Antagonistic activity of pigment-forming streptomycets isolated from various anthropogenic zones of Tashkent, Uzbekistan

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Abstract. Actinomycetes play an important role in soil formation and soil fertility. Improvement of soils is connected with their activity. they transform and destroy complex organic compounds (cellulose, chitin, lignin, and others) that are inaccessible to many other microorganisms. Actinomycetes are of the greatest interest for biotechnology as producers of antibiotic substances. Antagonistic activity to phytopathogens of local strains of pigment-forming actinomycetes of the genus Streptomyces isolated from various anthropogenic zones of Tashkent was shown. Active strains with high antagonistic activity to plant pathogens were selected. The results showed that the significant was the antagonistic effect of Streptomyces sp.15 to the studied phytopathogens, while the zone of no growth of pathogens reached from 22 mm to 26 mm.

1 Introduction

Actinomycetes play an important role in soil formation and soil fertility. Improvement of soils is connected with their activity. they transform and destroy complex organic compounds (cellulose, chitin, lignin, and others) that are inaccessible to many other microorganisms. Actinomycetes are of the greatest interest for biotechnology as producers of antibiotic substances [1, 2]. Recently, many preparations have been obtained that are used in agricultural practice and in the food industry [1-5].

In particular, the relevance of their application is obvious in "ecological farming", which is aimed at obtaining high quality products. The control of populations of phytopathogenic fungi that cause various plant diseases remains a topical problem, the solution of which can reduce significant crop losses [5-9]. The chemical fungicides used to combat them do not always solve this problem and can lead to chemical contamination of agricultural products and the environment. Therefore, there is a growing interest in biofungicides - microbial populations isolated from the natural environment and capable of suppressing and destroying an undesirable population. In this regard, actinomycetes are promising, because often they have the ability to synthesize antibiotic substances with antifungal activity [7-12].

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The ability to form antibiotics is a key feature of actinomycetes, which stimulated the study of this group of microorganisms in all countries of the world. Actinomycetes produce a wide range of antibiotics of various groups: aminoglycosides (streptomycin, kanamycin, gentomycin), macrolides (erythromycin, oleandromycin), polyenes (nystatin, levorin), polypeptides, actinomycins, anticancer drugs, etc. The number of reports of new antibiotics, produced by actinomycetes [1-7].

To date, more than 8,000 antibiotics have been isolated from microorganisms, and about 4,000 have been obtained from other organisms: lichens, plants, and animals. The most important and wide class of antibiotic producers are microorganisms [11-13].

The synthesis of antibiotics is characteristic of almost all genera of actinomycetes, in particular, such as Actinomadura, Actinoplanes, Micromonospora, Microtetraspora, Streptosporangiaceae [13]. The ability to produce antibiotics is especially widespread among actinomycetes of the genus Streptomyces. The mathematical model proposed by Milind G. Watve et al. shows that streptomycetes can potentially produce 100,000 antimicrobial substances [11-13].

Antagonism has a great influence on soil fertility. Abundantly developing in the soil, beneficial antagonist microbes retard the development of many phytopathogenic bacteria and fungi and thus heal the soil [4-8]. In a comparative study of actinomycetes of different systematic positions isolated from the soils of Kazakhstan, the largest number of antagonists of phytopathogenic microorganisms (Fusarium solani, Botrytis cinerea, Rhizoctonia solani 231 B - pathogens of root rot of agricultural plants and Bacterium carotovorum 19 - pathogen of mucous bacteriosis of cabbage) was found among cultures of the genus Streptomyces. The antagonistic properties of actinomycetes of rare genera (Actinomadura, Micromonospora, Streptosporangium, etc.) in relation to phytopathogens are much less pronounced. It is assumed that this is due to their low abundance in the studied soils and their less active participation in the competition for the substrate. Received new natural antibiotics - pigments: No. 2167 - an antibiotic from the group of quinones produced by Actinomadura sp. PC. IMiV 2167 and blue antibiotic pigment No. 731 (Y) from Streptomyces sp., pcs. IMiV 731, the novelty of which was proved on the basis of comparison with all known antibiotics - pigments using a computer database of biologically active substances developed by D. Verdi [1-8].

Actinomycetes of the genus Streptomyces are producers of such secondary metabolites as antibiotics, enzyme inhibitors, and pigments. Some pigments have antibiotic properties, so that many pigmented microorganisms are antibiotic producers. There is such a close correlation between pigmentation and the formation of secondary metabolites that, in the presence of pigments, the formation of antibiotics and other biologically active substances can be expected with a high degree of probability [3-9].

Thus, it can be said that, due to their characteristics, actinomycetes can successfully compete with phytopathogenic microorganisms in the soil. In some soils, a relatively small number of actinomycetes can be found, but almost all of them turn out to be antagonists.

In this regard, the problem of searching for new strains of actinomycetes producing biologically active substances with a wide range of environmental effects, possessing phytostimulating, antiviral, fungicidal, antioxidant properties, which can be the basis of new biological products, is topical [1-8].

The aim of our study was to determine the antagonistic ability of pigment-forming actinomycetes isolated from various anthropogenic zones in Tashkent.

2 Materials and methods

The objects of research were 6 local strains of actinomycetes of the genus Streptomyces, isolated from various anthropogenic zones of Tashkent, forming soluble pigments.

The antagonistic properties of streptomycetes were studied by the agar block method [2]. The test cultures were collection strains of micromycetes - phytopathogens - pathogens in plants: *Verticillium dahliae, Fusarium solani, F.oxysporum*.

To grow test cultures of microscopic fungi, Czapek's nutrient medium was used, g/l: $NaNO_3$ - 2; KH_2PO_4 - 1; $MgSO_4$ - 0,5; KCl - 0,5; $FeSO_4$ - traces, sucrose - 20, tap water - 1 l; pH 6,8-7,0. The cultures were grown for 7 days at a temperature of 27 ºC [1-8].

Streptomycetes were grown for 5-7 days at a temperature of 37°C on a starch-ammonia agar (CAA) nutrient medium, g/l: NaNO3 - 1,0; $MgSO_4$ - 1,0; K_2HPO_4 - 1,0; $CaCO_3$ - 3,0, NaCl - 1,0, starch - 10,0; tap water - 1 l; pH = 6,8-7,0, agar - 20,0 [1-7].

3 Results and discussion

During the microbiological examination of soils in Tashkent, we isolated 35 pigment-forming strains of actinomycetes, which were assigned to the genus Streptomyces. Of the isolated pigment-forming actinomycetes, 6 strains forming soluble pigments (RP) were selected, which stained the nutrient medium in various colors from pale pink to dark green (Fig. 1).

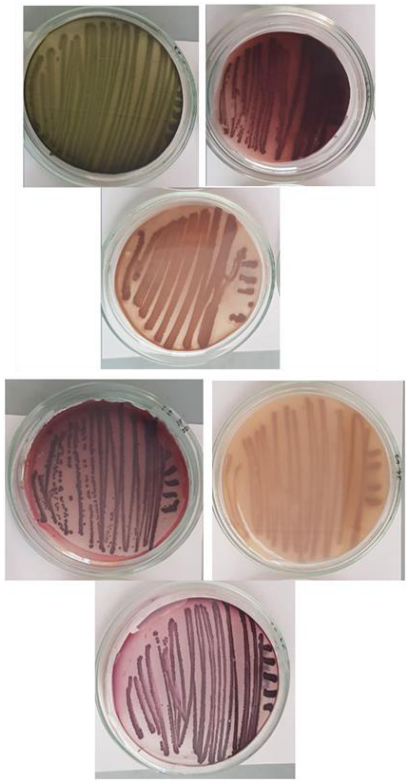

Fig. 1. Formation of various soluble pigments by streptomycetes (CAA medium)

Studies have been carried out to determine the antagonistic properties of selected cultures of actinomycetes to phytopathogens - pathogens in plants: *Verticillium dahliae, Fusarium solani, F.oxysporum* (Table 1).

The results showed that actinomycetes of the genus Streptomyces sp. 13 and Streptomyces sp. 34 inhibited the growth of V.dahliae, while the zone of inhibition of the growth of the fungus was 24 and 14 mm, respectively, but did not inhibit the growth of fungi of the genus Fusarium.

Table 1. Antagonistic action of pigment-forming streptomycetes to phytopathogens

#	**Actinomycetes**	**Phytopathogens, zone of absence D=mm**		
	Genus Streptomyces, strains	**Verticillium dahliae**	**Fusarium solani**	**Fusarium oxysporum**
1	13	22+1.3	-	-
2	15	25+ 0.2	24+0.8	22+1.2
3	21	45+0.1	28+0.2	26+0.4
4	26	16+0.8	18+1.3	14+0.7
5	32	16+1.2	14+0.9	16+0.3
6	34	14+0.3	-	-

Streptomyces sp.26 and Streptomyces sp.32 strains showed low activity, while growth suppression of V.dahliae was 16 mm, and F.solani - 18 and 14 mm, F.oxysporum - 14 and 16 mm, respectively.

Significant was the antagonistic effect of Streptomyces sp.15 to the studied phytopathogens, while the zone of no growth of pathogens reached from 22 mm to 26 mm. The highest antagonistic activity was shown by Streptomyces sp. 21 to all studied phytopathogens. At the same time, the zone of no growth of V.dahliae, D=46 mm; Fusarium solani, D=28 mm; Fus.oxysporum, D=26 mm (Fig. 2).

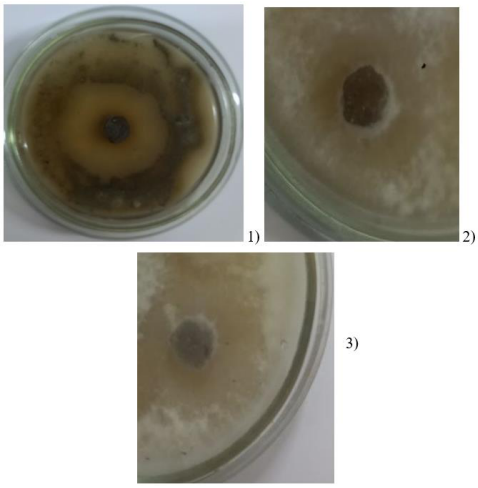

Fig. 2. The inhibitory effect of the pigment-forming strain of Streptomyces sp. to phytopathogens:1) Verticillium *dahliae;* 2) *Fusarium solani;* 3) *Fusarium oxysporum*

Thus, it was established that local strains of pigment-forming actinomycetes of the genus Streptomyces isolated from soils of various anthropogenic zones of Tashkent had a

rather high antagonistic activity against micromycetes-phytopathogens. And, since the use of saprophytic microorganisms in the fight against parasitic fungi and bacteria is based on the antagonistic relationships of various microbes, they can be used to recommend them for theoretical and practical use in the development of new biological preparations to combat fungal plant diseases.

4 Conclusion

Significant was the antagonistic effect of Streptomyces sp.15 to the studied phytopathogens, while the zone of no growth of pathogens reached from 22 mm to 26 mm. The highest antagonistic activity was shown by Streptomyces sp. 21 to all studied phytopathogens. At the same time, the zone of no growth of V.dahliae, D=46 mm; Fusarium solani, D=28 mm; Fus.oxysporum, D=26 mm

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