RHIZOSPHERIC MICROBIAL ANTAGONISTS AGAINST SOME ROOT-ROT PATHOGENS AND THE SENSITIVITY OF SOME POTENT ANTAGONTSTS TO FUNGICIDES

By

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ABSTRACT

Bacterial and actinomycete isolates were obtained from the rhizosphere of cotton plants (Giza 70). These isolates were tested for their potency in antagonizing Rhizoctonia solani and Sclerotium rolfsii. The following results were obtained:

- Out of 722 bacterial isolates investigated, 160 isolates showed antagonism against R.solani. Out of these antagonistic isolates, 83 isolates were weak, 43 moderate, and 34 isolates were potent antagonists. Scl.rolfsii was antagonized by 171 bacterial isolates which consisted of 66 weak, 51 moderate and 54 potent antagonists. The majority of the potent antagonists against both pathogens were found to belong to genera Pseudomonas and Bacillus.

The most potent bacterial antagonists were investigated for their sensitivity to the

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fungicides Vitavax Captan and Topsin M 70 in vitro. The results showed that most of the investigated isolates were sensitive to Vitavax Captan, but Topsin M 70 showed lower toxicity. Results also showed that the potent antagonists belonging to the same genus differed in their tolerance to the same fungicide; and the same bacterial isolate differed in it's sensitivity to different fungicides.

- Out of 627 actinomycetes isolates tested, 281 isolates showed antagonism against R. solani. These antagonists were found to be ,81 isolates weak, 78 moderate and 122 isolates were potent antagonists. Scl.rolfsii was antagonized by 279 actinomycetes isolates out of which 87 isolates were weak, 93 moderate and 99 isolates were potent antagonists. The potent actinomycetes antagonists against both fungi were found to belong to genus Streptomyces.

  Investigating the most potent antagonistic actinomycete isolates for their sensitivity to fungicides, in vitro,showed that Vitavax Captan was more toxic than Topsin M70.

INTRODUCTION

The microbial antagonists in the rhizosphere of the different plants play a role in controlling the root-rot pathogens. The presence of microbial antagonists against the root-rot pathogens in the rhizosphere of different plants was reported by many investigators including Stevenson, 1956; Waksman, 1957; Naim and Husein, 1958; Teliz-Ortiz and Berkholder, 1960; Olsen, 1965; Roa and Roa, 1966: Shklyar and Mansurova, 1968; Vlakhov, 1968; Broadbent and Baker, 1969; Broadbent and Waterworth, 1971; Aly, 1974; El-Said, 1976; El-Goorani *et al.*, 1976; Mahmoud *et al.*, 1980; Sirry *et al.*, 1981 and Neweigy *et al.*, 1982*a*.

This investigation was carried out aiming to verify whether microbial antagonists are still present in the rhizosphere of cotton plants (Giza 70), inspite of the seed-dressing with fungicides. The sensitivity of some potent antagonists to some fungicides was also investigated.

MATERIALS AND METHODS

Isolates of bacteria and actinomycetes from

the rhizosphere of cotton plants (previously seed dressed with fungicides; Vitavax Captan and Topsin M70), were obtained during plate counting. These isolates were investigated for their antagonistic efficiency against the two pathogenic fungi Rhizoctonia solani and Sclerotium rolfsii, in vitro, according to Johanson et al. (1960).

The pathogens Rhizoctonia solani and Sclerotium rolfsii as well as the fungicides Vitavax Captan and Topsin M 70 were obtained from Plant Pathology Institute Agric. Res. Center, Giza.

Antagonistic bacteria:

Bacterial isolates obtained from the plates of total microbial count, on soil extract agar medium, were purified on the same medium and were used for studying their antagonistic efficiency against the pathogenic fungi R. solani and Scl. rolfsii The study of the antagonism was carried out as follows:

One streak was made, from 24 hrs. active culture of each bacterial isolate, near the periphery of petri-dishes Plates were incubated

for 2 days at 30°C. Then, standard discs (6 mm diameter) of R.solani or Scl.rolfsii were transferred each to the middle of petri-dishes. Plates were reincubated and examined daily for antagonism. After 48 hrs from the pathogen inoculation, plates were examined for the presence or absence of inhibition zone and the width of the inhibition zone was measured in the four replicates and the mean was recorded.

The highly antagonistic bactrial isolates were reinvestigated, as mentioned before, for confirmation and screening to obtain the most potent antagonists against each of the two pathogens R.solani and Sclerotium rolfsii. The bacterial isolates which proved to be potent antagonists against the two pathogens were kept in the refrigerator for preliminary identification and for using the most potent antagonists in further experiments concerned with their tolerance to different concentrations of the fungicides.

3- Antagonistic Actinomycetes:

Actinomycetes isolates obtaied from colonies which appeared on plates of Jensen's agar medium

during actinomycetes count were purified actinomycete isolates against R.solani and Scl.rolfsii was carried out on soil extract agar medium plates as follows:

One streak of 6 days old conidia was made near the periphery of petri-dishes. After 3 days incubation at 30oC standard dises of the growth of R.solani or Scl.rolfsii were transferred each to the middle of the petri-dishes containing the actinomycete isolates (3-4 cm. far from the antagonist). The plates were reincubated and examined daily for antagonism. After 48 hrs. from the pathogen inoculation, plates were examined for the presence or absence of inhibition zone and the width of the inibition zone was estimated in the replicates and the average was recorded. The potent actinomycete antagonists were reinvestigated for confirmation and selecting the most potent antagonists against both pathogens to be used in further experiments concerend with their tolerence to fungicides. The appearance of the growth and microscopic examination of smears were helpful in the preliminary identification of the potent antagonists.

In all the tests of the antagonism, the microbial isolates which showed clear zone of inhibition were considered as antagonistic isolates against the investigated pathogen. According to the width of the inhibition zone, antagonists were grouped into the following categories.

1- Weak antagonists, where the width of the inhibition zone was less than 5mm.
2- Moderate antagonists, where the width of the inhibition zone was from 5-15 mm.
3- Potent antagonists, where the width of inhibition was more than 15 mm.

Any test for antagonism was made in four replicates.

Effect of fungicides on the most potent antagonistic bacteria and actinomycetes:

Soil extract agar medium was prepared (100 ml. portions in 250 ml. Erlenmeyer flasks). Different concentrations of each fungicide were added each to the autoclaved and cooled (45oC) medium, to make the desired concentrations to be tested. One ml. portions of the suitable dilutions of bacteria or actinomycetes conidia were added each to sterile Petri-dishes before pouring

the melted medium. After solidification, plates were incubated at 30oC for 5 days.

- Four replicates were made for every treatment .

The percentage of inhibition (inhibition index) was calculated according to the following formula:

$$\text{Inhibiton Index} = \frac{\text{Mean number of colonies of control} - \text{Mean number of colonies of treatment}}{\text{Mean number of colonies of control}} \times 100$$

RESULTS AND DISCUSSION

Antagonistic Bacteria:

1- Bacterial antagonists against R.solani and Scl.rolfsii:

Data in Table (1) indicate that out of 722 bacterial isolates investigated, 160 isolates antagonized R.solani. Regarding the efficiency of the antagonists, against R.solani, 83 isolates were found to be weak antagonists, 43 isolates were moderate and 34 isolates were potent antagonists.

Table (I): Antagonistic bacterial isolates from the rhizosphere of cotton plants, against Rhizoctonia solani on soil extract agar medium.

Stage of isolation	Number of tested isolates	Number of antagonists	Number of antagonists which were :			Percentages of antagonists which were : (%)			Percentage of total antagonists (%)
			weak	moderate	high	weak	moderate	high	
0 time	97	12	6	4	2	50	33.3	16.7	12.5
7 days	50	4	1	3	-	25	75.0	-	8.0
15 days	83	17	7	6	4	41	35.29	23.52	20.48
30 days	152	23	11	6	6	48	26.0	26.0	44.2
60 days	160	50	29	8	13	58	16.0	26.0	31.2
90 days	180	54	29	16	9	53	29.6	16.6	30.0
Total	722	160	83	43	34	51.8	26.8	21.2	22.1

Table (2) indicates that out of 722 bacterial isolates investigated, 171 isolates antagnonized Scl.rolfsii. Out of these antagonists, 66 isolates were weak, 51 isolates moderate and 54 isolates proved to be efficient antagonists.

The preliminary identification showed that most of the potent antagonists belonged to genera Pseudomonas and Bacillus.

The production of antibiotic substances, effective against the soil borne pathogens, by members of the genus Pseudomonas was demonstated by Naim and Husein (1958); Teliz-Ortiz and Berkholder (1960); Roa and Roa (1966); and Shklyar and Mansurova (1968) and El-Said (1976).

Naim and Husein (1958); Roa and Roa (1966); Vlakhov (1968); Broadbent and Baker (1969); Broadbent and Waterworth (1971); Aly (1974); El-Goorani et al. (1976); Mahmoud et al. (1980); Sirry et al. (1981) and Neweigy et al. (1982), found that Bacillus sp. isolates, from soil, antagonised the rootrot pathogens. The effect of Bacillus sp. isolates may be

Table (2) : Antagonistic bacterial isolates from the rhizosphere of cotton plants, against Sclerotium rolfsii, on soil extract agar medium.

Stage of isolation	number of tested isolates	No. of antagonists	Number of antagonists which were:			percentage of antagonists which were :			percentage of total antagonists
			weak	moderate	high	weak	moderate	high	
0 Time	97	13	13	-	-	100 %	- %	-	13.4 %
7 days	50	2	1	1	-	50 %	50 %	-	4 %
15 days	83	42	21	11	10	50 %	26 %	24 %	50.6 %
30 days	152	52	14	20	18	26.9%	38.4 %	34.7%	34.2 %
60 days	160	22	5	3	14	22.7%	13.6 %	63.6%	13.75%
90 days	180	40	12	16	12	30 %	40 %	30 %	22.2 %
Total	722	171	66	51	54	38.8%	29.8%	31.5%	23.6 %

due to the production of antibiotics by these isolates. Olsen (1965) and Roa and Roa (1966) reported that members of the genus Bacillus produce antibiotics in soil. So, Bacillus isolates may inhibited the pathogens in vitro by antibiotics production.

The results also show that inspite of the seed dressing with fungicide, microbial antagonists were still present in the rhizosphere of cotton plants (Giza 70), indicating that chemical control did not abolish the biological control. However, after 7 days from sowing, the period of maximal toxicity of fungicide on soil microorganisms (Neweigy et al., 1982 b), showed more severe effect on the percentage of antagonists.

Antagonistic actinomyectes:

Actinomycetes were grouped according to the colour of their secretions in the medium. This was done to find out which actinomycete colour groups show more antagonism against the root-rot pathogens. Hence the prevailing of such colour groups which proved to be efficient antagonists, in the soil samples may be taken as indication for the richness of these samples in the actinomycete antagonists.

1- Actinomycete antagonists against R.solani:

Data in Table (3) indicate that out of 637 actinomoycete isolates investigated, 281 isolates showed antagonism against R.solani. The actinomycete antagonists consisted of 81 weak isolates, 78 moderate and 122 isolates proved to be potent antagonists.

In case of the non-coloured actinomycetes, the percentage of isolates which showed antagonism against R.solani was 40%, but most of the coloured actinomycetes showed higher percentages of antagonists.

Concerning the efficiency of the antagonists, 25.5% of the non-coloured antagonists proved to be potent antagonists. In case of the coloured actinomycetes the percentages of potent antagonists almost were higher than that of the non-coloured.

The majority of, the violet antagonists (86.9%), yellow antagonists (80%) and orange antagonists (66.7%) were potent antagonists. On the other hand, the poorest coloured antagonists were the blue and dark brown actinomycete isolates.

Table (3): Antagonistic actinomycetes isolates, from the rhizosphere of cotton plants, against Rhizoctonia solani , on soil extract agar medium.

Colour of isolates (pigment)	Number of tested isolates	Number of tested antagonists	Number of antagonists which were:			Percentages of antagonists which were: (%)			Percentage of total anatagonists (%)
			weak	moderate	high	weak	moderate	high	
Non-pigmented.	235	94	38	32	24	40	34.5	25.5	40
Pigmented.									
Dirty black	41	27	8	6	13	25.6	22.2	48.2	65.8
Rose	24	12	6	4	2	50.0	33.3	16.7	50.0
Bluc	5	1	1	-	-	100.0	-	-	20.0
Violet	121	46	-	6	40	-	13.1	86.9	38.0
Brown	50	30	8	8	14	26.6	26.6	46.8	60.0
Dark brown	8	2	2	-	-	100.0	-	-	25.0
Orange	14	6	2	-	4	33.3	-	66.7	45.8
Yellow	40	20	-	4	16	-	20.0	80.0	50.0
Black	42	20	8	4	8	40.0	20.0	40.0	47.6
Grey	26	12	6	6	-	50.0	50.0	-	46.1
Miscellaneous	21	11	2	8	1	18.1	72.7	9.09	52.3
Total	627	281	81	78	122	28.8	43.5	43.5	44.8

2- Actinomycete antagonists against Scl.rolfsii:

Date in Table (4) indicates that out of 627 actinomycetes isolates investigated, 279 isolates antagonized Scl.rolfsii. The antagonists were found to be 87 week, 93 moderate and 99 potent antagonistic isolates.

In case of the non-coloured actinomycetes, the percentage of isolates which antagonized Sci.rolfsii was 41,7%, but some coloured actinomycetes showed higher percentages of antagonists. However, the percentages of antagonists were 80% of the yellow, 64% of the brown and 53.8% of the grey actinomycetes. The other coloured isolates gave approximately equal or lower percentages of antagonists.

Concerning the efficiency of the antagonists against Scl.rolfsii, it was found that 32.70% of the non-coloured antagonists were potent in antgonizing Scl.rolfsii. However, some coloured actinomycetes showed higher percentages of the potent antagonists among their respective groups It was found that 57.3% of the grey antagonists 52% of the violet; 43.5% of the brown antagonists

Table (4): Antagonistic actinomycetes isolates, from the rhizosphere of cotton plants, against Sclerotium rolfsii , on soil extract agar medium.

Colour of isolates (pigment)	Number of tested isolates	Number of antagonists	Number of antagonists which were:			Percentage of antagonists which were: (%)			Percentage of total antagonists (%)
			weak	moderate	high	weak	moderate	high	
Non-pigmented	235	98	28	38	32	28.5	38.8	32.7	41.7
Pigmented:									
Dirty black	41	18	10	4	4	56.0	22.0	22.0	43.9
Rose	24	6	4	-	2	66.6	-	33.4	25.0
Blue	5	1	-	1	-	-	100.0	-	20.0
Violet	121	46	11	11	24	24.0	24.0	52.0	38.0
Brown	50	32	10	8	14	31.5	25.0	43.5	64.0
Dark brown	8	3	-	2	1	-	66.6	33.4	37.5
Orange	14	6	2	4	-	33.4	66.6	-	42.8
Yellow	40	32	14	8	10	43.7	25.0	31.3	80.0
Black	42	12	4	4	4	33.3	33.3	33.3	28.5
Grey	26	14	2	4	8	14.2	28.5	57.3	53.8
Miscellaneous.	21	11	2	9	-	18.1	81.9	-	52.3
Total	627	279	87	93	99	33.1	33.3	35.6	44.4

were potent in antagonizing Scl.rolfsii. On the other hand, the blue and orange actionmycetes antagonists did not include any potent antagonist against Scl.rolfsii.

The preliminary identification showed that the potent antagonistic actinomycete isolates belonged to genus Streptomyces. This is in agreement with kurylowicz (1972)who reported that more than 98% of the actinomycetes antibiotics are produced by members of the genus Streptomyces.In addition, many earlier investigators found that Streptomyces isolates antagonized the root-rot pathogens (Stevenson, 1956; Shklyar and Mansurova, 1968; Broadbent and Baker,1969;Broadbent and Waterworth, 1971; Sirry etal., 1981 and Neweigy et al., (1982).

The results also showed that, the treatment of seeds with fungicides before sowing did not abolish the antagonistic actinomycetes in the rhizosphere of the cotton plants.

The aim of grouping actinomycete isolates on the basis of the colour of their pigmented secr-

etions to find out whether the abundance of certain colour groups could be taken as indicator for the richness in the antagonistic potency was fulfilled. The abundance of actinomycete groups which produced yellow, violet and brown pigments could be considered as indication for richness in the actinomycetes antagonistic potency. These actinomycete colour groups showed higher percentages of antagonists among their respective colour groups. Also, high percentages of these antagonists were found to be potent antagonists.

Effect of fungicides on the potent bacterial antagonists:

Table (5) show that out of the 5 bacterial antagonists, 3 isolates were very sensitive to Vitavax Captan and were completely inhibited at 5 ppm of the chemical. The fourth isolate was inhibited at 50 ppm. while the fifth isolate (Bacillus sp.) highly tolerated the toxicant and 10,000 ppm could not cause complete inhibition. On the other hand, Topsin M70 showed lower toxicity to the tested antagonists.The strains which were very sensitive to Vitavax Captan tolerated moderate or high concentrations of Topsin

Table (5): Effect of the fungicides Vitavax Captan and Topsin M70 on the most potent antagonistic (Pseudomonas sp. and Bacillus sp.) isolates.

Treatment	Inhibition Index				
	Bacillus sp. (1)	Pseudomonas sp. (2)	Bacillus sp. (3)	Pseudomonas sp. (4)	Bacillus sp. (5)
			Vitavax Captan		
5 ppm	100	100	62.73	00.00	100
50 ppm	100	100	68.32	100	100
100 ppm	100	100	69.87	100	100
200 ppm	100	100	78.26	100	100
300 ppm	100	100	78.88	100	100
400 ppm	100	100	80.74	100	100
500 ppm	100	100	81.98	100	100
1000 ppm	100	100	82.29	100	100
5000 ppm	100	100	84.78	100	100
10,000 ppm	100	100	90.99	100	100
			Topsin M 70		
5 ppm	32.55	42.10	50.62	7.14	30.33
50 "	44.18	56.14	72.5	9.99	80.42
100 "	48.83	64.91	67.5	10.28	80.82
200 "	53.48	70.17	70.	25.55	100
300 "	56.97	78.94	71.25	29.41	100
400 "	63.95	91.22	72.99	34.07	100
500 "	69.76	100	100	44.44	100
1000 "	74.41	100	100	81.48	100
5000 "	84.42	100	100	100	100
10,000 "	100	100	100	100	100

M70. It is worthy to mention that the bacterial antagonist Bacillus sp.(3) which tolerated high concentrations of Vitavax Captan, tolerated only moderate concentrations of Topsin M70.

Results show that the potent antagonists belonging to the same genus differed in their tolerence to the same fungicide, and the same bacterial isolate differed in its sensitivity to different fungicides. It seems that the effect of the fungicide against certain microorganism is correlated with the chemical composition of the fungicide and the sensitivity of the organisn which maybe correlated with the rate of uptake of the fungicide by the microorganism. The higher the rate of the fungicide uptake the higher the sensitivity of the microorganism (Mathre, 1968).

Effect of fungicides on the potent actiomycete antagonists:

Vitavax Captan was more harmful than Topsin M70 on the growth of antagonistic actinomycetes. Actinomycete isolates giving the same pigment, differed in their sensitivity to the same fungicide (Table 6).

Generally, It is concluded that, fungicides

Table (6): Effect of the fungicides Vitavax Captan and Topsin M 70% the most potent antagonistic Actinomycetes.

Treatment	Inhibition Index of the potent antagonistic coloured actinomycetes isolates											
	Violet				Dirty				Yellow		Rose	Brown
	1	2	3	4	1	2	3	4	1	2	1	1
Vitavax Captan												
5 ppm	100	11.00	15.00	20.00	100	12.22	9.12	10.00	100	21.25	100	14.7
50 "	100	25.0	100	100	100	40.5	100	100	100	61.29	100	100
100 "	100	92.5	100	100	100	80.4	100	100	100	80.00	100	100
200 "	100	100	100	100	100	99.2	100	100	100	100	100	100
300 "	100	100	100	100	100	100	100	100	100	100	100	100
400 "	100	100	100	100	100	100	100	100	100	100	100	100
500 "	100	100	100	100	100	100	100	100	100	100	100	100
1000 "	100	100	100	100	100	100	100	100	100	100	100	100
5000 "	100	100	100	100	100	100	100	100	100	100	100	100
10,000 "	100	100	100	100	100	100	100	100	100	100	100	100
Topsin M 70%												
5 ppm	79.	00.0	00.00	0.0	100	13.33	6.66	4.00	47.72	3.00	86.93	00.00
50 "	84.	00.0	00.00	0.0	100	20.	14.44	20.00	62.	35.48	100	16.66
100 "	86.	00.00	0.0	0.0	100	33.33	18.8	28.8	69	36.7	100	50.55
200 "	89.	00.00	0.0	0.0	100	66.66	22.2	40.4	79	37.8	100	52.22
300 "	93.	00.00	0.0	16.66	100	80.	33.3	52.3	86	39.9	100	66.66
400 "	99.5	00.00	0.0	16.66	100	86.6	41.4	60.9	92	41.93	100	68.88
500 "	100	00.00	0.0	16.66	100	88.8	49.9	62.7	100	49.35	100	75.8
1000 "	100	25.	0.0	50.	100	90.0	57.7	76.8	100	56.45	100	83.33
5000 "	100	75	33.3	66.	100	93.3	66.6	84.4	100	88.7	100	96.66
10,000 "	100	100	72.2	100	100	100	93.3	100	100	100	100	100

differed in their toxicity towards the investigated potent antagonistic microbial isolates. However, Vitavax Captan almost showed more toxic effect than Topsin M70. This result is in agreement with earlier results obtained by the authors on the effect of these fungicides on the different groups of microorganisms (Neweigy et al.,1982 b). Also, earlier results by the authors showed that Vitavax Captan was more toxic to the root-rot pathogens than Topsin M70(Neweigy et al.,1982 c). So, it is recommended to search for fungicides having selective high toxicity to the pathogens with the least toxicity to the potent antagonists. Such condition will give chance for the potent antagonists (biological control) to play a role supporting the chemical control.

In this study, the investigators gave only a touch on the sensitivity of the potent antagonists to different fungicides. This was carried out to through the light on this important topic which is concerned with the effect of chemical control on the antagonists responsible for biological control.

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عزلات ميكروبية من ريزوسفير نبات القطن (جيزة ٧٠) تضاد بعض فطريات عفن البذور ، وحساسية بعض العزلات القويـة في التضاد للمبيدات الفطرية

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و محمد صلاح عبد العزيز فليفل**

تم الحصول علي عزلات من البكتريا والأكتينوميسيتات مـن ريزوسفير نباتات القطن (جيزة ٧٠) واختبرت هذه العزلات لمعرفه قدرتها علي تضاد الريزوكتونيا سولاني وسكليروسيوم رولفزيـاي واسفرت الدراسة عن النتائج الآتية :

ـ عند اختيار ٧٢٢ عزلة بكتيرية لقدرتها علي التضافان ١٦٠ عزلة كانت تضاد ريزوكتونيا سولاني منها ٨٣ عزلة كانت ضعيفة في التضاد، و ٤٣ عزلة كانت متوسطة بينما ٣٤ عزلة أظهرت تضـادا عاليا لهذا الفطر.

أما بخصوص التضاد مع الفطر سكليروشيوم رولفزياي فقـد أثبتت التجارب أن ١٧١ عزلة بكتيرية كانت تضاد هذا الفطر منها ٦٦ عزلة كانت ضعيفة في التضاد ، ٥١ عزلة كانت متوسطة بينما ٥٤ عزلة أظهرت تضادا عاليا مع هذا الفطر والعريف الأولي للبكتريـا عالية التضاد أثبت أن الغالبية العظمي منها كانت لجنسي البسيوموناس والباسلس.

وبعض العزلات البكتيرية التي أثبتت كفاءة عالية حدا فـي التضاد ثن دراسة حساسيتها للمبيدين الفيتافاكس كانتان والتوبسين م ٧٠. وقد أظهرت النتائج أن أغلب العزلات المختبرة كانت حساسة للفيتافاكس كبتان ولكن التوبسين م ٧٠ كان أقل سمية. وقد أظهرت النتائج أيضا أن البكتيريا عالية التضاد والمنتمية لنفس الجنـس

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اختلفت في درجة تحملها لنفس المبيد والعزلة البكتيرية الواحدة اختلفت في درجة تحملها للمبيدات المختلفة.

ـ وبخصوص الأكتينوميسيتات فانه باختبار ٦٢٧ عزلة للتضاد مع الريزوكتونيا سولاني فان ٢٨١ عزلة ضعيفة، ٧٨ عزلة متوسطة، ١٢٢ عزلة كانت عالية التضاد أما بخصوص تضاد عزلات الأكتينوميسيتات للفطر سكليروشيوم رولفزياي فان ٢٧٩ عزلة أظهرت تضادا لهذا الفطر منها ٨٧ عزلة كانت ضعيفة ، ٩٣ متوسطة و ٩٩ عزلة كانت عالية التضاد لهذا الفطر.

والتعريف الأولي لعزلات الاكتينوميسيتات العالية التضاد أثبتت أنها تنتمي الي جنس Streptomyces

وقد تم دراسة بعض عزلات الأكتينوميسيتات العالية جدا في التضاد بالنسبة لحساسيتها للمبيدات ، وأظهرت الدراسة أن الفيتافاكس كبتان كان أشد سمية عليها من التوبسين م ٧٠.