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Suppression of Root Rot Incidence in Faba Bean Fields by Using Certain Isolates of Trichoderma

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Trichoderma harzianum (T1 & T3) and *T. viride* (T2), which proved themselves as mycobiocides against broomrape, were evaluated for their antagonistic effect against the growth of root rot pathogens *in vitro* as well as for controlling disease incidence in greenhouse and field conditions. *Fusarium solani* f.sp. *fabae*, *Rhizoctonia solani* (AG-4) and *Sclerotium rolfsii* were isolated from diseased faba bean plants showed high pathogenic ability to cause root rot infection on the same host plant. *In vitro* test *Trichoderma* spp. caused high significant reduction (< 90%) in mycelial radial growth of root rot pathogens, while complete inhibition of fungal growth was observed when Rizolex-T was added to the growth medium at concentrations of 100, 200 and 400 ppm for *R. solani* (AG-4), *S. rolfsii* and *F. solani* f.sp. *fabae*, respectively. All Trichoderma treatments (as soil drench) as well as seed coating with Rizolex-T significantly decreased root rot incidence of faba bean at both pre- and post-emergence stages compared with check treatment under greenhouse conditions. Results obtained from field experiment confirmed with those recorded in greenhouse. Trichoderma treatments showed more significant reduction in disease incidence than Rizolex-T treatment. *Trichoderma viride* (T2) applied as seed coating or soil drench showed superior significant reduction in disease incidence than *T. harzianum* (T1 & T3) treatments. Application of *Trichoderma* spp. (T1, T2 and T3) as soil drench resulted in more efficient reduction in root rot incidence than treatment of Trichoderma and fungicide as seed coating at both pre- and post-emergence stages. The results obtained, in the present study, indicate that the usage of *T. harzianum* (T1 & T3) and *T. viride* (T2) as biocidal agents against root rot pathogens, *i.e. F. solani* f.sp. *fabae*, *R.. solani* (AG-4) and *S. rolfsii* could be considered another beneficial and promising approach, additional to the control of broomrape, for application to control certain soilborne pathogens causing root diseases.

Key words: biological control, faba bean, *Fusarium solani* f.sp. *fabae*, mycobiocides, Rizolex-T, root rot, *R. solani* (AG-4), *S. rolfsii*, *Trichoderma harzianum* and *T. viride*.

Faba bean (*Vicia faba* Linn.) is considered among the important leguminous crops cultivated in the valley and newly reclaimed lands for their green pods and dry seeds. Soilborne diseases are responsible for serious losses in agriculture production. Faba bean proved vulnerable to root rot disease caused by certain soilborne fungi, *i.e. Fusarium solani, Rhizoctonia solani* and *Sclerotium rolfsii* (Khalifa, 1997). This

disease appears during the growing season at seedling stage of plant growth and may happen earlier at pre-emergence stage.

Complete control of soilborne pathogens is often difficult to achieve. In recent years the goal of biological control as viable and reliable practice in modern agriculture has increased dramatically. The application of biological control using microorganisms proved to be successful for controlling various plant diseases in many countries (Sivan, 1987). It is still not easy and costly in application; however it can serve as the best control measure under greenhouse conditions. In addition, its application is safe, unhazardous for human, farm animals and avoids the environmental pollution.

Therefore, the use of bioagents in the present study for controlling root rot disease of faba bean is considered important especially in view of its wide prevalence in Egypt.

The main target of the present study was to evaluate three isolates of *Trichoderma* spp., *i.e. Trichoderma harzianum* (T1 & T3) and *T. viride* (T2), which proved their biological effect as mycobiocides against broomrape infection under field conditions (Abdel-Kader *et al.*, 1998 and Abdel-Kader, 1999), for their additional purpose as biocide against root rot pathogens.

So far, the objectives of the present investigation conducted with evaluation of mycobiocides as antagonistic agents against the mycelial growth of root rot pathogens *in vitro*. Furthermore, the efficacy of mycobiocides for controlling root rot incidence of faba bean under greenhouse and field conditions was also evaluated.

Materials and Methods

Isolation and identification of the causal organism

Samples of faba bean plants (*Vicia faba* Linn.) cv. Giza 3 showing root rot symptoms collected from different fields located at Al-Aiat territory, Giza governorate were subjected to isolation trails for the causal organism (s). The purified fungi were identified according to cultural and microscopical characters described by Barnett and Hunter (1972). The anastomosis group of the fungus *R. solani* was kindly defined at Plant Pathology Institute, Agricultural Research Centre. All fungal cultures were kept onto PDA slants at 5°C for further studies.

Three cultures of *Trichoderma* spp. which have mycobiocidal effect against broomrape, *i.e. Trichoderma harzianum* (T1 & T3) and *Trichoderma viride* (T2) obtained kindly from Plant Pathology Dept., National Research Centre, were used in the present work as antagonistic bioagents against root rot pathogens of faba bean. These isolates were cultured on PDA slants and served as biocontrol agents during this study.

Pathogenicity test

Pathogenic ability of isolated fungi to cause root rot of faba bean was tested under greenhouse conditions. Faba bean seeds cv. Giza 3 were sown in pots (25 cm diameter) containing loamy soil artificially infested individually, at the rate of

5% w : w, with the inoculum of each isolate tested which were previously grown for two weeks on sand barley medium (1:1, w : w and 40% water). Five pots, each containing five seeds, were used as replicates for each isolate tested as well as check (untreated). Fungal infection on faba bean was observed throughout the growth period up to 40 days from sowing. The percentage of root rot infection was recorded at pre-and post-emergence stages after 10 and 40 days from sowing date, respectively.

In vitro test

The inhibitory effect of *Trichoderma* spp. tested and fungicide (Rizolex-T) on the linear growth of root rot pathogens, *i.e. Fusarium solani* f.sp. *fabae, Rhizoctonia solani* (AG-4) and *Sclerotium rolfsii* was *in vitro* evaluated. Dual culture technique (Ferreira *et al.*, 1991) was followed for determination the antagonistic effect of *Trichoderma* spp. (T1, T2 and T3) against the mycelial growth of present root rot pathogens. Disks, 5mm diameter, were taken individually from marginal growth of either antagonists or pathogens tested grown for 7 days on PDA medium and placed on opposite sides of Petri dishes containing PDA medium. Inoculated plates were incubated for 5 days at 25±1°C. Five replicates were used for each particular fungus tested. Growth reduction of pathogenic fungi was determined using the formula stated by Ferreira *et al.* (1991).

The fungicidal effect on fungal growth was tested as the following description. Six concentrations of Rizolex-T, *i.e.* 0, 25, 50, 100, 200 and 400ppm based on the active ingredient were prepared in PDA medium poured in Petri dishes. Check treatment was fungicide-free medium. Petri dishes were inoculated with 5mm disks of 7 days old fungal cultures. Five replicates were used for each treatment. All previous plates were incubated at 25±1°C for 7 days then examined. Percentage of reduction in fungal growth was calculated as the growth in different treatments relative to those in check treatment (antagonistic fungi or fungicide-free medium).

Greenhouse experiment

Evaluation of biological and chemical treatments for controlling root rot of faba bean was carried out under greenhouse conditions. Pots (25 cm diameter), containing loamy soil, were artificially infested individually with the most aggressive isolate of each of *Fusarium solani* f.sp. *fabae, Rhizoctonia solani* (AG-4) and *Sclerotium rolfsii* at the rate of 5% (w : w) of soil weight as mentioned before. Infested soil was irrigated for one week, then reinfested individually at the same rate with isolates tested of *Trichoderma* spp. (T1, T2 and T3) to obtain the following treatments:

Trichoderma harzianum (T1) + *Fusarium solani* f.sp. *fabae*
Trichoderma harzianum (T3) + *Fusarium solani* f.sp. *fabae*
Trichoderma viride (T2) + *Fusarium solani* f.sp. *fabae*

The same fungal combinations were also undertaken between *Trichoderma* spp. and either *R. solani* (AG-4) or *S. rolfsii*. Another set of pots containing loamy soil artificially infested with the inoculum of each of fungus tested alone served as comparison treatment. Faba bean seeds cv. Giza 3 were surface disinfected by immersing for 5 min in 2% sodium hypochlorite solution, then washed several times

with sterilized water and placed on filter paper sheet to air dry. Disinfected seeds were coated with the fungicide Rizolex-T at the rate of 3g/ kg seeds. Faba bean seeds were sown at the rate of 5 seeds/pot, with five replicates for each particular treatment. Percentage of root rot infection at pre- and post-emergence stages was calculated after 10 and 40 days of sowing date, respectively.

Field experiment

Trichoderma spp. were evaluated as soil and seed treatments in field located at Al-Aiat territory, Giza governorate. Faba bean in this field was heavily damaged by root rot pathogens during the last five seasons. Inocula of Trichoderma grown on sand barley medium, as stated earlier, were used as soil treatment and / or seed coating. Inoculum of each of *Trichoderma* isolates T1, T2 and T3 was incorporated individually with the top 20 cm of soil surface at planting row sites at the rate of 120g / m^2 (after Abdel-Kader, 1997), while faba bean seeds were coated, one hour before sowing, with each of *Trichoderma* spp. isolate spore suspension at concentration of $6x10^6$ spore/ml prepared from 7 days old PDA cultures. The fungicide Rizolex-T was used in the present study in form of seed dressing (3g/kg seeds) as a reference for Trichoderma treatments. A field experiment consisted of plots (7.5x10.5m) each comprised of 12 rows and 30 holes / row, which were conducted in a Complete Randomized Block Design with three replicates (plots) for each mycobiocide isolate tested as well as check. Faba bean seeds cv. Giza 3 were sown in all treatments at the rate of 3 seeds / hole. Plots received the traditional agricultural practices. Observations of root rot infection at both pre- and post-emergence stages were made up to 60 days, and the average percent of disease incidence was calculated.

Statistical analysis

Results obtained were statistically analyzed according to Steel and Torrie (1987).

Results and Discussion

Isolation, identification of the causal organisms and their pathogenicity

Isolation from the collected faba bean samples showing root rot symptoms resulted in three isolates of each *Fusarium solani* f.sp. *fabae*, *Rhizoctonia solani* (AG-4) and *Sclerotium rolfsii*. Evaluation of pathogenic ability of these fungal isolates revealed that they are able, to different degrees, to attack germinated seeds, seedlings and faba bean plants. Data in Table (1) show that *F. solani* f.sp. *fabae* (isolate No. 2), *Rhizoctonia solani* AG-4 (isolate No. 3) and *Sclerotium rolfsii* (isolate No. 3) were the most aggressive isolates to cause root rot infection at both pre- and post- emergence stages.

Isolates of *S. rolfsii* showed the highest ability to cause root rot infection followed by isolates of *F. solani* f.sp. *fabae* and *R. solani*. These results are in a harmony with those reported by Khalifa (1997).

In vitro test

The inhibitory effect of the antagonists *Trichoderma* spp. and fungicide Rizolex-T on the mycelium radial growth of faba bean root rot pathogens was

Table 1. Pathogenic ability of different isolates of *F. solani* f.sp. *fabae*, *R. solani* (AG-4) and *S. rolfsii* to induce root rot infection of faba bean under greenhouse conditions

Fungus	Isolate No.	Root rot incidence (%)	
		Pre-emergence	Post-emergence
F. solani f.sp. *fabae*	No. 1	13.3	24.4
	No. 2	26.7	38.7
	No. 3	13.3	26.7
R. solani (AG-4)	No. 1	13.3	25.0
	No. 2	20.0	33.3
	No. 3	26.7	44.3
S. rolfsii	No. 1	26.7	27.6
	No. 2	33.3	30.5
	No. 3	40.0	44.4
LSD at 5% for Fungi (F)		8.6	6.1
Isolates (I)		1.4	1.2
Between (F x I)		6.7	7.4

evaluated *in vitro*. Laboratory test for the biological antagonistic effect of *T. harzianum* (T1 & T3) and *T. viride* (T2) against the growth of *F. solani* f.sp. *fabae*, *R. solani* (AG-4) and *S. rolfsii* is a simple approach for understanding a small sector of biological system in disease control as well as the influence of chemical fungicide on root rot pathogens.

Data in Table (2) and Fig. (1) reveal that the growth of the three pathogenic fungi tested decreased as a result of the antagonistic effect of *Trichoderma* spp. compared with check treatment. *Trichoderma viride* (T2) caused the highest significant reduction (95.5%) in mycelial growth of *R. solani* (AG-4) followed by *S. rolfsii* (93.3%) and *F. solani* f.sp. *fabae* (91.1%).

Furthermore, the inhibitory effect of *T. harzianum* (T1 & T3) on the growth reduction of *R. solani* (AG-4) was significantly different, while no significant differences were observed with the other two pathogens. These results are in agreement with those reported by Abdel-Kader (1997) who reported that *Trichoderma* spp. could completely overgrow the pathogen and cover the entire medium surface.

Moreover, *T. harzianum* and *T. viride* were reported to inhibit the mycelial radial growth of *F. solani*, *R. solani* and *S. rolfsii* through their ability to produce toxic metabolites into the growth medium, *i.e.* Trichodermin, peptide antibiotics and acetaldehyde or other acidic volatiles (Upadhyay and Mukhopadhyay, 1986). On the other hand, the inhibition of the pathogens growth was correlated with the increase of Rizolex-T concentrations in medium. Complete inhibition in the growth of *R. solani* (AG-4), *S. rolfsii* and *F. solani* f.sp. *fabae* occurred at concentrations of 100, 200 and 400ppm, respectively.

Table 2. The *in vitro* mycelial linear growth (mm) and reduction (%) relative to the check of faba bean root rot pathogens in response to *Trichoderma* isolates and Rizolex-T

Treatment		Linear growth (mm)			Reduction relative to check (%)		
		F. solani f.sp. *fabae*	*R. solani* (AG-4)	*S. rolfsii*	*F. solani* f.sp. *fabae*	*R. solani* (AG-4)	*S. rolfsii*
T. harzianum	T1	16	12	14	82.2	86.7	84.4
T. harzianum	T3	14	21	12	84.4	76.7	86.7
T. viride	T2	8	4	6	91.1	95.6	93.3
Rizolex-T (ppm)	25	61	54	59	32.2	40.0	34.4
	50	42	26	42	53.3	71.1	53.3
	100	23	0	18	74.4	100	80.0
	200	9	0	0	90.0	100	100
	400	0	0	0	100	100	100
Check (untreated)		90	90	90	-	-	-

LSD at 5% for Treatment (T): 4.6
Pathogens (P): 1.8
T x P : 6.3

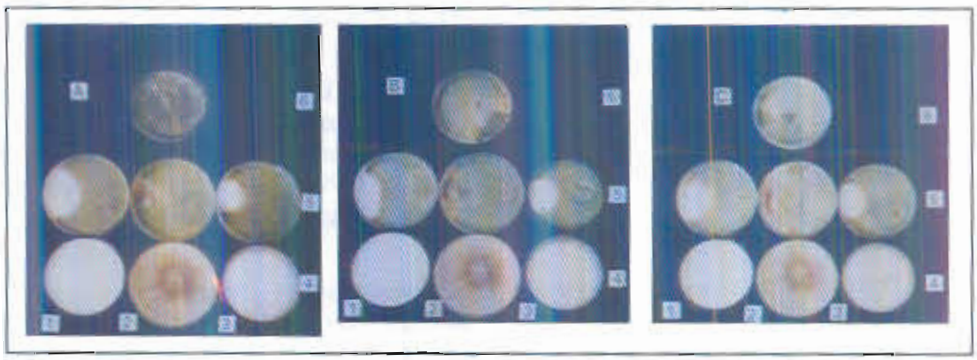

Fig. 1. Antagonistic effect of *Trichoderma* spp. against root rot pathogens
A- *T. viride* (T2). **B-** *T. harzianum* (T1) **C-** *T. harzianum* (T3)
1- *F. solani* f.sp. *fabae*. **2-** *R. solani* (AG-4). **3-** *S. rolfsii*
4- pathogens alone. **5-** mycobiocides + pathogens
6- mycoherbicide

In this regard, many investigators reported similar trend, where these pathogens were completely inhibited within the range of 100-400ppm of Rizolex-T (Katania and Verma, 1990; Katania *et al.*, 1991; Abdel-Kader, 1997 and Ragab *et al.*, 1999).

Greenhouse experiment

Effect of biological and chemical treatments on root rot incidence of faba bean was evaluated in greenhouse. Data in Table (3) show that all *Trichoderma* spp. and Rizolex-T treatments significantly reduced root rot incidence of faba bean at both pre- and post- emergence stages in comparison with check treatment. Data also show that the biological treatments significantly reduced the incidence of root rot disease of faba bean when compared with chemical treatment. The highest significant reduction in disease incidence was observed in *T. viride* (T2) treatment, where the recorded percentage of root rot infection at pre- and post-emergence stages were 13.3, 6.6 and 6.6% as well as 15, 13.3 and 15% for *F. solani, R. solani* and *S. rolfsii*, in respective order. *Trichoderma harzianum* (T1 & T3) showed no significant differences in the recorded root rot incidence caused by all pathogens tested at both pre- and post-emergence stages. The observed beneficial effect of biological treatment may be due to the fact that *Trichoderma* spp. are able to inhibit and parasitize many soilborne pathogens (Upadhyay and Mukhopadhyay, 1986).

Table 3. Faba bean root rot incidence (%) as affected by *Trichoderma* spp. and fungicidal treatments under greenhouse conditions

Treatment	*F. solani* f.sp. *fabae*		*R. solani* (AG-4)		*S. rolfsii*	
	Pre-emergence	post-emergence	Pre-emergence	post-emergence	Pre-emergence	post-emergence
T. harzianum T1	20.2	30.0	13.3	31.6	13.3	23.3
T. harzianum T3	20.0	25.0	20.0	31.6	20.0	23.3
T. viride T2	13.3	15.0	6.6	13.3	06.6	15.0
Rizolex-T	26.7	33.3	20.0	26.1	20.0	37.2
Check (untreated)	33.3	50.0	26.7	55.3	26.7	57.4
LSD at 5% for			pre-emergence		post-emergence	
	Treatment (T) :		5.8		7.3	
	Fungi (F) :		4.6		2.1	
	Between (T x F) :		6.1		6.4	

On the other hand, seed treatment with Rizolex-T (3g/kg) resulted in significant reduction in disease incidence caused by all pathogens tested comparing with the check treatment at both pre- and post-emergence stages. This effect was significantly lower than biological treatment in the present study. Similar results were also reported by many investigators concerning various crops affected with root rot pathogens (Li *et al.*, 1997; Barakat *et al.*, 1996 and Ragab *et al.*, 1999).

Field experiment

Field experiment was carried out to evaluate the efficacy of *Trichoderma* spp. as biocidal treatment as well as seed dressing with Rizolex-T as chemical treatment for controlling faba bean root rot incidence under naturally infested field conditions. Recorded results are presented in Table (4). Data obtained show that, at pre-emergence stage, Trichoderma and Rizolex-T treatments significantly decreased the root rot incidence in comparison with the check treatment. All Trichoderma treatments showed significant reduction in disease incidence comparing with Rizolex-T treatment.

Table 4. Evaluation of *Trichoderma* spp. and Rizolex-T as control measures against faba bean root rot incidence under field conditions

Treatment		Root rot incidence (%)			
		Pre-emergence	Reduction (%)	Post-emergence	Reduction (%)
Soil drench	*T. harzianum* T1	15.2 *	37.7	11.3 **	44.3
	T. harzianum T3	14.1	42.2	11.2	44.8
	T. viride T2	11.3	53.7	7.1	65.0
Seed dressing	*T. harzianum* T1	17.3	29.0	14.6	28.1
	T. harzianum T3	16.1	34.0	14.8	27.1
	T. viride T2	13.3	45.5	10.6	47.8
	Rizolex-T	19.8	18.8	16.4	19.2
Check (untreated)		24.4	-	20.3	-
LSD at 5 %		1.6	-	2.8	-

* Based on numbers of emerged seedlings in relative to number of sown seeds.
** Based on numbers of diseased seedlings in relative to number of emerged seedlings.

Seed coating or soil drench with *Trichoderma viride* (T2) showed superior significant reduction in disease incidence than applied *T. harzianum* (T1 & T3). Similar results were recorded at the post-emergence stage , although no significant differences were observed when faba bean seeds were coated with either *T. harzianum* (T1 & T3) or Rizolex-T. Data also show that, applying of *Trichoderma* spp. as soil drench resulted in more reduction in root rot incidence than applying Trichoderma or Rizolex-T as seed coating at both pre- and post-emergence stages. These significant differences could be due to the initial inocula of *Trichoderma* spp. introduced into the soil.

However, the introduced bioagents and fungicide as well to the soil facing undesirable conditions. Therefore, they must withstand these conditions in order to achieve the proposed target .In this concern, such phenomena are suggested by many investigators. Sivan (1987) reported that the high population density of *T. harzianum* introduced through soil treatment technique enables the fungus to adapt itself against environmental conditions resulting in dominance of high fungal population. Moreover, he added that any root colonizing microorganism given the advantage of being the first to colonize the root, has the potential to preempt the nutrient supply of

pathogens. These two suggestions may clarify the low root rot disease incidence recorded in the present study when *Trichoderma* spp. were applied as soil treatment to the contaminated soil with root rot pathogens, *i.e. F. solani* f.sp. *fabae, R. solani* (AG-4) and *S. rolfsii* under artificial infestation (greenhouse experiment) and natural infestation (field experiment) conditions.

It could be suggested that, in the present study, the biological equilibrium between the introduced biological agents and other soil microflora seems to be in favour of *Trichoderma* spp. against the root rot pathogens resulting in disease incidence reduction within the range of 37.7–53.7% and 44.3–65.0%, in respective order, compared with check treatment at both pre- and post-emergence stages. Similar results were obtained after mixing *T. harzianum* with soil naturally infested with *R. solani* the causal of bean root rot under field conditions (Abdel-Kader, 1997).

On the other hand, chemical treatment could also give satisfactory protection to the growing plants against different pathogens but for short time due to their expected degradation when exposed to the different environmental conditions in the soil (Abdel-Kader, 1997).

In the present study, Rizolex-T at the recommended dose (3g/kg seeds) showed less protection than that of biological treatment against root rot pathogens causing reduction in disease incidence by 19.8 and 16.4%, respectively at pre- and post-emergence stages when used as faba bean seed coating. These results may be attributable temporarily to fungicidal effect against the pathogens propagules before its degradation in the soil.

The results obtained in the present study indicate that the usage of *Trichoderma* spp., *i.e. T. harzianum* (T1 & T3) and *T. viride* (T2), as biocide agents against root rot pathogens, *i.e. F. solani* f.sp. *fabae, R. solani* (AG-4) and *S. rolfsii* could be considered beneficial and promising approach, in addition to their activities against broomrape infection.

Studying fungal-fungal interaction as well as the ecology and survival of Trichoderma in the field may lead to the development of more efficient formula of Trichoderma inoculm having high antagonistic effect against soilborne plant pathogens.

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المكافحة البيولوجية لمرض عفن الجذور فى الفول البلدى باستخدام عزلات خاصة من فطريات الترايكودرما

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تم اجراء هذة الدراسة بهدف اختبار قدرة بعض عزلات من الفطريات ترايكودرما هارزيانم (ت١ & ت٣) وترايكودرما فيردى (ت٢)، و التى سبق تقييمها بنجاح كمبيدات ميكروبية ضد اصابة النباتات بالحشائش المتطفلة (الهالوك)، على تثبيط نمو الفطريات المسببة لمرض عفن جذور الفول البلدى تحت ظروف المعمل بالاضافة الى قدرتها على خفض نسبة حدوث الاصابة بعفن الجذور وذلك تحت ظروف الصوبة و الحقل.

أظهرت نتائج العزل من نباتات الفول البلدى المصابة بمرض عفن الجذور وجود ثلاث عزلات من كل من الفطريات فيوزاريوم سولانى فورما سبيشس فابى و ريزوكتونيا سولانى (ايه جى- ٤) و سكليروشيوم رولفزياى. وقد اثبتت هذة العزلات قدرتها على احداث مرض عفن الجذور بدرجات مختلفة لنباتات الفول البلدى تحت ظروف الصوبة.

أظهرت الاختبارات المعملية ان فطريات الترايكودرما المختبرة تسببت فى نقص معنوى للنمو الميسوليومى للفطريات الممرضة بنسبة تزيد عن ٩٠%، بينما تسببت التركيزات ١٠٠ و٢٠٠ و٤٠٠ جزء فى المليون من المبيد الفطرى ريزولكس- ت فى احداث تثبيط كامل للفطريات ريزوكتونيا سولانى (ايه جى- ٤) و سكليروشيوم رولفزياى و فيوزاريوم سولانى فورما سبيشس فابى على التوالى .

فى تجارب الصوبة وجد ان اضافة لقاح فطريات الترايكودرما الى التربة و كذلك تغطية بذور الفول البلدى قبل الزراعة بكل من لقاح الفطريات او المبيد الفطرى (ريزولكس- ت) كان له تاثير معنوى على خفض نسبة حدوث مرض عفن الجذور بالمقارنة بدون المعاملة ، وقد تاكدت هذه النتائج عند تطبيق هذة المعاملات تحت ظروف الحقل.

أظهرت النتائج التفوق المعنوى لمعاملات الترايكودرما عن معاملة المبيد الفطرى فى خفض نسبة الاصابة بمرض عفن الجذور. وفى هذا المجال اظهرت عزلة الفطر ترايكودرما فيردى (ت ٢)، عند استخدامها كمعاملة تربة او تغطية للبذور، تفوقها المعنوى فى خفض نسبة الاصابة المرضية عند مقارنتها بمثيلاتها ترايكودرما هارزيانم (ت١ ، ت٣).

وجد ان اضافة لقاح فطريات الترايكودرما الى التربة تعتبر احسن المعاملات المختبرة حيث انها تسببت فى خفض معنوى لنسبة حدوث الاصابة بعفن الجذور لنباتات الفول البلدى فى كل من اطوار الانبات و البادرة و ذلك عند المقارنة بمعاملة تغطية البذور سواء بلقاح هذة الفطريات او بالمبيد الفطرى ريزولكس.

تشير النتائج التى تم الحصول عليها فى هذة الدراسة ان استخدام فطريات الترايكودرما هارزيانم (ت١ و ت٣) و الترايكودرما فيردى (ت٢) فى مكافحة مرض عفن جذور الفول البلدى، المتسبب عن الفطريات فيوزاريوم سولانى فورما سبيشس فابى و ريزوكتونيا سولانى (ايه جى- ٤) و سكليروشيوم رولفزياى، تعتبر من الطرق البديلة للمبيدات المفيدة الواعدة سهلة التطبيق و الممكن تطبيقها تحت ظروف الحقل لمكافحة فطريات التربة المسببة لامراض الجذور و ذلك بالاضافة الى قدرتها على مكافحة الاصابة بالحشائش المتطفلة (الهالوك).