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PROSPECTS FOR THE USE OF EXTREMOPHILIC SOIL BACTERIA OF THE GENUS BACILLUS IN THE BIOCONTROL OF POTATO DISEASES

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Abstract. The article reveals current social problems of improving people's health by replacing chemical plant protection products (pesticides) with environmentally friendly and safe biological agents in the biocontrol of diseases and pests of vegetable crops and potatoes. The prospects for using extremophilic soil bacteria of the genus *Bacillus* in the biocontrol of potato diseases are determined. As a result of the research, *Bacillus sp*. RT-3 and *Bacillus sp*. RT-6 extremophilic bacteria showed high antagonistic activity against phytopathogens *Phytophtora infestans*, *Fusarium oxysporum f. sp. lycopersici*, *Fusarium solani*, *Alternaria solani*, *Alternaria alternata* and *Rhizoctonia solani*.

Key words: extremophilic bacteria, potatoes, diseases, biocontrol.

INTRODUCTION

About 2 million tons of synthetic pesticides are used annually in the world to control diseases and pests of agricultural crops, which creates an environmental threat to the environment and public health. Since vegetable crops consumed by the population have been most often exposed to various diseases and attacked by pests in recent years, it is necessary, first of all, to solve social problems of improving human health by replacing plant protection chemicals (pesticides) with environmentally friendly and safe biological agents in the biocontrol of diseases and pests of vegetable crops and potatoes.

Currently, the problem of environmental safety of chemical fungicides used to combat phytopathogens that cause various diseases of agricultural crops is particularly acute. Their widespread use can lead to negative consequences for human health and the environment.

One of the solutions to this problem is to tighten the requirements for chemicals and replace them with biological agents. The most promising and environmentally friendly methods in the

fight against diseases of agricultural crops is the use of biofungicides to increase yields and improve product quality.

An analysis of the development trends in the field of plant protection in Russia, the USA and other countries has shown that the use of a biological method, in particular, antagonist microorganisms and plant resistance, has a certain prospect against phytopathogenic organisms.
Scientists from many countries of the world prefer the use of biological preparations of bacterial origin [1]. In addition, when choosing microorganisms for the development of biological products, it is necessary to pay special attention to such properties as the ability to have antagonistic activity against pathogens of various diseases in order to be able to use them also as biofungicides instead of chemical fungicides.

Among soil antagonist bacteria, *Bacillus Cohn* bacteria are promising agents of biological control of phytopathogens. The role of antibiotic substances in the antagonism of bacteria of the genus *Bacillus* to soil micromycetes has been most studied [2].
Many species of spore-forming bacteria produce various antibiotics. Thus, *Bacillus subtilis* strains produce bacitracin, subtilin. Many of them prevent the growth of fungi [3].
The spectrum of antagonistic activity in bacteria of the genus *Bacillus* is wide: their metabolites, for the most part, are represented by antibiotics of the polypeptide and aminoglycoside series [4].

Along with infectious diseases, plants are affected by a variety of non-communicable diseases, which have an extremely diverse nature. Non-infectious phytopathogenic factors can be temperature fluctuations, drought, excessive moisture, nutrient deficiencies, soil salinity, violation of tillage technology, etc. When plants are exposed to adverse factors (stressors), a tense state occurs in it, a deviation from the norm is stress [5]. In this regard, the role of stress factors in the formation of plant predisposition to infectious diseases should be taken into account [6].

Fungal plant diseases cause great damage to agriculture. The main reason is infected seeds and favorable conditions in the soil for the development and accumulation of phytopathogenic microflora. In addition, chemicals designed to combat plant diseases are poisonous, and seed treatment with fungicides slows down the production of full shoots, especially in extreme conditions for germination (cold weather, lack or excess moisture, soil crust, etc.).

Only extremophilic microorganisms can survive in soil in conditions where non-infectious environmental factors are present, therefore, in recent years, a high interest in extremophilic microorganisms has been explained by their biological activity.

The biological method of plant protection is the basis for strategic ecological and biological control of harmful organisms in agricultural crops. The use of biological products for plant protection is becoming an urgent problem due to the need to ecologize agriculture [7].

In the development of modern methods of biological control of phytopathogenic fungi, studies of microbial antagonism processes are of great importance. Many types of soil bacteria produce various antibiotics, preventing the growth of fungi [8].

Potato phytophthorosis (pathogen - *Phytophtora infestans*), fuzariose wilt (pathogens - *Fusarium oxysporum f. sp. lycopersici, Fusarium solani*), alternariosis (pathogens - *Alternaria solani, Alternaria alternata*) and rhizoctoriasis (pathogen - *Rhizoctonia solani*) are causing significant damage. Sources of infection are contaminated soil and infected potato tubers.

Late blight of potatoes is the most harmful disease of potatoes. The yield is reduced by 70%. One of the main sources of infection is infected seed tubers.

Fuzariose wilt is a disease that affects tubers during storage. The main source of potato rhizoctoniosis is mycelium on tubers and in the soil. The fungus causes the main harm during the development of seedlings.

Alternariosis can destroy up to 50% of the potato crop in a season. The source of infection is mycelium and conidia, which persist in tubers. In this regard, in order to combat infectious diseases of potatoes, it is necessary to carry out pre-sowing treatment of potato tubers with biofungicides based on microorganisms antagonists to potato phytopathogens.

In this regard, the purpose of our research was to study the antagonistic activity of 6 species of extremophilic bacteria of the genus *Bacillus* isolated by us to 15 potato phytopathogens - *Fusarium oxysporum f.sp.capsici 778, Fusarium oxysporum 974, Fusarium javanicum 749, Fusarium solani 809, Fusarium verticillioides 312, Fusarium solani 785, Rhizoctonia solani 620, Cladosporium oxysporium 97,1 Phytophthora infestans 978, Aspergilius niger 815, Alternaria alternata, 940, Alternaria alternata, 975, Alternaria alternata, 650, Alternaria solani,986, Alternaria solani,809.*

MATERIALS AND METHODS

A method for determining the antagonistic activity of microorganisms.

To determine the antagonistic ability towards phytopathogens causing various plant diseases, the "wells" method was used, which is based on the diffusion of antibiotic substances accumulated by microorganisms in a liquid nutrient medium into agar or the growth of the bacteria themselves, pushing back the growth of phytopathogens. To do this, a bacterial suspension of bacterial strains was instilled into wells made in agar. From the wells, the antibiotic substances contained in the culture liquid diffuse into the thickness of the agar, which was previously seeded with a test culture, as a result of which no growth zones were formed around them [9].

Phytopathogenic fungi were taken from the collection of microorganisms of the Institute of Genetics and Experimental Biology of Plants of the Academy of Sciences of the Republic of Uzbekistan.

RESULTS AND DISCUSSION

The climate and soils of Surkhandarya region differ from other regions of the republic. The climate ranges from dry desert in the south to subtropical in the north. The average temperature in January is +3°C, in July +45-+60 °C.

The quality and agricultural properties of the land have been significantly changed under the influence of natural and technological factors affecting the soil.

In the desert zone, salinization and wind erosion are among the negative factors. Gypsum horizons predominate in gray-brown soils.

In gray-earth soils, the main factor reducing the fertility of irrigated soils is water erosion.

Strong winds are blowing, causing dust storms. In spring, these winds quickly dry up the arable soil layer, which leads to additional watering. In summer, winds sharply reduce air humidity, increase evaporation and transpiration of plants, and cause the loss of fruit elements [10].

In such harsh soil and climatic conditions, only extremophilic microorganisms can survive. We isolated 6 dominant bacteria from the soil in which the Surkhandarya region Angor and Sherabad districts planted potatoes, examined pure cultures for their antagonistic activity against the main phytopathogens of potatoes genus of *Alternaria, Fusarium, Rhizoctinia, Cladosporium* and *Phytophthora*.

Studies have found that *Bacillus sp*.PT-3 and *Bacillus sp*.PT-6 strains of the six dominant bacteria studied showed high antagonistic activity to phytopathogens that fall into *Alternaria* generation (Table 1).

The conducted studies showed that of the 6 extremophilic bacteria isolated by us, only 2 strains - *Bacillus sp*. RT - 3 and *Bacillus sp*. RT-6 had high antagonistic activity against phytopathogens of the genus *Fusarium, Rhizoctonia, Cladosporium* and *Phytophthora* (Table 2, Figure 1).

Table 1

Antagonistic activity of extremophilic soil bacteria of the genus *Bacillus* in relation to phytopathogenic fungi of the genus *Alternaria*

Extremophilic soil bacteria	Suppression of the growth of phytopathogenic fungi, D, мм				
	Alternaria alternata, 940	*Alternaria alternata, 975*	*Alternaria alternata, 650*	*Alternaria solani, 986*	*Alternaria solani, 809*
Bacillus sp.PT-1	-	-	11	8	-
Bacillus sp.PT-2	20	-	28	-	10
Bacillus sp.PT-3	**40**	18	12	12,4	15
Bacillus sp.PT-4	-	-	-	-	-
Bacillus sp.PT-5	-	-	12	-	-
Bacillus sp.PT-6	**60**	20	**60**	-	**25**

Table 2

Antagonistic activity of extremophilic soil bacteria of the genus *Bacillus* in relation to phytopathogenic fungi

Phytopathogenic fungi	Suppression of the growth of phytopathogenic fungi, D, мм					
	PT-1	PT-2	PT-3	PT-4	PT-5	PT-6
Fusarium oxysporum f.sp.capsici 778	-	10	30	-	30	70
Fusarium oxysporum 974	-	-	-	-	-	80
Fusarium javanicum 749	-	-	55	-	-	50
Fusarium solani 809	-	-	70	-	-	80
Fusarium verticillioides 312	-	40	50	-	-	80
Fusarium solani 785	-	-	-	-	-	-
Rhizoctonia solani 620	-	-	70	-	-	80
Cladosporium oxysporium 971	-	-	55	-	-	70
Phytophthora infestans 978	-	-	-	-	-	50
Aspergilius niger 815	-	-	-	-	-	-

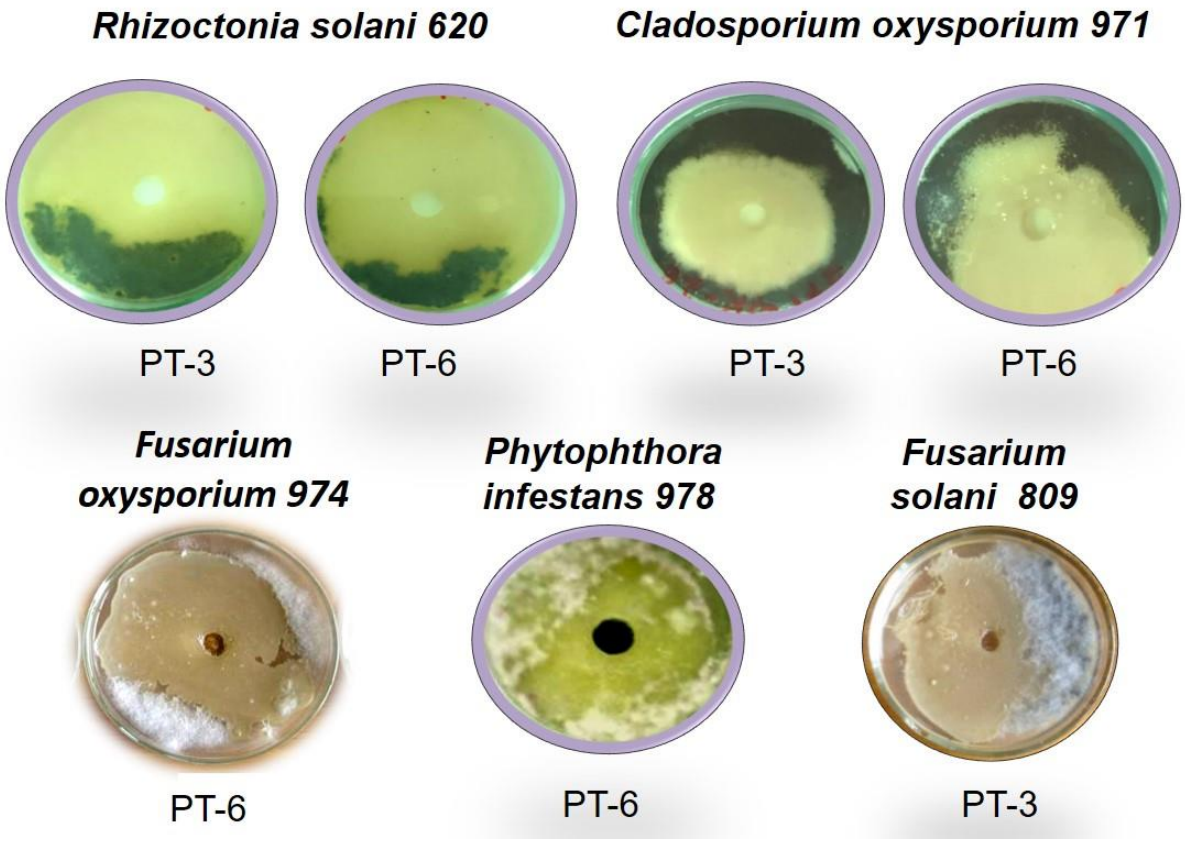

Figure 1. Antagonistic activity of extremophilic soil bacteria of the genus *Bacillus* in relation to phytopathogenic fungi

CONCLUSION

From the results obtained, it can be concluded that the extremophilic soil bacteria *Bacillus sp*.RT-3 and *Bacillus sp.*RT-6 isolated from the soils of the Surkhandarya region can be a biotechnological potential for obtaining new generation biofungicides based on them for biological control of potato phytophthorosis, fuzariose wilt, rhizoctoniosis and alternariosis.

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