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TRICHODERMA SPP. AS ALTERNATIVE BIOAGENTS TO CONTROL ROOT-ROT AND WILT DISEASES ON FABA BEAN IN EGYPT

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ABSTRACT

Root-rot and wilt diseases of faba bean caused by *Rhizoctonia solani* (Kuhn), *Fusarium oxysporum* (Schlecht) and *F. solani* (Mart) are of the most destructive diseases in Egypt. Biological control was used as an alternative method which plays a major role for controlling many root-rot and wilt diseases and reducing the use of chemical fungicides. Thirty *Trichoderma* isolates obtained from faba bean rhizosphere at different locations were tested for their antagonistic effects against *F. solani*, *F. oxysporum* and *R. solani in vitro*. *Trichoderma* sp-T_{25} was the best isolate since recorded the highest growth reduction of the tested three pathogenic fungi, followed by *Trichoderma* sp-T_6 in this respect. Ten *Trichoderma* spp. were tested for their antagonistic effects against *R. solani*, *F.* oxysporum and *F. solani*, which decreased damping off, root-rot and wilt diseases under greenhouse conditions. *T. hamatum*-$_2$, and *T. harzianum* were the highly effective antagonists in controlling wilt disease since it recorded the highest percentage of healthy survival plants. Meanwhile, *T. harzianum* and *T. hamatum*-$_2$ were the highly effective treatment for controlling *F. solani* and *R. solani*, respectively. Under field conditions, *T. hamatum*-$_2$ and *T. harzianum* were the most effective treatments in reducing damping-off, root-rot and wilt diseases which recorded the highest increase in survived plants during 2015 and 2016 growing seasons when compared to the biocontrol products (Bio Arc and Bio Zeid).

Keywords: Faba bean, root-rot and wilt diseases, biological control, *Trichoderma* sp, Bio Arc, Bio Zeid.

RÉSUMÉ

Les maladies de pourriture des racines et du flétrissement de la fèverole causées par *Rhizoctonia solani* (Kuhn), *Fusarium oxysporum* (Schlecht) et *Fusarium solani* (Mart) sont les maladies les plus préjudiciables en Egypte. Des méthodes biologiques sont utilisées comme méthodes alternatives et jouent un rôle majeur dans le contrôle de nombreuses maladies de pourritures des racines et de flétrissement tout en visant à réduire l'utilisation de solutions chimiques. 30 isolats de Trichoderma ; obtenus dans les rhizosphères de féverole en différents lieux ont été testés in vitro sur leurs effets antagonistes vis-à-vis de *F. solani, F. oxysporum*, et *R. solani*. La souche Trichoderma sp-T25 a été l'isolat le plus performant depuis le départ et a présenté la plus grande réduction de croissance sur les 3 pathogènes testés, suivi de Trichoderma sp-T6. Dix *Trichoderma spp* ont été expérimentés pour leur effet antagoniste envers *R.solani*, *F. oxysporum* et *F*. solani et ont montré une réduction de la fonte des semis, de la pourriture des racines et de la du flétrissement en conditions sous serre. *T. hamatum* et *T harzanium* sont les antagonistes les plus performants dans le contrôle du flétrissement et ont montré dès le départ le plus haut pourcentage de plante saines survivantes. Dans le même temps, T. *harzanium et T. hamatum* ont été les plus performants pour contrôler *F. solani et R. solani*. En condition de plein champ, *T. hamatum* et *T.harzanium* ont été les traitements les plus efficaces pour réduire la fonte des semis, la pourriture des racines et la dégénérescence et ont montré une augmentation maximale de plants vivants durant les saisons 2015 et 2016 en comparaison aux produits de biocontrôle ((Bio Arc and Bio Zeid).

INTRODUCTION

Faba bean (*Vicia faba* L.) is one of the most important leguminous crops which cultivated on large scale in many countries and attacked by several diseases. Damping off, root-rot and wilt diseases caused by *R. solani*, *F. solani* and *F. oxysporum* are the most important and widespread fungal diseases observed at all locations which affecting faba bean production in Egypt (Abdel-Monaim 2013). The wide use of chemical fungicides has been the cause of the appearance of resistant plant pathogens, leading to the occurrence of serious plant diseases in addition to their deleterious effects on environment and the human being health. Therefore, many researches focus on using an alternative control method could play a major role for controlling many soil-borne pathogens and reducing the use of chemical pesticides in a system of integrated plant disease management (Porras *et al.,* 2008, Deshmukh *et al.,* 2010 and Ryota *et al.,* 2010). This work aimed to isolate and identify of the causal pathogens of damping-off, root-rot and wilt diseases and to test their pathogenicity toward faba bean plants. Evaluation of the antagonistic activity of fungal and bacterial strains against virulent isolates of the pathogenic fungi (*F.oxysporium*-Fo_{19}, *F.solani*-Fs_4 and *R. solani*-R_{20}) was done under greenhouse conditions. The most affective antagonistic isolates were identified using Biolog system technique to test the ability of these isolates in utilizing different carbon sources and amino acids.

MATERIALS AND METHODS

ISOLATION AND IDENTIFICATION OF THE CAUSAL PATHOGENS

Naturally infected faba bean plants showing root-rot and wilt symptoms were collected from various locations represented different governorates of Egypt. The isolated fungi were purified and identified as *R. solani*, *F. solani* and *F. oxysporum* according to their morphological features at the Unit of Identification of Microorganisms, Plant Pathology Research Institute, Agricultural Research Center, Giza, Egypt using the keys given by Singh, 1982 and Barnett and Hunter, 1987.

BIOLOGICAL CONTROL

Isolation, purification and identification of the *Trichoderma* spp.

Different *Trichoderma* isolates were isolated from healthy faba bean plants rhizosphere collected from natural heavily infested field and purified according to Goh, 1999. The most affective antagonistic isolates of *Trichoderma* spp. were identified using Biolog-System technique (Biolog, 2000) at the Identification of Microorganisms Unit, Plant Pathology Research Institute, A.R.C., Giza, Egypt.

Determination of biocontrol *Trichoderma*'s activities *in vitro.*

This experiment was carried out to study the antagonistic activity of thirty isolates of *Trichoderma* obtained from rhizosphere of healthy faba bean plants against the virulent isolates of *F. oxysporum, F. solani* and *R. solani in vitro*.

The virulent isolates of the three pathogenic fungi and the antagonistic *Trichoderma* spp. were prepared by growing them on PDA medium at 26 ^{o}C ±2 for 5-7 days. In each treatment, the standard disk (5 mm diameter) of each pathogenic fungus was inoculated at one side in a petri-plate (9 cm diameter) 1 cm from the periphery in opposite to another disk from each test of antagonistic fungus. Three plates were used as replicates for each treatment. The control plates were inoculated with each pathogen alone onto one side of the plates. All inoculated plates were incubated at 26±2 ^{o}C until the growth completely covered the plate surface in control treatment. The plates were then examined and linear growth of each pathogenic fungus was measured to determine the growth reduction according to (Abou-Zeid *et al*. 2002) using the following formula:

$$G = \frac{C - T}{C} \times 100$$

Where as:

G= percentage of fungal growth reduction

C= Fungal growth of control (Pathogen alone).

T= Fungal growth of treatment (Pathogen against the antagonist).

Determination of Biocontrol activity of *Trichoderma* spp. *in vivo*

This experiment was carried out to study the antagonistic activity of effective *Trichoderma* isolates, which tested *in vitro* to evaluate their ability to protect faba bean plants (Giza-429) against infection with soil-borne pathogens of damping off, root-rot and wilt diseases caused by *R. solani*, *F. solani* and *F. oxysporum*.

Pathogenic fungi were grown on sorghum grain sand medium for 15 days at 26±2 °C. The antagonistic *Trichoderma* spp. were grown on PD broth medium. The inoculum potential of each of the antagonist was (6×10^6spore/ml) and prepared as a spore suspension.

Soil was infested with the pathogenic fungi at the rate of 3-5% (Abou-Zeid *et al*., 2002) then irrigated and left 7 days to enhance fungal growth. The pots were arranged in a complete randomized block design. Faba bean seeds (cv. Giza 429) were treated with biocontrol agents as seed socking and soil drenching. Five seeds were sown per pot, and three replicates were used for each treatment. Untreated seeds were sown in infested soil as control.

Disease incidence was recorded as the percentage of pre- and post- emergence damping-off as well as healthy survived plants 15, 30 and 60 days after planting in case of *R. solani* and *F. solani*, meanwhile disease incidence was recorded as the early wilt and late wilt 30 and 60 days after planting in case of *F. oxysporum*, according to (Abou-Zeid *et al*. 2002).

Determination of the biocontrol activities of *Trichoderma* spp. against root-rot and wilt pathogens under field conditions.

This experiment was carried out in the 2015 and 2016 growing seasons at Giza Governorate to study the effects of application of active bioagent of *Trichoderma* spp. and their efficiency compared to recommended biocides (Bio Zeid and Bio Arc) on disease incidence of root-rot and wilt pathogens of faba bean (Giza-429 cv.). The tested biocides and the dose of their application were shown in Table I.

The experiment was designed as a complete randomized block design with three replicates for each treatment. Plant density was 17 plants / m^2. (The area of each replicate should be considered)

The agricultural practices were applied as recommended for all treatments. The tested biocides (Bio Zeid and Bio Arc), and active bioagent were used at a recommended dose (2.5 g / kg seeds) as seed dressing and soil drenching in case of root-rot and wilt diseases.

Percentages of damping-off and root-rot and wilt severity were recorded 30 and 90 days after sowing. Disease severity index (DSI) was carried out based on a scale from 0 (non- visible damage) to 5 (completely destroyed roots) as described by (Salt, 1981). Percentage of root-rot was recorded according to the formula:

$$\textbf{DSI} = \frac{\sum d}{dmax \ X \ n} X\,100$$

Where as:

d is the disease rating possible,

dmax is the maximum disease rating and

n is the total number of plants examined in each replicate.

Statistical analysis: Data obtained were subjected to Computer Statistical Package (CO-STATE) originated by (Anonymous, 1989).

Table I: Tested products, active ingredient, types and rate of application
Produits testés, matière active, type de produit et dose d'emploi

Tested products	Active ingredient	Type	Rate of use per/ L.
Bio Arc	*Bacillus megaterium* 6% (w/w)	Biofungicide	2.5 g
Bio Zeid	*Trichoderma album* 2.5 % (w/w)	Biofungicide	2.5 g

RESULTS AND DISCUSSION

ISOLATION, IDENTIFICATION OF THE CAUSAL ORGANISMS

The isolated fungi, which were found to be associated with root-rot and wilt symptoms of faba bean plants collected from various locations at different governorates, were purified and identified as *R. solani*, *F. solani* and *F. oxysporum..*

Virulent pathogenic isolates *F. oxysporum* Bani-Sweif-Fo_{19}, *F. solani* El-Nubaria-Fs_4 and *R. solani* El-Menia-R_{20} proved to be of high pathogenic during previous work in pathogenicity carried out at the Identification of Microorganisms Unit, Plant Pathology Research Institute, A.R.C., Giza, Egypt.

BIOLOGICAL CONTROL

Isolation and identification of the antagonistic microorganisms

More than 30 *Trichoderma* isolates were isolated from healthy faba bean plants' rhizosphere and assayed for their antagonistic activity against *F. oxysporum* Bani-Sweif-Fo_{19}, *F. solani* El-Nubaria-Fs_4 and *R. solani* El- Menia-R_{20} *in vitro* and *in vivo*. The most affective antagonistic isolates were identified as *T. harzianum*, *T. hamatum, T. atroviride, T. viride*, *T. virens* and *T. aureoviride* using Biolog system.

Determination of biocontrol agent's activity *in vitro*

Data presented in Table II indicate that all 30 *Trichoderma* spp. caused significantly growth reduction of *F. oxysporum*-Fo_{19}, *F. solani*-Fs_4 and *R. solani*-R_{20}, on PDA medium. In addition, *Trichoderma* sp.-T_{25} recorded the highest reduction of the linear growth of the tested pathogens.

Trichoderma sp.-T_8 gave the highest growth reduction of *F. oxysporum* followed by *Trichoderma* sp.-T_{22} and *Trichoderma* sp.-T_{25}. However, *Trichoderma* sp.-T_4 gave the lowest growth reduction in this respect when compared with control.

Also, *Trichoderma* sp.-T_{25}, *Trichoderma* sp.-T_6 and *Trichoderma* sp.-T_2 showed the highest antagonistic effect against *F. solani* which resulted the highest percentages of growth reduction of *F. solani*. While, *Trichoderma* sp.-T_9 was the lowest growth reduction in this respect. Meanwhile, *Trichoderma* sp.-T_6 caused the highest percentages of growth reduction of *R. solani* followed by *Trichoderma* sp.-T_{25} and *Trichoderma* sp.-T_1. On the other hand, *Trichoderma* sp.-T_{12} showed the lowest percentage in growth reduction of *R. solani* when compared with control.

These results are in harmony with those obtained by (Obagwu and Korusten, 2003) who reported that biological control is known to be very effective against soil borne diseases. *Trichoderma* showed an interesting control against various pathogens (Gan *et al*., 2006). Antimicrobial metabolites produced by different fungal bioagents (*T. hamatum*, *T. harzianum*, *T. viridetilis*) inhibited the growth of *F. oxysporum, R. solani*, *F. solani* and *Sclerotinia sclerotiorum in vitro* (Abou- Zeid *et al.*, 2002 and Svetlana *et al.,* 2010).

Table II: Effect of the antagonistic fungi on the reduction percentage in linear growth of the pathogenic fungi *F. oxysporum*, *F. solani* and *R. solani in vitro* after incubation at 26±2°C for 5-6 days.

Effets des champignons antagonistes sur le pourcentage de réduction de la croissance linéaire sur les champignons parasites *F. oxysporum, F. solani* et *R. solani in vitro* après incubation 5-6 jours à 26±2°C

Isolates code No.		*F. oxysporum*		*F. solani*		*R. solani*	
		Liner growth	Reduction%	Liner growth	Reduction%	Liner growth	Reduction%
T_1	Sakha	2.5	72.22	2.4	73.33	3.47	61.44
T_2	Sakha	2.8	65.22	2.0	77.77	3.73	58.55
T_3	Kleen	2.23	75.22	2.7	70.0	4.33	51.89
T_4	Sidy -Salem	3.8	57.77	3.3	63.33	4.7	47.77
T_5	El-Nubaria	2.87	68.11	2.7	70.0	3.7	58.88
T_6	El-Nubaria	2.27	74.78	1.97	78.11	2.8	68.88
T_7	Kafr-El Dowwa	2.73	69.66	2.8	68.88	4.13	54.11
T_8	Etay-El Baroud	2.17	75.89	2.2	75.55	3.53	60.77
T_9	Etay-El Baroud	2.7	70.0	3.33	63.0	4.23	53.0
T_{10}	Gemmeiza	2.4	73.33	2.2	75.55	3.73	58.55
T_{11}	Gemmeiza	2.87	68.11	2.1	76.66	4.2	53.33
T_{12}	Kafr-El Zayat	3.0	66.66	2.73	69.66	4.37	51.44
T_{13}	Meet-Ghamr	3.1	65.55	2.7	70.0	3.87	57.0
T_{14}	Meet-Ghamr	2.57	68.9	2.2	75.55	3.9	56.7
T_{15}	Aga	3.0	66.66	3.2	64.44	4.13	54.11
T_{16}	Toukh	3.1	65.55	2.47	72.56	3.8	57.77
T_{17}	Kafr -Shokr	2.33	74.11	2.7	70.0	3.77	58.11
T_{18}	Kafr -Shokr	2.67	70.33	2.5	72.22	4.43	50.78
T_{19}	Faquos	3.13	74.11	2.7	70.0	3.77	58.11
T_{20}	Hehia	2.8	68.88	2.8	68.88	3.97	55.88
T_{21}	Hehia	3.3	63.33	2.83	68.55	4.13	54.11
T_{22}	El- Bagour	2.2	75.55	2.7	70.0	3.8	57.77
T_{23}	El-Bagour	3.23	64.11	3.1	65.55	4.03	55.22
T_{24}	Serce- Alian	2.7	70.0	2.7	70.0	4.1	54.44
T_{25}	Sides	2.2	75.55	1.73	80.77	3.37	62.55
T_{26}	Sides	3.57	60.33	2.33	74.11	3.90	56.67
T_{27}	Beni-Seuif	3.4	62.22	2.63	70.77	4.0	55.55
T_{28}	Biba	3.33	63.0	3.2	64.44	3.83	57.44
T_{29}	El- Menia	2.83	68.55	2.13	76.33	3.7	58.88
T_{30}	El- Menia	2.97	67.11	2.6	71.11	4.1	54.44
Control	Sakha	9.0	0.0	9.0	0.0	9.0	0.0
	LSD 0.05	**0.33**	**3.70**	**0.41**	**4.54**	**0.34**	**3.77**

Determination of antagonistic fungi against wilt/root-rot diseases *in vivo* under greenhouse condition

Ten *Trichoderma* isolates were tested for their antagonistic effects against *F. oxysporum* Bani-Sweif-Fo_{19}, *F. solani* El-Nubaria-Fs_4 and *R. solani* El- Menia-R_{20} on faba bean Giza-429 cv., which decreased wilt and root-rot diseases under greenhouse conditions.

Data in Table III indicated that all *Trichoderma* isolates significantly decreased the early and late wilt disease of *F. oxysporum*-Fo_{19} *in vivo* compared to control. *T. hamatum*-$_2$, and *T. harzianum* were the highly effective antagonists in controlling wilt disease since it recorded the highest percentage of healthy survival plants. However, *Trichoderma* sp. was the lowest antagonistic effect in controlling wilt disease.

Table III: Evaluation of antagonistic fungal isolates on faba bean wilt disease caused by *F. oxysporum* under greenhouse conditions.
Efficacité des isolats fongiques antagonistes sur la maladie de la féverole causée par *F. oxysporum* sous serre.

Trichoderma isolates	**Governorates**	**Locations**	***F. oxysporum***		
			Early wilt %	**Late wilt %**	**Survived plants**
T. harzianum	**Bani-Sweif**	Sides	6.67	20.0	73.33
***T. hamatum*-$_1$**	**El- Behira**	El-Nubaria	13.33	33.33	53.33
***T. hamatum*-$_2$**	**El –Dakahlia**	Meet-Ghamr	20.0	13.33	66.67
T. viride	**El-Monofia**	El- Bagour	6.67	40.0	53.33
T. atroviride	**Kafr El-Shikh**	Sakha	13.33	26.67	60.0
T. aureoviride	**El- Menia**	El- Menia	13.33	26.67	60.0
T. virens	**El-Sharqia**	Faquos	0.0	33.33	66.67
***Trichoderma sp*-$_1$**	**El-Qalubia**	Kafr -Shokr	26.67	33.33	40.0
***Trichoderma sp*-$_2$**	**El- Behira**	Etay-El Baroud	13.33	40.0	46.67
***Trichoderma sp*-$_3$**	**El -Gharbia**	Gemmeiza	20.0	33.33	46.67
Control			33.3	46.67	20.0
LSD $_{0.05}$			**17.49**	**20.29**	**11.86**

Also, data in Table IV show that all the tested *Trichoderma* spp. significantly decreased pre- and post-emergence damping-off caused by *F. solani* and *R. solani* compared to the control treatment. *T. harzianum* and *T. hamatum*-$_2$ were the highly effective antagonists for controlling *F. solani* and *R. solani*, respectively.

Table IV: Evaluation of antagonistic fungal isolates on faba bean root-rot diseases caused by *F. solani* and *R. solani* under greenhouse conditions.
Efficacité des isolats fongiques antagonistes sur la pourriture des racines de féverole causée par *F. solani* et *R. solani* sous serre.

Trichoderma isolates	*F. solani*			*R. solani*		
	Pre	**Post**	**Survival**	**Pre**	**Post**	**Survival**
T. harzianum	26.67	6.67	66.67	20.0	20.0	60.0
***T. hamatum*-$_1$**	26.67	20.0	53.33	20.0	33.33	46.67
***T. hamatum*$_{-2}$**	20.0	6.67	73.33	20.0	6.67	73.3
T. viride	33.33	13.33	53.33	33.33	20.0	46.67
T. atroviride	33.33	20.0	46.67	33.33	13.33	53.33
T. aureoviride	40.0	13.33	46.67	40.0	6.67	53.33
T. virens	33.33	6.67	60.0	33.33	13.33	53.33
***Trichoderma sp*$_{-1}$**	40.0	20.0	40.0	26.67	40.0	33.33
***Trichoderma sp*$_{-2}$**	26.67	40.0	46.67	40.0	20.0	40.0
***Trichoderma sp*$_{-3}$**	33.33	26.67	40.0	46.67	13.33	40.0
Control	53.33	33.33	13.33	66.7	26.67	6.67
LSD $_{0.05}$	**16.56**	**17.49**	**16.98**	**12.58**	**15.0**	**11.71**

Many investigators used bio-agents as potential antagonist for controlling many plant pathogens (Deshmukh *et al.,* 2010 and Ryota *et al.,* 2010). Most the individuals of the genous *Trichoderma* are promising and effective biocontrol agents in controlling damping-off and root-rot diseases of crop plants caused by *R. solani* and *Fusarium* spp (Boubekeur *et al*., 2012). *T. hamatum* and *T. harzianum* enhancing growth of root system as evidenced by increased biomass may be positively acted in diseases control, produced cell wall-degrading enzymes and the antibiotics thus could act synergistically with other mechanisms (Vinale *et al*., 2006), activating a wide variety of protective mechanisms designed to prevent pathogen replication and spreading. In addition, there are other defense mechanisms represented by several *Trichoderma* spp. include myco- and hyperparasitism, nutrient competition, antibiosis, cell wall degrading enzymes (Abd-El-Khair *et al.,* 2011), fast production of reactive oxygens pieces (De Gara *et al*.,2003), alterations in the cell wall constitution, accumulation of antimicrobial secondary metabolites known as phytoalexins (Agrios, 2005) activation, synthesis of defense peptides and proteins (Castro and Fontes 2005).

Determination of antagonistic fungi against wilt/root-rot diseases under field condition

This experiment was carried out to study the effect of faba bean inoculation with effective *Trichoderma* spp. (*Trichoderma harzianum, T. hamatum*$_{-2}$ and *T. virens*) and biocides (Bio Arc and Bio Zeid) on disease incidence of root-rot and wilt diseases on faba bean plants caused by *R. solani* and *Fusarium* spp*.* under field conditions during the 2015 and 2016 growing seasons. Data in Table V revealed that applying effective isolates of *Trichoderma* spp. (*Trichoderma hamatum*$_{-2}$*, T. harzianum* and *T. virens*) compared by recommended biocides (Bio Arc and Bio Zeid) as seed dressing and soil drenching significantly decreased root-rot and wilt disease severity and increasing survival plants of faba bean under field conditions during two successive seasons compared with control treatment. *Trichoderma hamatum*$_{-2}$ and *T. harzianum* were the most effective bio-agents in reducing damping-off, root-rot and wilt diseases during 2015 and 2016 growing seasons when compared to Bio Arc and Bio Zeid even if Bio Arc and Bio Zeid stayed the best one globally.

Table V: Effect of treating faba bean seeds with affective bio-agents and different biocids on the incidence of damping-off under field conditions during 2015 and 2016 growing seasons.
Efficacité des semences de féverole traitées avec des microorganismes et différents biopesticides sur la fonte des semis en conditions de plein champ durant les saisons 2015 et 2016.

Different antagonists	2015 growing season					2016 growing season				
	Damping-off %			Efficacy * %	Plant survival %	Damping-off %			Efficacy * %	Plant survival %
	Pre-	Post-	Total			Pre-	Post-	Total		
T. hamatum-$_2$	7.4	3.3	10.7	74.25	89.3	7.9	4.7	12.6	66.13	87.4
T. harzianum	8.3	3.9	12.2	70.50	87.8	8.3	5.4	13.7	63.17	86.3
T. virens	8.7	5.2	13.9	66.25	86.1	9.8	6.6	16.4	55.91	83.6
Bio-Zeid	5.6	4.1	9.7	76.75	90.3	6.2	5.2	11.4	69.35	88.6
Bio-Arc	4.3	3.1	7.4	82.50	92.6	4.2	4.7	8.9	76.08	91.1
Control	24.3	16.1	40.4	--------	59.6	20.9	16.3	37.2	-------	62.8
LSD $_{0.05}$	**1.35**	**1.15**	**2.49**		**3.06**	**1.93**	**1.03**	**1.48**		**5.17**

These results are similar to those obtained by (Mclaren *et al*., 1994; Abou-Zeid *et al.,* 2002 and Gupta *et al*., 2003) who reported that, seed treatment with bioagents and biofungicides decreased percentage of pre- and post-emergence damping-off caused by *R. solani* and *F. solani* and increase the survival plants compared with the control*. T. harzianum*, Bio Zeid (*T.album*) and Bioarc (*B. megaterium*) were the most effective treatments. *B. megaterium, T. harzianum*, Bio Zeid (*T. album*) and *T. hamatum* were the most effective treatment which activated of soil microbes and decreased the population of *R. solani* (Wu *et al*., 2000; and Abd-El-Khair *et al*. 2011). *Bacillus* spp. and one fungicide (Vitavax 200) as a seed coating of legume crops produced a significant decrease of damping-off disease and increase in the percentage of surviving plants (Abou-Zeid *et al.,* 2003).

CONCLUSION

The present study showed the antagonistic activities of 30 *Trichoderma* isolates in controlling soil-borne diseases of faba bean. *T. hamatum*$_{-2}$ and *T. harzianum* are very effective against wilt and rot-root soil borne diseases of faba bean *in vitro*, *in vivo* and under field conditions. Biological control is a promising alternative to synthetic fungicides and is now becoming a critically needed component of integrated disease management system.

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