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EFFECT OF THE FUNGICIDES VITAVAX CAPTAN AND TOPSIN M 70 ON THE PATHOGENIC FUNGI *RHIZOCTONIA SOLANI. FUSARIUM OXYSPORUM F.SP. VASINFECTUM* AND *SCLEROTIUM ROLFSII*

By

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ABSTRACT: The, *in vitro,* study showed that Vitavax Captan completely inhibited the growth of *S. rolfsii* at very low concentration (5 ppm), but *R. solani* required 100 ppm of the chemical for its complete inhibition. In case of *Fusarium oxysporum,* 500 ppm of Vitavax Captan were required for the complete inhibition of the fungus.

Concerning Topsin M70, *Fusarium oxysporum* was sensitive to Topsin M70 where 100 ppm of the fungicide completely inhibited the fungus. *Rhizoctonia solani* could tolerate high doses of the chemical and was completely inhibited by the addition of 1000 ppm of the fungicide. *Sclerotium rolfsii* tolerated very high concentrations of the fungicide and the highest dose used in the investigation (10.000 ppm) did not cause complete inhibition.

For both fungicides, it was found that the higher the concentration of the fungicide the greater the inhibition of the fungal growth. This was observed with all investigated fungi.

Fungicides application decreased the fungal counts in sterilized soil infested with *R. solani. S. rolfsii* or both of them. This was observed in cultivated and uncultivated soils. The higher the dose of the fungicide the more reduction in fungal counts.

The seed dressing of cotton var. Giza 70 with fungicides increased the percentages of germination and survival plants and decreased the damping-off percentages as compared to their respective control. Vitavax Captan was more effective against *S. rolfsii* and Topsin M70 was more effective against *F. oxysporum f.sp. vasinfectum*.

INTRODUCTION

Rhigoctonia solani was reported as the main pathogen which causes root-rot on bean, cowpea, broad bean, lupine, French bean, chick pea and other crops **(Beckeet, 1957; Shawky, 1964; Ashour *et al.*, 1964; Sirry *et al.*, 1970; Habib, 1979 and El-Shewy, 1982). Weber (1931)** listed 189 species as hosts for *Sclerotium rolfsii*. *Fuasrium oxysporum f. sp. vasinfectum* cause wilt on cotton **(Darrage, 1963 and Sabet and Kararah, 1971).**

Nowadays, many fungicides are used for the control of these root-rot and damping-off pathogens.

Since pathogenic fungi may differ in their sensitivity towards any fungicide. So it was found of importance to study the spectrum of efficiency of two fungicides namely Vitavax Captan and Topsin M 70 against the aforementioned root-rot and wilt pathogens.

MATERIALS AND METHODS

The pathogenic fungi *Rhizoctonla solani* Kuhn., *Fusarium oxysporum* Schlecht f. sp. *vasinfectum* (Atk) and *Sclerotium rolfsii* Sacc. were obtained from Plant Pathology Inst. Agric. Res. Center, Giza, Egypt. The fungicides Vitavax Captan and Topsin M 70 were kindly supplied by the fungicides laboratory of the same Institute. Then the following studies were carried out.

1- Effect of fungicides on the growth of pathogenic fungi *in vitro*:

The poisoned food technique was used to determine the effect of fungicides on the mycelial growth of pathogenic fungi *Rhizoctonia solani*, *Fusarium oxysporum* and *Sclerotium rolfsii*. Concentrations used for each fungicide were 5, 50, 100, 200, 300, 400, 500, 1000, 5000 and 10,000 ppm active ingredient. Concentrations were obtained by adding the appropriate amount of stock suspensions, or their dilution to 100 ml. portion of autoclaved and cooled (45°C) soil extract agar medium. Fungicides were thoroughly mixed into the melted medium and poured in 5 plate for each flask. Soil extract agar medium without fungicide! addition was used for control. After agar Solidification, 6-mm plugs containing the fungus growth were cut from *7-daya* old culture and transferred to the middle of agar medium plates containing the different concentrations of the fungicides. Plates were incubated at 25°C for 5-days. The mean diameter of mycelial growth was recorded after 48 hours and then at 24 hours intervals. The data are recorded for 120 hrs from commencement; however, the experiment was ended at an earlier time if the growth In one plate covers the agar surface. Percentage of growth inhibition (inhibition index) was calculated according to the following formula; reported by **Abou-Neama**(**1978**).

Inhibition Index:

$$\text{Inhibition Index} = \frac{\text{Mean diameter of control - Mean diameter of treatment}}{\text{Mean diameter of control}} \times 100$$

Effect of fungicides on the counts of pathogenic fungi inoculated to sterilized cultivated and uncultivated soils:

Each isolate of the pathogens was grown on Sorghum medium for 3 weeks (**Whitehead, 1975**). Sterilized pots containing sterilized soil was inoculated with *R. solani, S. rolfsii* or two pathogens at the rate of 2%. After one week, surface sterilized cotton seeds var. Giza-70 were sown in the infested pots after receiving the following treatments:

a-Control.

b- Seed dressing with normal field application rate (N) of the fungicide.

c- Seed dressing with 10 fold the normal rate (10 N) of the fungicide.

These treatments were carried out for each fungicide. Four replicates were made for every treatment.

In case of the uncultivated Soil heat-killed seeds (at 100°C for 1hr. in the oven) substituted the ordinary seeds, then the aforementioned treatments were carried out. The pots were 25 cm. diameter. Ten seeds were sown in each pot. Pots were irrigated with sterilised water every 3 days. Fungal plat count was made at intervals on Martin's medium **(Martin, 1950).**

x - N for Vitavax Captan was 3 g/kg seeds.

- N for Topsin M70 was 2 g g/kg seeds.

Effect of seed dressing with fungicides on reducing the damping-off in cotton var. Giza 70 sown in sterilized soil infested with the pathogens *R. solani. F. oxysporum* and *S. rolfsii*:

The pathogenicity test was carried out using sterilized soil in 25 cm. sterilized pots. The pots were inoculated with 2% of any of the pathogens *R. solani. F. oxysporum f. sp. vasinfectum, S.*

rolfsii or a mixture of the pathogens grown on Sorghum medium. Four pots were left without fungi inoculation, and were sown with surface sterilized seeds to serve as control. Inoculated pots with any of the pathogens were sown with cotton seeds which received the following treatments:

1- Surface sterilized seeds.

2- Surface sterilized seeds dressed with normal field application rate of Vitavax Captan.

3- Surface sterilized seeds dressed with normal field application rate of Topsin M70.

- Ten seeds were sown in each pot.
- Four replicates were made for every treatment. Pots were irrigated every 3 days with sterilized water. The percentages of germination-and pre-emergence damping-off were estimated after 21 days from sowing, while the percentages of post-emergence damping-off and survival plants were estimated after 45 days from sowing.

RESULTS AND DISCUSSION

Effect of the fungicides Vitavax Captan and Topsin M70% **on pathogenic fungi, *in vitro*:**

A. Effect of Vitavax Captan on pathogenic fungi:

Data in **Table (1)** show that Vitavax Captan completely inhibited the growth of *Sclerotium rolfsii* at very low concentration (5 ppm), but *Rhizoctonia solani* required 100 ppm of the chemical for its complete inhibition. In ease of *Fusarium oxysporum* 500 ppm of Vitavax Captan were required for it's complete inhibition. These results are in agreement with the findings of **Mukhopadya and Thake (1971)** who reported that carboxin (Vitavax) significantly reduced the growth of *S. rolfsii*. *in vitro,* at very low concentration (1 ppm).

B. Effect of Topsin M70% **on pathogenic fungi:**

Table (1): Effect of the fungicides Vitavax Captan and Topsin M70 on the growth of the pathogenic fungi *R. solani*, *F. oxysporum* and *S. rolfsii*.

Fungi Concentration	*Rhizoctonia solani* Inhibition index at intervals (hours from commencement)				*Fusarium oxysporum* Inhibition index at intervals (hours from commencement)				*Sclerotium rolfsii* Inhibition index at intervals (hours from commencement)			
1-Vitavax Captan												
ppm	48 hrs	72 hrs	96 hrs	120 hrs	48 hrs	72 hrs	96 hrs	120 hrs	48 hrs	72 hrs	96 hrs	120 hrs
5 ppm	56.36	71.81	81.1		35.41	27.39	12.22	14.28	100	100	100	100
50 ppm	60.00	78.18	85.5		54.16	45.00	14.00	21.45	100	100	100	100
100 ppm	100	100	100		100	100	86.66	81.42	100	100	100	100
200 ppm	100	100	100		100	100	100	83.57	100	100	100	100
300 ppm	100	100	100		100	100	100	88.50	100	100	100	100
400 ppm	100	100	100		100	100	100	88.50	100	100	100	100
500 ppm	100	100	100		100	100	100	100	100	100	100	100
2- Topsin M70												
5 ppm	16.36	16.36	42.20		16.66	21.91	23.30	35.70	00.00	00.00	00.00	00.00
50 ppm	47.27	59.09	67.77		54.00	72.60	76.00	85.00	20.00	42.80	42.90	44.44
100 ppm	56.36	67.27	75.55		100	100	100	100	28.00	47.60	47.96	48.80
200 ppm	60.00	70.00	77.77		100	100	100	100	36.00	52.38	52.52	52.99
300 ppm	63.63	74.50	82.22		100	100	100	100	44.00	54.76	56.81	57.50
400 ppm	67.27	78.18	83.33		100	100	100	100	50.00	57.14	62.28	62.28
500 ppm	70.90	81.81	85.50		100	100	100	100	54.00	61.90	68.18	78.90
1000 ppm	100	100	100		100	100	100	100	100	71.42	74.24	75.00
5000 ppm	100	100	100		100	100	100	100	100	78.57	78.57	78.57
10,000 ppm	100	100	100		100	100	100	100	100	81.50	82.00	86.66

Data in **Table (1)** indicate that *Fusarium oxysporum* was sensitive to Topsin M70% where 100 ppm of the fungicide completely inhibited the fungus. *Rhizoctonia solani* could tolerate high doses of the chemical and was completely inhibited by the addition of 1000 ppm of the fungicide. *Sclerotium rolfsii* tolerated very high concentrations of the fungicide, since the highest dose used in this investigation (10,000 ppm) did not cause complete inhibition of the fungus.

When Topsin M (70% thiophanate methyl) was used against the pathogens *R. solanl* and *S. rolfsii*. it was found that lower concentrations caused partial Inhibition. At those lower concentrations, the effect of thiophanate methyl (TPM), on the growth of the fungi, increased with time. This may be due to hydrolysis of the compound to more toxic derivative. The *in vitro* conversion of thiophanate methyl (TPM) to carbendazim (MBC) was recorded by earlier investigators. **Selling *at al*.(1970)** reported that when TPM was shaken in tap-water, for 5 days, MBC was detected. **Vonk and Kaare-Sijpesteijn (1971)** reported that the conversion of TPM to MBC increased the fungitoxic effect of TPM.

The results indicate that the investigated pathogenic fungi differed in their sensitivity to the same fungicide, and different fungicides differed in their effect on the same pathogen.

It, seems that sensitivity of the pathogen to pertain fungicide is governed, at least partially, by the speed of penetration of the chemical to the fungus. **Mathre (1968)** suggested that the fungicide (carboxin) (DMOC) or its product of degradation oxycarboxin (DCMOD) were fungistatic against *R. solani* and *Ustilago maydis*. Although he found a rapid uptake of C^{14} DMOO (carboxin) and C^{14} DCMOD (oxycarboxin) by the above fungi, the resistant fungus *Fusarium oxysporum f. sp.*

lycopersici absorbed very little of the fungicide from solution.

Results also show that, the higher the concentration of the fungicide, the greater fungal growth inhibition occurred. This was found with both fungicides and with all investigated pathogens.

Effect of fungicides on fungal counts in soil and rhizosphere of cotton plants sown in sterile soil infested with_the pathogens *R. solani* and *S. rolfsli*:

Data in **Table (2)** show that fungicides application decreased the fungal counts in sterilized soil infested with the pathogens *Rhizoctonia solani* or *Sclerotium rolfsii*. This was observed in the cultivated and uncultivated soils. However, the effect was more obvious in the uncultivated soil. It seems that root exudates supply the pathogens with nutrient compounds which increase their tolerance to the toxic effect of such chemicals. Data also show that the higher the application dose the more effect on fungal counts. This logic result was observed with both fungicides in cultivated and uncultivated soils infested with *Rhizoctonia solani* or/and *Sclerotium rolfsii*.

The toxic effect of the fungicides on the pathogens was obvious after 7 days from application and the severe effect lasted at least up to 30 days from application after which fungal survivals either continued to decrease or remained nearly constant or started to increase slowly. However, fungal counts; in all treatments; were far lower than that of control till the end of the experiment after 90 days from fungicide application. This indicates the persistence of the fungicides in the sterilized soil in the absence of soil microflora which play an important role in the degradation of these compounds. It is worthy to mention that many investigators found that fungicide application adversely affected the fungal count in soil **(Riohardson, 1954;**

Table (2): Effect of fungicides on fungal counts in soil and rhizosphere of cotton plants sown in sterile soil infested with the pathogens *R. solani* and *S. rolfsii*. **(×10^5/g dry weight)**

Time of Sampling (days)	Cultivated sterilized soil					Uncultivated sterilized soil				
	Control with inoculum	Vitavax captan		Topsin M70		Control with inoculum	Vitavax captan		Topsin M70	
		N	10 N	N	10 N		N	10 N	N	10 N
Infested with *Rhizoctonia solani*										
0-time	10.2	11.00	6.50	8.66	8.33	4.5	4.22	5.05	5.44	4.66
7-days	18.4	5.62	1.00	6.60	4.77	4.7	1.67	0.22	2.88	2.00
15-days	35.5	5.57	0.99	5.33	3.44	5.9	1.16	0.17	1.33	0.56
30-days	33.6	1.68	1.08	5.33	2.22	4.4	1.15	0.72	1.27	0.74
60-days	20.7	4.37	3.12	12.40	4.22	5.5	1.44	0.51	1.37	0.51
90-days	39.7	16.25	12.00	23.30	16.80	6.5	1.44	0.14	2.34	0.16
Infested with *Sclerotium rolfsii*										
0-time	7.3	4.11	4.11	5.66	9.22	5.5	3.02	4.14	5.77	5.55
7-days	10.1	1.77	0.77	3.78	4.85	5.5	1.18	0.16	2.60	1.48
15-days	18.3	1.20	0.32	2.11	0.81	5.9	0.14	0.13	0.46	0.32
30-days	22.2	1.83	0.66	2.87	1.54	6.5	0.45	0.50	0.28	0.34
60-days	34.4	3.11	1.66	3.22	2.82	3.6	0.61	0.16	0.94	0.52
90-days	52.5	4.10	4.60	8.80	5.94	4.5	1.11	0.10	2.00	0.83
Infested with Mixture from *R. solani* and *S. rolfsii*										
0-time	7.1	4.44	7.22	5.77	4.80	4.9	3.55	7.22	2.22	3.77
7-days	9.5	2.44	0.57	3.65	1.37	3.8	0.58	0.71	1.33	1.26
15-days	12.2	0.24	0.51	2.37	0.46	3.3	0.32	0.18	1.11	0.12
30-days	22.6	1.44	0.70	1.55	0.60	4.5	0.35	0.32	0.58	0.18
60-days	24.9	2.77	0.27	2.41	1.13	5.3	0.32	0.52	1.32	0.28
90-days	32.5	6.20	4.88	8.88	4.50	5.5	1.11	1.00	1.52	1.27

Domsch, 1959; Naumann, 1970; and Wainright and Pugh, 1975).

The data also indicate that the fungicide Vitavax-Captan seemed to be more toxic than Topsin M70 to the pathogens *Rhizoctonia solani* and *Sclerotium rolfsii*. This result is in agreement with the earlier results obtained, *in vitro*.

The fungicides proved their drastic effect on the pathogenic fungi *Rhizoctonia solani* and *Sclerotium rolfsii* in sterilized Infested soil which is a step forward condition nearly resembling the natural conditions.

Effect of the fungicides Vitavax Captan and Topsin M70 on the incidence of damping-off in cotton plants sown in sterilized soil infested with *R. solani, F. oxysporum* and *S. rolfsii*.

Data in **Table (3)** indicate that the Investigated fungi proved to be pathogenic to cotton seedlings. These pathogenic fungi reduced the percentages of germination and survival plants and Increased the pre-emergence and almost increased the post-emergence damping-off as compared to their respective control. Concerning the virulence of the pathogens *Rhizoctonia solani* was the most virulent followed by *Sclerotium rolfsii* then *Fusarium oxysporum*. However, the infestation with the three pathogens gave the most severe effect than when any of the pathogens was inoculated solely.

Fungicides application increased the percentages of germination and survived plants and almost decreased the pre- and post-emergence damping-off as compared to their respective percentages in the infested soil with any of the pathogens. This was true for both fungicides Vitavax Captan and Topsin M70 applied at normal field application rate against the pathogens *R. solani, S. rolfsii* and *F. oxysporum*.

These results are in agreement with the results of many earlier investigators, by

Table (3): Effect of the fungicides on the percentages of germination pre- and post- emergence damping-off and survival plants of cotton in sterilized soil infested with *R. solani, F. oxysporum* and *S. rolfsii.*

Treatment	% Germination	% damping-off		% Survival plants
		Pre-emergence	Post-emergence	
Control	**95**	**5**	**2.5**	**92.5**
Rhizoctonia solani	**67.5**	**32.5**	**10.0**	**57.5**
Vitavax Captan	**75.0**	**25.0**	**2.5**	**72.5**
Topsin M70	**77.5**	**22.5**	**7.5**	**70.0**
Fusarium oxysporum	**75**	**25**	**5.0**	**70.0**
Vitavax Captan	**80**	**20**	**2.5**	**77.5**
Topsin M70	**85**	**15**	**2.5**	**82.5**
Sclerotium rolfsii	**70.0**	**30.0**	**2.5**	**67.5**
Vitavax Captan	**87.5**	**12.5**	**--**	**87.5**
Topsin M70	**75.0**	**25.0**	**7.5**	**67.5**
Mixture of the 3 pathogens…….	**62.5**	**37.5**	**12.5**	**50.0**
Vitavax Captan	**77.5**	**22.5**	**7.5**	**70.0**
Topsin M70	**75.0**	**25.0**	**7.5**	**67.5**
L.S.D. 5%	**6.60**			**7.015**
L.S.D. 1%	**8.92**			**9.413**

seed dressing of various plants with different fungicides **(Farahat, 1970; Jhooty and Behar, 1970; Papuvizas and Lewis, 1975; Badr, 1979; Abd El-Lateef *et al*., 1979 and Habib, I979).**

Vitavax Captan was more effective against *S. rolfsii* since it gave higher survival plants 87.5% compared to that of Topsin M70 which was 67.5%. This result is in agreement with the result obtained *in vitro* by **Mukhopadya and Thake (1971)**. On the other hand, Topsin M70 seemed to be more effective against *F. oxysporum* since the percentage of survival plants was 82.5% compared to that obtained with Vitavax Captan (77.5%). These results are in line with the results obtained *in vitro*, in an earlier part of this investigation **(Table 1)** which showed higher sensitivity of *S. rolfsii* to Vitarax Captan and *F. oxysporum* was more sensitive to Topsin M70.

Summing up the results in this study show that the investigated pathogenic fungi differed in their sensitivity towards the same fungicide, and fungicides differed in their effect on the same pathogen. So, it may be preferable to use suitable blends or mixtures than ,'Single fungicide or to search for broad-spectrum fungicides to control efficiently most of the pathogens.

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تأثير المطهرات الفطرية الفيتافاكس كابتان والتوبسين م٧٠ على الاريزوكتونيا سولاني ، والفيوزاريوم أوكسيسبورم ، وسكليروشيوم رولفزياي

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تم دراسة تأثير المبيدات الفطرية الفيتافاكس كابتان والتوبسين م٧٠ على الفطريات الاريزوكتونيا سولاني ، والفيوزاريوم أوكسيسبورم ، وسكليروشيوم رولفزياي وأسفرت الدراسة عن النتائج الآتية:

١- في المعمل:

أ- الفيتافاكس كابتان:

الفيتافاكس كابتان ثبط كلية نمو سكليروشيوم رولفزياي عند تركيز منخفض جداً (٥جزء في المليون) ، ولكن التثبيط الكلي للريزوكتونيا سلاني تطلب ١٠٠ جزء في المليون من المبيد ، في حين أن ٥٠٠ جزء في المليون من المبيد كانت ضرورية لإحداث التثبيط الكامل للفيوزاريوم أوكسيسبورم.

ب-توبسين م٧٠ :

أثبتت التجارب أن فطر الفيوزاريوم أوكسيسبورم كان حساس للتوبسين م٧٠ حيث أن ١٠٠ جزء في المليون من المبيد ثبطت كلية هذا الفطر ، في حين تحمل الاريزوكتونيا سولاني جرعات أعلى من المبيد وقد تم تثبيط نمو هذا الفطر بإضافة ١٠٠٠ جزء في المليون من هذا المبيد. وتحمل فطر سكليروشيوم رولفزياي ١٠٠٠٠ جزء في المليون من المبيد دون حدوث تثبيط كامل لنموه.

وعند التركيزات المنخفضة من المبيدات وجد أنه كلما زاد تركيز المبيد كلما زاد تثبيط نمو الفطر وذلك في حالة أي من المبيدين ومع أي من الفطريات المختبرة.

٢- عند حقن التربة المعقمة بالريزوكتونيا سولاني أو سكليروشيوم رولفزياي أو كلاهما فإن المعاملة بالمبيدات قللت أعداد الفطر وذلك في التربة المنزرعة وغير المنزرعة وكلما زادت جرعة المبيد كلما نقصت أعداد الفطر.

٣- وقد أظهرت التجارب أيضاً أن معاملة بذرة القطن جيزة ٧٠ بالمبيدات ثم زراعتها في تربة معقمة محقونة بالفطريات المرضية ، أدى إلى زيادة النسبة المئوية للإنبات والنسبة المئوية للنباتات التي قاومت الذبول ، وقللت النسبة المئوية للذبول وذلك بالمقارنة بالكنترول (غير المعامل بالمبيدات).

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