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THE EFFECT OF *Bacillus subtilis* MICROBIAL FERTILIZER ON FUNGAL DISEASES IN TOMATO (*Solanum lycopersicum* L.) PLANTS

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ДЕЙСТВИЕ МИКРОБНОГО УДОБРЕНИЯ *Bacillus subtilis* НА ГРИБКОВЫЕ ЗАБОЛЕВАНИЯ РАСТЕНИЙ ТОМАТА (*Solanum lycopersicum* L.)

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Abstract. The study was conducted to investigate the effect of Bacillus subtilis on tomato plant diseases. The study area is Samukh district of the Republic of Azerbaijan. Our studies were conducted on experimental plants in the laboratory of plant disease diagnostics of the Azerbaijan State Agrarian University. The experiment was conducted in 3 variants: control, application of microbial fertilizer (MGT), standard application of fertilizer + application of Bacillus subtilis (SGT + MGT). Tomato plant cuttings are planted in pots after application of microbial fertilizer (1 ml / 10 l). At the beginning of flowering, fertilizer (1 ml / 100 l) was applied as a spray on the leaves. When comparing the experimental variants, it was confirmed that high tomato yield and disease resistance are observed when using microbial fertilizer. The study of the effect of Bacillus subtilis bacteria on tomato plant diseases has not been previously conducted in Azerbaijan.

Аннотация. Исследования проводились с целью изучения влияния *Bacillus subtilis* на заболевания растений томата. Район исследований — Самухский район Азербайджанской Республики. Наши исследования проводились на опытных растениях в лаборатории диагностики болезней растений Азербайджанского государственного аграрного университета. Опыт проводился в 3 вариантах: контроль, внесение микробного удобрения (МГТ), стандартное внесение удобрения+внесение *Bacillus subtilis* (СГТ+МГТ). Черенки растений томата высаживаются в горшки после внесения микробного удобрения (1 мл/10 л). В начале цветения удобрение (1 мл/100 л) вносилось в виде опрыскивания по листьям. При сравнении вариантов эксперимента, подтвердилось, что высокая урожайность томатов и устойчивость к заболеваниям наблюдается при использовании микробного удобрения.

Изучение влияния бактерий *Bacillus subtilis* на заболевания растений томата ранее в Азербайджане не проводилось.

Keywords: tomato, microbial fertilizer, Bacillus, diseases, test plant.

Ключевые слова: томат, микробное удобрение, Bacillus, болезни, тест-растение.

Tomato or tomato plant (*Solanum lycopersicum* L.) is an annual herbaceous plant. There are many species, subspecies and species diversity. Tomatoes with three type-diversity are cultivated:

1. High-growing tomatoes: the Bush is non-stemmed, the stems are thin, and when they bear fruit, they lie on the ground. Among the varieties Rybka-52, Southern-1644, and etc. can be mentioned.

2. Stemmed tomatoes: their stems are thick and solid, do not lie on the ground when they bear fruit. Among the varieties, Dwarf, Neva, Krasnodar, Volgograd, and etc. can be mentioned.

3. Determinate or weakly branched dwarf (dwarfish) tomatoes. Among the varieties Pushkin-1853, First-grown, collective Farmer-34, and etc. can be mentioned. Since Tomato is a heat-loving plant, it is cultivated mainly in the middle and southern regions. The homeland of the tomato is the tropical regions of America. Tomatoes consist of a thin peel, fleshy part, seed chambers and seeds. Tomatoes with a lot of internal seed chambers are the best tomatoes.

Up to 600 cultivated varieties of tomatoes are known. These differ from one another in shape, colour, position of the top (ribbed), size, number and location of the seed chamber. The colour of tomatoes can be red, pink or yellow in different shades. Tomatoes are oval, flattened-round and conical, and the top is smooth, or ribbed. Depending on the ripeness, tomatoes are green, gray, pink and red in colour. They can also ripen when stored and transported. According to their size, they is divided into large, medium-large and small varieties. Large ones weigh more than 100 g, medium-sized ones - 60-100 g, and small ones — up to 60 g.

Tomatoes are divided into cooking and canning groups according to agricultural characteristics. Table varieties of tomatoes are most often used in cooking for the preparation of salads, 1st and 2nd dishes. They are juicy and delicious. Canned varieties of tomatoes are used to make tomato paste, tomato puree, and tomato juice. These tomatoes should contain a lot of dry matter. The fleshy part of tomatoes to be put in vinegar and salt should be firm.

Tomato contains on average 93-96% water, 0.61% mineral matter, up to 4% carbohydrates, 0.19% fat, 0.84% cellulose.

Tomato contains 1.4 mg% of iron, as well as K, Mg, Na, Ca, P, J and other elements.

Tomatoes contain 30 mg% vitamin C, 1.4 mg% carotene (vitamin A), B1, B2, B3, PP and P vitamins. Tomatoes contain 0.4–0.6% organic acids (malic, lemon, small amount of amber and sorrel), 0.1–0.2% pectin substance, and 0.3% starch in thick tomatoes. The bitter taste of tomatoes depends on the amount of solanine glucoside in it. Ripe tomatoes contain 4 mg%, semi-ripe tomatoes 5 mg, and ripe tomatoes 8% solanine glycosides. Tomatoes contain carotene, lycopene and xanthophyll. There are a lot of tomato varieties such as Mayak, Biryuchekut, Bazar Ajabi, Gumbert and others. Mayak is a fast-growing, productive variety. The fruit is medium-sized, flat-round or round in shape, smooth surface, red in colour, pleasant taste. Tomato varieties close to this variety include Voskhod, Donskiy, First, Volga early, Zarya, Kolkhozny (Farm-type), early Moldova and Tamenes. Tomatoes belonging to the productive Maykop variety according to their morphological and commercial characteristics are combined in one group. This includes Brekodey, Opolchenets, Odessa, Hadiya, Soviet, Southern and other varieties [1-6].

Tomato varieties grown in the middle zone include Planli-904, Delicacy, Erliana2, Akhbutin-85, Early Ripening, Talalixin-186, Belorussia-225, Shatilov-35 and others. These varieties are mainly regionalized in the Urals, Bashkortostan, Tatarstan, Chuvashia and Lower Volga.

Bizon-639, Gribov-1180, Pushkin-1853, Early Ripening -1165, Karlik-1185, Alpatyeva-905a and multi-fruited Ural varieties are among the tomatoes grown in the northern regions.

Krasnodar, Volgograd-5/95, Donetsky-3/2-1, Bizon-639, Gribov and others are among the most mentioned tomato varieties in the literature in recent years. In addition to these, there are Large-fruited, Shtamblyi-152, Voskhod-119, Simferopol-765, Small-fruited, Malyutka, Rybka, Kuban, Gavaliyaokshar, Gonets and other varieties. Pridnestrov, Yenisei, Mashinli-1, Marinadli, and etc., are among the small-fruit varieties grown and regionalized in recent years.

Increasing productivity in the framework of ensuring food safety, minimizing the use of chemical fertilizers to prevent environmental pollution is one of the priorities at present. The evaluation of plant stimulating bacteria (PGPR) and the investigation of biological fertilizers that increase the productivity of the plant are among the important issues with the studies carried out to solve these problems (https://patents.google.com/patent/RU2538157C1/ru).

Research material and methodology

The study was conducted on test plants at the Plant Diseases Diagnostics Laboratory of the Azerbaijan State Agrarian University on April 15, 2023. Before planting, microbial fertilizer (1 ml/ 10 L of water) was applied to potato tubers. For soil analysis, a sample was taken from the top 30 cm of the soil. The results of the soil analysis are given in Table 1.

Table 1

SOIL ANALYZES TAKEN FROM THE STUDY AREA

Substances	*Unit*	*Value*
Organic matter (humus)	%	4.60
Phosphorus (P2O5) assimilable	kg/ha	47.8
Potassium (K2O) assimilable	kg/ha	1423
Nitrogen	%	0.20
Ph	-	7.3
Salt	%	0.010
Alabaster		5.9

Based on the analysis results, the soil of the research area is weakly alkaline, low-leaved, low-salinity soil. Based on the results, it was determined that the soil is fertile, rich in humus, high in nitrogen content, rich in assimilable phosphorus and potassium. As Option 1 is a control, no fertilizer has been applied. In the 2nd option, the microbial fertilizer (1 ml/ 10 L of water) was prepared and applied. In Option 3, both fertilizer and microbial fertilizer were applied. At the beginning of the flowering period, microbial fertilizer was applied to the leaves in the form of spraying (1 ml of bacillus subtilis /100 L of water).

Chlorinated water should not be used when preparing the solution. The use of fungicide should not be given simultaneously with bacterial fertilizer. When spraying, it is necessary to take care that the mortar is not sunny, given that ultraviolet rays can have a detrimental effect on the bacterium [7].

Artificial infection of alternariosis and sepiariosis was carried out in plants. As can be seen from the pictures, during the use of microbial fertilizer, diseases spread poorly, the plant is healthier. As can be seen from the picture, microbial fertilizer application (MFA) reduced the severity of alternariosis and sepiariosis in plants by 56% and promoted plant growth.

Figure 1. The view of the tomato plant upon microbial fertilizer application (MFA)

Figure 2. The view of the tomato plant upon standard fertilizer application + Bacillus subtilis application (SFA+MFA)

Figure 3. The view of the tomato plant in the control (C, without fertilizer application) conditions

During standard fertilizer application + Bacillus subtilis application (SFA+MFA), the plants developed quickly, as they were both protected from diseases and adequately supplied with nutrients. As a result, the plants have increased immunity and the development of diseases is completely weakened. In the case, when no application was used, the severity of the disease in plants increased sharply.

Conclusion

Based on the data obtained in this study, it can be concluded that the microfertilizer consisting of *Bacillus subtilis* and *Bacillus amyloliquefaciens* bacteria has a positive effect on the growth of potato plants, the growth of green mass and the weight of the root, the increase in the weight of potato tubers, and therefore the increase in productivity, compared to the control.

Table 2

RESULT OF THE EXPERIMENT

Results	*Severity of Alternaria disease*	*Severity of Septoria disease*
Microbial fertilizer application (MFA)	24%	35%
Standard fertilizer application + Bacillus subtilis application (SFA+MFA)	35%	44%
Control (C, without fertilizer application)	86%	92%

According to the results in the table, it can be found that during the application of Microbial Fertilizer (MFA), the severity of the disease decreased sharply, and the plants were sufficiently protected from diseases. During the application, the severity of the Alternaria disease was determined to be 24%, and the severity of the Septoriasis disease was 35%.

Standard fertilizer application+Bacillus subtilis application (SFA+MFA) had 35% of Alternaria disease severity and 44% of Septoriasis disease severity. As can be seen from the table, the microbial fertilizer application provided more protection against diseases than the standard fertilizer application+Bacillus subtilis application. This is due to the fact that some fertilizers promote the development of disease-causing fungi.

In the control group (N, without fertilizer application), 86% of the severity of Alternaria disease and 92% of the severity of Septoriosis disease were determined. Because the severity of this disease was very severe, it caused complete drying and destruction of plants within 20 days.

Therefore, it can be concluded that it is possible to get satisfactory results in tomato cultivation by applying microbial fertilizer along with standard fertilizer. The expansion of the use of microbial fertilizers can significantly reduce the application of chemicals. It can be considered that the application of microbial fertilizers will be very useful in terms of preventing environmental pollution and ensuring sustainable agriculture.

References:

1. 1. Dospekhov, B. A. (2011). Metodika polevogo opyta: (s osnovami statisticheskoi obrabotki rezul'tatov issledovanii). Moscow, (In Russian).

2. Berkeley, R. C. W., & Logan, N. A. (1997). *Bacillus. In Principles and practice of clinical bacteriology* (pp. 185-204). John Wiley & Sons, Ltd..

3. Bandow, J. E., Brötz, H., & Hecker, M. (2002). Bacillus subtilis tolerance of moderate concentrations of rifampin involves the σB-dependent general and multiple stress response. *Journal of bacteriology, 184*(2), 459-467. https://doi.org/10.1128/jb.184.2.459-467.2002

4. Chabot, R., Antoun, H., & Cescas, M. P. (1996). Growth promotion of maize and lettuce by phosphate-solubilizing Rhizobium leguminosarum biovar. phaseoli. *Plant and soil, 184*, 311-321. https://doi.org/10.1007/BF00010460

5. Toro, M., Azcon, R., & Barea, J. (1997). Improvement of arbuscular mycorrhiza development by inoculation of soil with phosphate-solubilizing rhizobacteria to improve rock

phosphate bioavailability ((sup32) P) and nutrient cycling. *Applied and environmental microbiology, 63*(11), 4408-4412. https://doi.org/10.1128/aem.63.11.4408-4412.1997

6. Goswami, M., & Deka, S. (2019). Biosurfactant production by a rhizosphere bacteria Bacillus altitudinis MS16 and its promising emulsification and antifungal activity. Colloids and Surfaces B: Biointerfaces, 178, 285-296. https://doi.org/10.1016/j.colsurfb.2019.03.003

7. Chebotar', V. K., Shcherbakov, A. V., Maslennikova, S. N., Zaplatkin, A. N., Kanarskii, A. V., & Zavalin, A. A. (2016). Endofitnye bakterii-osnova kompleksnykh mikrobnykh preparatov dlya sel'skogo i lesnogo khozyaistva. *Agrokhimiya*, (11), 65-70. (In Russian).

Список литературы:

1. Доспехов Б. А. Методика полевого опыта: (с основами статистической обработки результатов исследований). М.: Альянс, 2011. 350 с.

2. Berkeley R. C. W., Logan N. A. Bacillus // Principles and practice of clinical bacteriology. – John Wiley & Sons, Ltd., 1997. P. 185-204.

3. Bandow J. E., Brötz H., Hecker M. Bacillus subtilis tolerance of moderate concentrations of rifampin involves the σB-dependent general and multiple stress response // Journal of bacteriology. 2002. V. 184. №2. P. 459-467. https://doi.org/10.1128/jb.184.2.459-467.2002

4. Chabot R., Antoun H., Cescas M. P. Growth promotion of maize and lettuce by phosphate-solubilizing Rhizobium leguminosarum biovar. phaseoli // Plant and soil. 1996. V. 184. P. 311-321. https://doi.org/10.1007/BF00010460

5. Toro M., Azcon R., Barea J. Improvement of arbuscular mycorrhiza development by inoculation of soil with phosphate-solubilizing rhizobacteria to improve rock phosphate bioavailability ((sup32) P) and nutrient cycling // Applied and environmental microbiology. 1997. V. 63. №11. P. 4408-4412. https://doi.org/10.1128/aem.63.11.4408-4412.1997

6. Goswami M., Deka S. Biosurfactant production by a rhizosphere bacteria Bacillus altitudinis MS16 and its promising emulsification and antifungal activity // Colloids and Surfaces B: Biointerfaces. 2019. V. 178. P. 285-296. https://doi.org/10.1016/j.colsurfb.2019.03.003

7. Чеботарь В. К., Щербаков А. В., Масленникова С. Н., Заплаткин А. Н., Канарский А. В., Завалин А. А. Эндофитные бактерии-основа комплексных микробных препаратов для сельского и лесного хозяйства // Агрохимия. 2016. №11. С. 65-70.

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