Article id: jae.2018.1.5.1
Journal of Agriculture and Environment, 2018, 1-5
doi: 10.23649/jae.2018.1.5.1
Advance Access Publication Date: 14 February 2018

NATURAL RESOURCES

ACTINOMYCETES OF SOME SOILS IN GEORGIA

Conflict of Interest

None declared.

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Associate editor: Alautdin Aliev
Received on 11 November 2017, revised on 29 December 2017, accepted on 10 January 2018.

Abstract
Four samples of soil from the saline soils of East Georgia (environs of the city Rustavi) have been taken. Different physiological groups of microorganisms, among them actinomycetes were isolated from these soils, and their quantitative composition has been studied. Among the four isolated strains of actinomycetes most revealed selective antagonistic activity towards the gram-positive and gram-negative microorganisms. the mutual antagonistic properties of antagonists were investigated.

Keywords: actinomycetes, nitrificators, cellulose-destructors, azotobacter, saprophytes, amylolytic bacteria.

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1 Introduction

Investigation of the qualitative and quantitative composition of microorganisms is of special interest today for the determination of soil fertility. Actinomycetes are one of the significant groups of soil-inhabiting associations of microorganisms. Many of them are antagonistic forms. Thus, studying of the conditions of their evolution and distribution peculiarities is significant (Zviagintsev, 1982; Mamulashvili et al., 2015; Mamulashvili et a., 2016).

The purpose of our investigation was to study the microflora of saline soils of east Georgia.

2 Materials and Methods

Both the gramm-positive and gramm-negative microorganisms served as test objects: *Elythrosporangium brasiliense, Actinosporangium violaceum, Staphylococcus aureus, Escherichia coli , Mycobacterium rubrum 874, Agrobacterium tumefaciens* (causes vine cancer), *Xanthomonas campestris* (infects cabbage), *Pectobacterium aroideae,* as well as actinomycetes isolated from saline soils.

Modern methods of soil microflora testing have been used in study (Tepper and Shilnikova, 2004). Cultivation of actinomycetes was performed on Krasilnikov's synthesized medium (CP-I). Antagonistic properties were studied by Block's method (Egorov, 1965).

3 Results and discussion

Four samples of soil, picked from saline soils of east Georgia have been tested.

Following physiological groups of microorganisms were isolated from the tested soils: saprophytic and amylolytic bacteria, fungi, cellulose-destructors, actinomycetes, nitrificators of the I and II phase and azotobacter. Results are demonstrated in table 1.

According to experimental results, it is clear that the quantitative composition of microorganisms of the tested soils is different. Saprophytes dominated in all four samples. They made in average 99.99% of the total number of microorganisms. This fact indicates that the studied soils are rich of plant and animal residues and an intensive process of transformation takes place here. Total amount of other groups of microorganisms in experimental samples made only 1%.

As for the percentage of particular group of microorganisms, in the third sample the amount of actinomycetes, azotobacter and cellulose-destructors prevailed, in the first sample content of amylolytic bacteria, fungi and anaerobic bacteria was higher. Content of actinomycetes was significantly higher in the fourth sample compared to other ones, while the second sample was rich of nitrificators of the II phase. It must be mentioned that no actynomycetes were discovered in the second sample.

Peculiarities of the distribution of antagonistic actynomycetes in experimental samples were studied on the next step of investigation. The pure cultures of actinomycetes were isolated from the soil samples, for this purpose (four strains: Rs1, Rs2, Rs3, Rs4) and analyzied to reveal the antagonistic properties. Experimental results are presented in table 2.

Table 1 – Number of microorganisms per one gram of the dry soil

Soil type	Saline							
Site of sampling	Environs of Rustavi							
	1		**2**		**3**		**4**	
Groups of micro-organisms	number	%	number	%	number	%	number	%
Saprophytes	63076	99,8	128571	99,9	133750	99,9	182857	99,9
Cellulose-destructors	9500	$1,5 \cdot 10^{-6}$	800	$0,6 \cdot 10^{-6}$	20000	$14,9 \cdot 10^{-6}$	5500	$3 \cdot 10^{-6}$
Amylolytic bacteria	$112,4 \cdot 10^{6}$	0,18	$8,39 \cdot 10^{6}$	0,013	$4,67 \cdot 10^{6}$	0,007	$5,15.10^{6}$	0,008
Anaerobic bacteria	627	$0,99 \cdot 10^{-6}$	633	$0,5 \cdot 10^{-6}$	505	$0,38 \cdot 10^{-6}$	661	$0,36 \cdot 10^{-6}$
Nitrificators (Iphase)	$80459,8 \cdot 10^{6}$	$60 \cdot 10^{-6}$	$369892,5 \cdot 10^{6}$	$276 \cdot 10^{-6}$	286956,5	$214 \cdot 10^{-6}$	311731,8	0,002
Nitrificators (IIphase)	17241,4	$9,4 \cdot 10^{-6}$	125806,5	$68,8 \cdot 10^{-6}$	107608,7	$58,8 \cdot 10^{-6}$	109497,2	$59,9 \cdot 10^{-6}$
Actinomyce tes	6896,55	$5,4 \cdot 10^{-6}$	-	-	18478,3	$14,4 \cdot 10^{-6}$	11173,2	$8,7 \cdot 10^{-6}$
Microscopic fungi	5100	$8 \cdot 10^{-6}$	7600	$6 \cdot 10^{-6}$	3150	$2,4 \cdot 10^{-6}$	2700	$1,5 \cdot 10^{-6}$
Total number of micro-organisms	$63189,45 \cdot 10^{6}$	$128580,32 \cdot 10^{6}$	$133755,09 \cdot 10^{6}$	$182862,73 \cdot 10^{6}$				
Soil humidity (%)	13	7	8	8,5				

From the table it is clear that the physiological activity of actinomycetes towards the experimental test-objects was revealed with different intensity. The most effective appeared to be the culture Rs4, which inhibited growth and development of *Pectobacterium aroideae* and *Esherichia coli* (size of the inhibition zone was 2.5mm), *Agrobacterium tumefaciens (*size of the inhibition zone was 1,9 mm), *Elythrosporangium brasiliense* and *Actinosporangium violaceum* (size of the inhibition zone was 0,5mm). The strain Rs1 revealed antagonism only against *Mycobacterium rubrum* 874 (size of the inhibition zone was 2,5mm) and *Elytrosporangium brasiliense* (size of the inhibition zone was 1,0mm).

The strain Rs3 was antagonistic only against *Mycobscterium rubrum* 874 (size of the inhibition zone was 1,8mm), *Staphylococcus aureus* and *Pectobacterium aroideae* (size of the inhibition zone was 0,5mm).

Table 2 – Antagonistic properties of actinomycetes

Test-object	Antagonistic culture			
	Strain rs1	Strain rs2	Strain rs3	Strain rs4
	Size of the inhibition zone, mm			
Elythrosporangium brasiliense	1,0	0,0	0,0	0,5
Actinosporangium violaceum	0,0	0,5	0,0	0,5
Staphylococcus aureus	0,0	0,5	0,5	0,0
Escherichia coli	0,0	0,0	0,0	2,5
Mycobacterium rubrum 874	2,5	1,0	1,8	0,0
Agrobacterium tumefaciens	0,0	0,0	0,0	1,9
Xanthomonas campestris	0,0	0,0	0,0	0,0
Pectobacterium aroideae	0,0	0,0	0,5	2,6

Strain of actinomycetes Rs2 revealed antagonism only against *Mycobacterium rubrum* 874 (size of the inhibition zone was 1,0mm), *Actinosporangium violaceum* and *Staphylococcus aureus* (size of the inhibition zone was 0,5mm).

From the experimental results it may be concluded that almost all actinomycetes isolated from saline soils of east Georgia revealed different level of antagonism.

The mutual antagonism of actinomycetes was studied as well. Experimental results are demonstrated in table 3.

Table 3 – The mutual antagonistic properties of actinomycetes

Test-object	Antagonistic strain			
	Strain Rs1	Strain Rs1	Strain Rs1	Strain Rs1
	Size of the inhibition zone, mm			
Strain Rs1	___	2,5	3,5	3,5
Strain Rs2	3,0		0,0	0,0
Strain Rs3	3,75	1,25	___	2,25
Strain Rs4	5,0	3,25	0,25	___

Obtained results demonstrate that actinomycetes isolated from soils of Rustavi environs reveal mutual antagonistic properties.

The most active was the strain Rs1, which inhibited the strain Rs4 (size of the inhibition zone was 0,5mm), the strain3 (size of the inhibition zone was 3,75mm) and the strain Rs2 (size of the inhibition zone was 3,0mm). The strain Rs2 inhibited the growth and development of strains: Rs4 (size of the inhibition zone was 3,25mm), Rs1(size of the inhibition zone was 2,5mm), and Rs3 (size of the inhibition zone was 1,25mm). The strain Rs3 inhibited growth of the strains Rs1 and Rs4.

Obtained results clear that the pure cultures of actinomycetes, isolated from Rustavi environs demonstrated selective activity against both, gram-positive and gram-negative microorganisms, as well as against each other.

4 Conclusions

• Active processes of transformation of the plant residues and nitrogen fixation takes place in saline soils (environs of Rustavi).

• The saline soil (environs of Rustavi) is rich of actinomycetes with selective antagonistic activity.

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