistance to the used pesticides [2, 3].

Under the conditions of climate change, an individual approach to the agrotechnology of early potatoes reduces the biotic and climatic load and select alternative forms of microfertilizers. At present, it is impossible to obtain high yields and safe production of early potatoes using only mineral fertilizers; therefore, scientists more often consider microbiological fertilizers as an alternative to classical technology that allows them to comprehensively influence the growth and development of plants [4, 5].

The development of plants and the formation of crops, among other things, are negatively affected by adverse climatic conditions arising from climate change around the world. There are a number of safe farming system solutions that allow agriculture to develop and increase yields and product quality. Most of the recommendations for growing environmentally friendly products are studied by college and university students in specialized disciplines, studying agronomists, vegetable growers and engineers, it is important to correctly apply modern knowledge in the production of agricultural products. To obtain environmentally friendly products, it is necessary to adhere to an integrated approach to the cultivation of early potato production. This is a scientifically based crop rotation with the inclusion of legumes, timely application of organic fertilizers in the autumn to improve soil fertility, integrated plant protection and the use of microbiological fertilizers, to develop plant resistance to environmental factors [5, 6].

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Intensive technologies widely used in agriculture are not always suitable for obtaining high yields of environmentally friendly potato products in the early stages [7]. The use of microbiological fertilizer allows you to accelerate the formation of yields in the early stages (on July 15). Intensive technologies widely used in agriculture are not always suitable for obtaining high yields of environmentally friendly potato products in the early stages [7]. The use of the microbiological fertilizer makes it possible to accelerate the formation of yields in the early stages (on July 15) due to the formation of a high concentration of beneficial microflora, which suppresses the development of pathogens [8]. The composition of the microbiological fertilizer Slavol includes six components, three of which are free-living nitrogen fixers that provide plants with nitrogen (*Derxia* spp., *Azotobacter chroococcum*, *Azotobacter vinelandi*). The following three components belong to representatives of the genus *Bacillus*, characterized by the ability to produce antibiotics with activity against phytopathogenic fungi. Antagonist bacteria of the genus *Bacillus* stimulate the formation of antimicrobial substances, vitamins, plant immunity, which is confirmed by our observations. Variants treated with the microbiological fertilizer Slavol were distinguished by faster plant development and resistance to the development of early blight, which contributed to favorable conditions during the formation of the crop [9,10].

2 Materials and methods

The research have studied the effect of the microbiological fertilizer Slavol on the growth, development and productivity of early potatoes of such varieties as Udacha, Bryansk delicacy, Red Scarlett, Zhukovsky early, Meteor, Riviera. The treatment with Slavol was carried out before planting by soaking the tubers and double foliar feeding with a frequency of 10 ... 15 days.

The studies were carried out in 2020 ... 2021 on the territory of the UNPC Vegetable Experimental Station named after V.I. Edelstein. On a plot with soddy-podzolic medium loamy soil, topsoil of 20...22 cm with the N content of 9.3 mg, P₂O₅ of 15.0 mg, K₂O of 8.3 mg per 100 grams of soil.

Research options are control and treatment with the microbiological fertilizer Slavol (before planting, soaking tubers for 3...4 hours in a solution concentration of 10 ml/l of water) + two foliar top dressings during the growing season with a frequency of 10...15 days. The first 15 days are after mass shoots, the second is in the budding phase. The studies were carried out on potato varieties: 1.

Udacha, 2. Bryansk delicacy, 3. Red Scarlett, 4. Zhukovsky early, 5. Meteor, 6. Riviera. All selected varieties are early ripe, for table use and processing with good taste, adapted for the Non-Chernozem Zone.

Potato cultivation was carried out using ridge technology, agricultural technology included such operations as autumn plowing, spring milling, cutting ridges before planting, planting, inter-row cultivation, hilling, preventive treatment against the Colorado potato beetle (in 2021) by Euphoria (ks) 0.2 l/ha + Break (me) 0.3 l/ha. Soil preparation was carried out taking into account the creation of a finely cloddy soil structure, in the spring period the impact of machinery on soil compaction was minimized, the cutting of ridges was carried out 3 days before planting to warm up the soil with a height of 16 ... 18 cm. Planting tubers was carried out on May 3–4, harvesting taking into account the structure of the crop July 15, the experiment was repeated three times, randomized placement, planting pattern of 70x35 cm, planting material of the middle fraction (40 ... 80 g). Before planting, the tubers were dried for 14 days to partially lose moisture and accelerate germination in early spring. In the variant with the microbiological fertilizer, the tubers were additionally soaked for 3–4 hours in a working solution (10 ml/10 l of water). Observations and records in the experiment were carried out according to generally accepted methods when conducting field and laboratory studies on potato crops [11, 12, 13].

3 Results and discussion

When considering the similarities and differences between the variants of the experiment on the passage of the phases of plant development and the duration of the interphase periods, we started with the emergence of seedlings. The earliest mass shoots were noted in the variants with the treatment of tubers with Slavol microbiological fertilizer, in the following sequence: variety Zhukovsky early (on day 18), Meteor, Riviera, Udacha (on day 20), Bryansk delicacy (on day 22). Seedlings in the control variants appeared 2–3 days later for each variety. The beginning of budding occurred in the same sequence as the seedlings in the variants treated with Slavol, and then the control variants. The maximum total period from germination to harvesting on July 15 was longer in the variant with treatment in the Zhukovsky early variety (56 days), which further affected the increase in yield. The minimum period from germination to harvesting on July 15 was 53 days in the control variant for varieties Udacha, Bryansk delicacy, Riviera. Accordingly, the duration of the interphase periods of early potatoes depends on the biological characteristics of the variety, optimal conditions during the growing season and methods of processing planting material. The average number of stems and plant height in the control

variants corresponded to the biological characteristics of the variety, and formed from 2.5 to 3.5 stems per plant. The minimum number of erect, high (up to 60 cm) stems was noted in the Meteor variety. The maximum number of stems was noted in the variety Bryansk delicacy up to 3...3.5 pieces per plant and an average height (50...55 cm). The remaining varieties in the control variants had intermediate values in terms of height and number of stems. The use of the microbiological fertilizer Slavol stimulated the emergence of more stems and increased the height of plants by an average of 32.6% and 10.8%, respectively.

The treatment of tubers and vegetative potato plants with the microbiological

fertilizer Slavol in experimental variants contributed to an increase in the leaf surface area on all studied potato varieties. The minimum difference in the increase in leaf area was noted between the control and treated variants in the Red Scarlett variety, the increase was 17.9%. The maximum difference between the variants was noted in the variety Bryansk delicacy by 43% in terms of leaf area. On average, for all varieties, the increase in leaf area was 32.9% (Fig. 1).

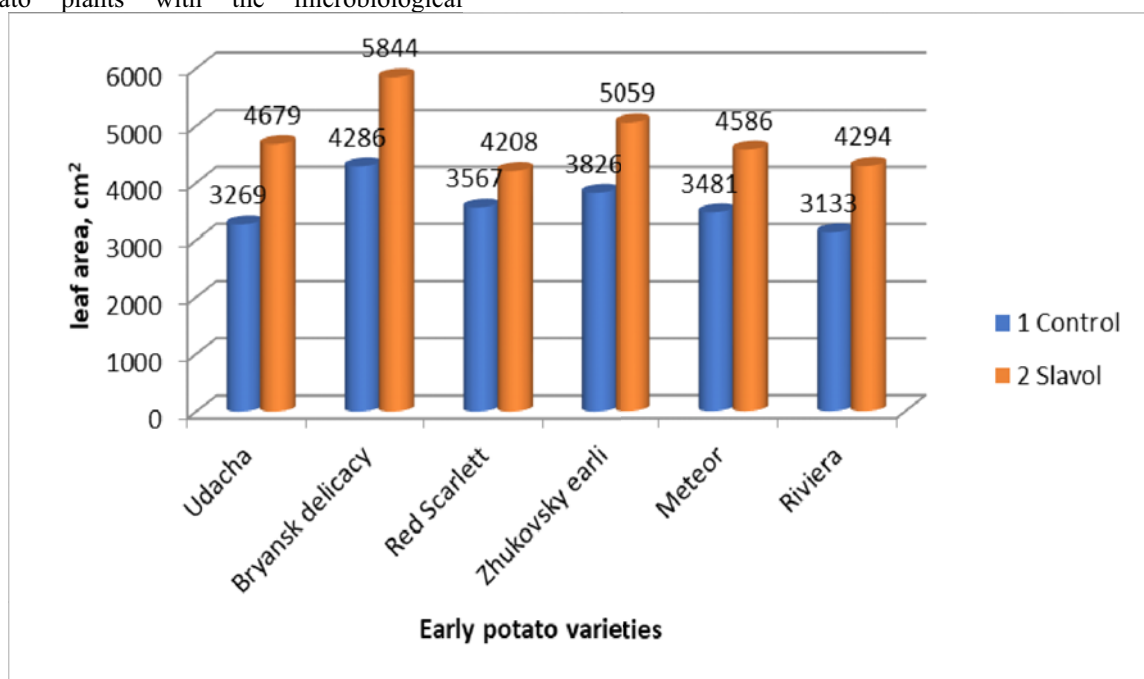


Fig. 1. Effect of the microbiological fertilizer Slavol on the leaf surface area of potato plants on average for 2020... 2021 per plant, in cm².

In the first half of the summer of 2020-2021, favorable conditions have developed for the development of alternariosis, which develops in dry and hot weather. Alternariosis is one of the dangerous potato diseases that can drastically reduce yields. Examination of plants for damage to the leaves was carried out in the flowering phase, according to a six-point scale, and the average% of the development of Alternaria was calculated. Strong damage to individual

plants was noted in the control variants in the varieties Zhukovsky early, Meteor, the average development was noted in the variety Udacha. The positive effect of the microbiological fertilizer Slavol also affected the development of alternariosis, so the listed varieties had signs of the disease, but the percentage of damage decreased 2...2.5 times. The minimum damage was noted on the varieties Bryansk delicacy and Riviera.

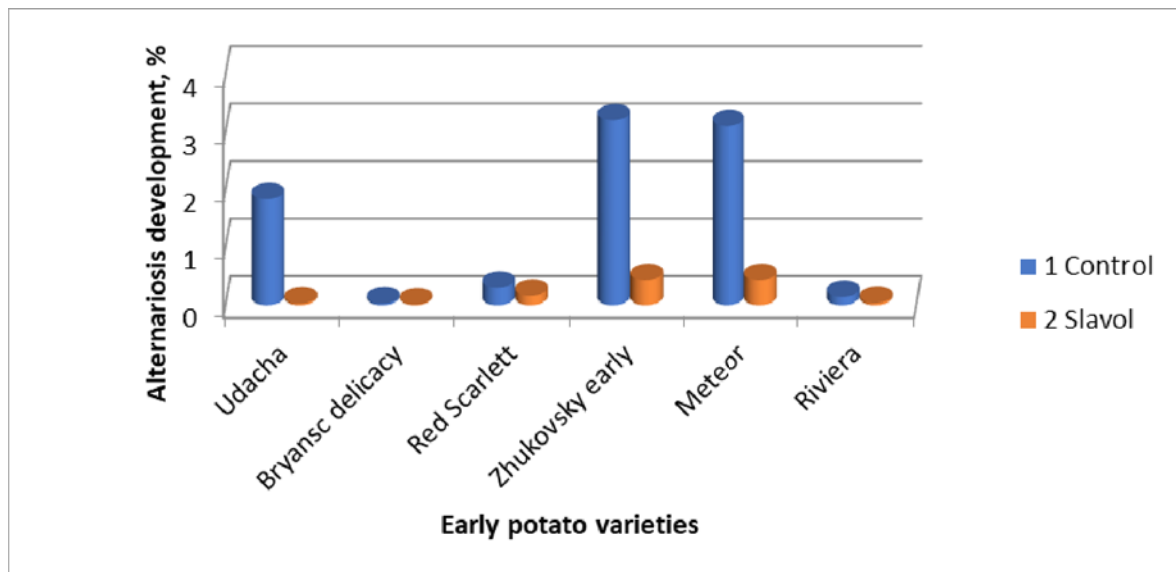


Fig. 2. Influence of microbiological fertilizer on the % development of early blight in early potato plants in the conditions of the Moscow region on average in 2020–2021.

Potato harvesting was carried out at an early date for the Moscow region, on July 15. During this period, the sale of imported potato products is mainly carried out, since the domestic potato does not have time to form a crop by this period. The rate of plant development and tuberization depends on the variety and growing conditions, especially in the first growing season. The use of the microbiological fertilizer on early potatoes contributed to the formation of the crop in the early stages and increased yields for all varieties. In the conditions of the Moscow region, early varieties of potatoes use the classical growing technology, on July 15, on average, you can get 400...500 grams of tubers from one bush. In the control variants for five

varieties, the mass of tubers from one bush ranged from 409...465 grams. In both variants, the yield of the variety Bryansk Delicacy was not high, the average weight of one bush in the control variant was 208 grams. The treated plants of the variety Bryansk delicacy with microbiological fertilizer Slavol also had a low mass of tubers from one bush (320 grams); however, the increase in relation to the control variant of this variety was 53.8%. On average, for all varieties, when using the microbiological fertilizer Slavol, the yield increased from 22.2 to 42.8% compared to the control.

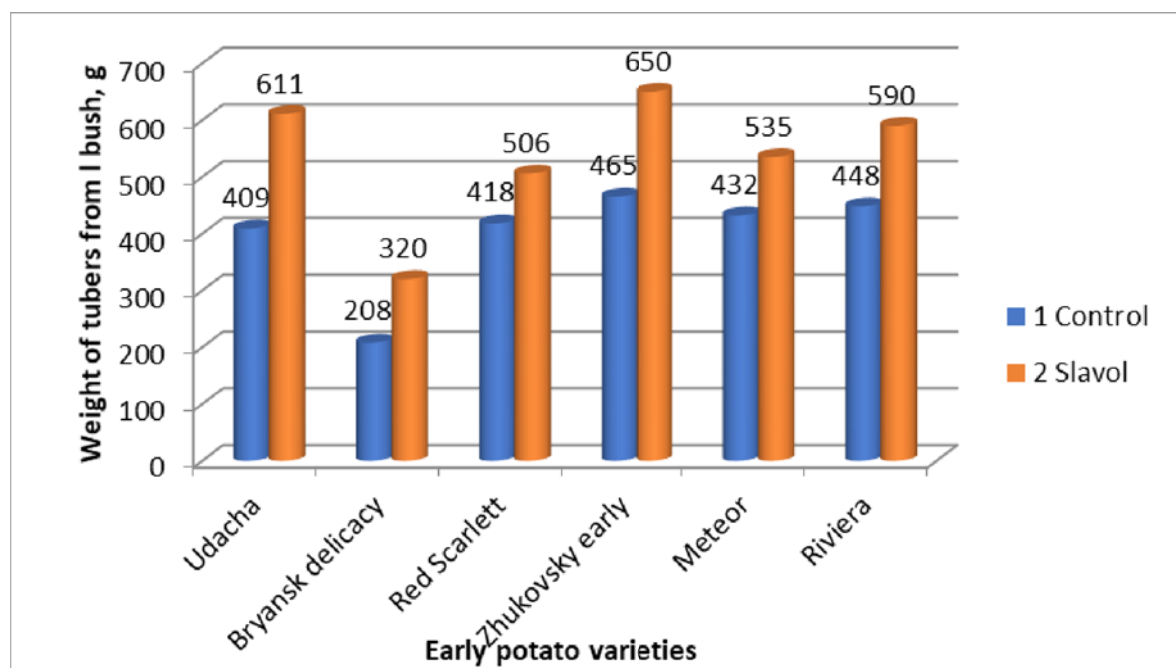


Fig. 3. Effect of the microbiological fertilizer Slavol on the average mass of tubers from one plant as of July 15 in the conditions of the Moscow Region on average in 2020–2022.

4 Conclusion

Thus, in the experiment, the positive effect of the microbiological fertilizer Slavol on the growth, development and yield of early potato varieties in the conditions of the Moscow region was established. The use of adapted varieties in combination with modern cultivation methods makes it possible to increase the yield due to the number and average weight of tubers per plant in the early stages (July 15).

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