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Bacterial Fertilizer Fosstim-3-Biocontrol of Tomato Diseases

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Abstract: ***Antagonistic activity of two preparative forms of bacterial fertilizer FOSSTIM-3 have been studied. It was found that the dry preparative form of bacterial fertilizer FOSSTIM-3 actively inhibited the growth of phytopathogenic fungi Cl. herbarumLink. 56, A. alternata 650, F. oxysporium 460 and F. solani 422 compared to the liquid preparative form of bacterial fertilizer FOSSTIM-3. It is recommended in the future to use dry preparative form of bacterial fertilizer FOSSTIM-3 for tomato cultivation.***

Keywords: dry and liquid preparative form, bacterial fertilizer FOSSTIM-3, immobilization, antagonistic activity, phytopathogenic fungi

1. Actuality of the Topic

Today tomato (*Solanum lycopersicum* L.) is one of the most demanded vegetable crops.

The development of biotechnological methods of protection the agricultural plants from diseases is associated with the development of new bacterial fertilizers, not only functionally effective, but also environmentally safe for both humans and soil microbiota.

Accelerating plant growth and increasing phosphorus uptake are not the only mechanisms for the positive effects of these microorganisms on plants. Microbiological mediated dissolution of phosphates by the release of organic acids is often combined with the formation of other metabolites that are involved in the biocontrol of phytopathogens that live in the soil [1].

The use of bacterial preparations is one of the promising methods for combating fungal diseases of agricultural plants. Intensive searches in phytopathogenic antagonists are conducted among different groups of microorganisms. It is known that some representatives of bacteria of the genus *Bacillus* act as antagonists of a wide range of phytopathogenic fungi that cause diseases of cereals and vegetables. In this regard, the development and implementation in agricultural practice of biological fertilizers based on bacteria of the genus *Bacillus*, is particularly important.

The sensitivity of bacteria to adverse environmental factors causes difficulties in the development of methods for their storage in the laboratory and the manufacture of biological preparations. It is established that the interaction of microorganisms with highly dispersed materials increases the physiological activity of cultures, as well as their survival in soils and in laboratory conditions in various preparative forms [2].

It is known that among the main reasons preventing the widespread of application of microbial preparations, experts emphasize their low manufacturability, as well as partial or complete loss of effectiveness against plant pathogens during long-term storage in liquid form [3].

2. Materials and Methods

In the laboratory of Soil Microbiology of the Institute of Microbiology of Uzbekistan Academy of Sciences have been developed preparative (liquid and dry) forms of bacterial fertilizer FOSSTIM-3 on the basis of local active phosphor-mobilizing salt-tolerant strain of bacteria *Bacillus subtilis* BS-26. The biological preparation is intended for pre-sowing treatment of vegetable seeds and potato tubers [4].

Replacement of free-cultivated cells of microorganisms in the traditional microbiological process by immobilized microorganisms could raise biotechnology to a qualitatively new, significantly higher level. The simplest and most affordable method of immobilization of enzymes and cells of microorganisms and the least toxic to the latter is adsorptive immobilization.

Previously, a technology developed by us for obtaining a dry form of bacterial fertilizer FOSSTIM-3 by adsorptive immobilization on phosphate flour of the cells *B. subtilis* BS-26 [5].

It is known that in the process of long-term storage of microorganisms on the various carriers can occurcertain disorders in the cells, affecting primarily the physiological properties of bacteria.

In this regard, the aim of our research was to study the antagonistic activity of two preparative forms of bacterial fertilizer FOSSTIM-3 against to phytopathogenic fungiof tomato.

The objects of our research were phytopathogenic fungi of tomato - *Cladosporium herbarum* Link. 56, *Alternaria alternate*650, *Fusarium solani*422 and *Fusarium oxysporium* 460, the liquid preparative form of bacterial fertilizer

FOSSTIM-3 - free cells of *B. subtilis* BS-26, dry preparative form of bacterial fertilizer FOSSTIM-3 - immobilized in phosphorite flours of the cells of *B. subtilis* BS-26.

Antagonistic activity of liquid and dry preparative forms of bacterial fertilizer FOSSTIM-3 have been checked by the method of Wells [6]. The results were evaluated after 3 days of incubation at 28-29^{0}Cby the diameter of the growth retardation zone of test cultures of phytopathogens on Chapek medium.

3. Results and discussions

We studied the antagonistic activity of the dry and liquid preparative forms of bacterial fertilizers FOSSTIM-3, on phytopathogenic fungi of tomato, *Cl. herbarum* Link. 56, *F. Solani*422, *A. alternata*650and *F. oxysporium* 460 (table.).

Table: Inhibition of growth of phytopathogenic fungi by dry and liquid preparative forms of bacterial fertilizers FOSSTIM-3

Preparativeform	Cell titer, lg CFU/g	Inhibition of phytopathogen growth (d, mm)		
		Cladosporium herbarum Link. 56	*Fusarium oxysporum 460*	*Alternaria alternata 650*
Liquid form	9,3±0,46	*27±0,26*	*15±0,23*	*30±0,26*
Dry form	9,23±0,46	*80±0,60*	*50±0,48*	*65±0,58*

From the presented data of the table it can be seen that the dry preparative form of bacterial fertilizer FOSSTIM-3 more actively inhibited the growth of phytopathogenic fungi *Cl. herbarum* Link. 56, *A. alternata* 650, *F. oxysporium* 460 and *F. solani* 422 compared to the liquid preparative form of bacterial fertilizer FOSSTIM-3.

Dry preparative form of bacterial fertilizer FOSSTIM-3 had showed the largest zone of growth suppression in relation to *Cl. herbarum*Link. 56: d zone of oppression was 80±0,60 mm, while the liquid preparative form of this fertilizer showed the smallest zone and d zone of oppression was 27±0,26 mm. Dry preparative form of bacterial fertilizer FOSSTIM-3 showed antagonistic activity and in relation to *A. alternata* 650, d zone of oppression was 65±0,58 mm, it was in the free cells of *B. subtilis* BS-26 this indicatoer was 30±0,26 mm. The cells of *B. subtilis* BS-26 which immobilized on phosphate flour also showed antagonistic activity in relation to *F. oxysporium* 460, d of the inhibition zone was 50±0.48 mm, while free cells of B. subtilis BS-26 showed the smallest zone – 15±0.23 mm. Immobilized cells on phosphate flour of *B. subtilis* BS-26 suppressed the growth of *F. solani* 422 by 60 %, free cells by 20 % (Fig. 1.), respectively.

4. Conclusion

Thus, the study of the antagonistic activity of the dry preparative form of bacterial fertilizer FOSSTIM-3 revealed that that after 4 years of storage on phosphate rock cells *B. subtilis* BS-26 did not lose its antagonistic activity compared to the liquid preparative form. This suggests that in the future for tomato cultivation can be recommended dry preparative form of bacterial fertilizer FOSSTIM-3, as more technological in terms of stability of antagonistic activity of bacteria.

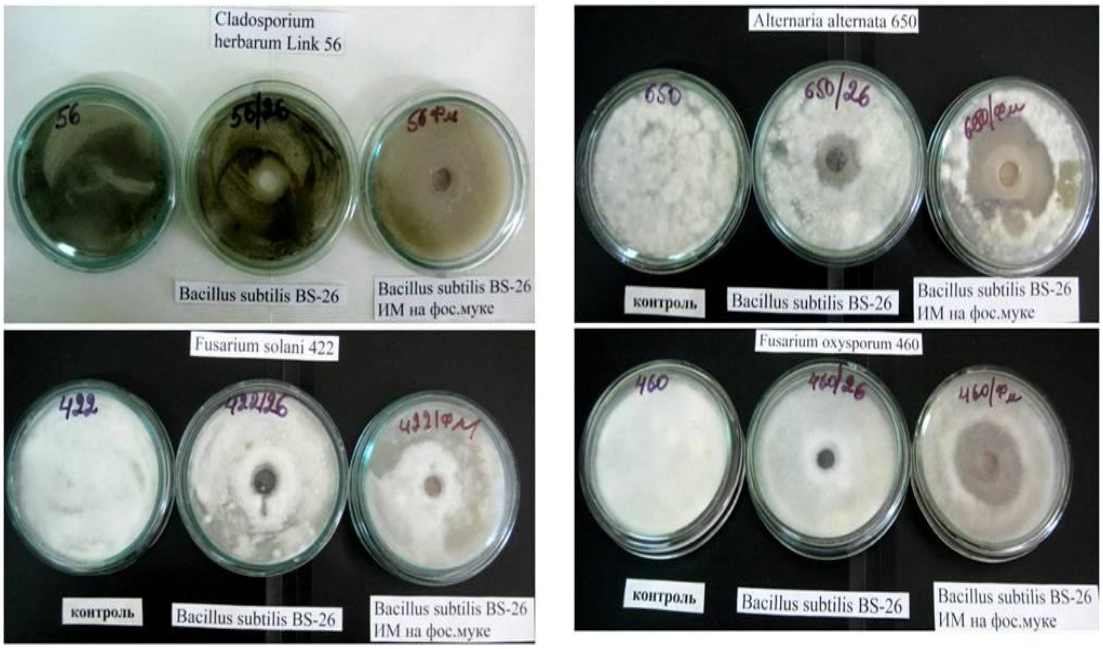

Figure 1: Inhibition of growth of tomato phytopathogenic fungi*Cl. herbarum* Link. 56 and *F. solani* 422, *A. alternata* 650 and *F. oxysporium* 460, immobilized on phosphate rock by cells *B. subtilis* BS-26

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