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CONTROL OF SEED-BORNE BEAN PATHOGENS WITH SOME ANTAGONISTIC FUNGI AND NON FUNGICIDAL TREATMENTS.

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ABSTRACT

Ten associated fungi of bean seeds were isolated, purified and identified as *Alternaria alternata, Aspergillus* spp*., Botrytis cinerea, Fusarium solani, Macrophomina phaseolina, Penicillium* sp*., Rhizoctonia solani, Sclerotinia sclerotiorum, Trichoderma viride and Verticillium* spp*.* Four tested fungal isolates (*R. solani, M. phaseolina, F. solani,* and *S. sclerotiorum*) were proved to be pathogenic producing different degrees of pre-emergence and post-emergence damping-off and root rot symptoms on bean cultivars, namely; Contender, Narina, Bolista and Giza-6. The most virulent isolates inducing PRD were *F. solani, M*. *phaseolina* and *R*. *solani* whereas *S. sclerotiorum* was the least virulent. Moreover, the highest levels of PTD were obtained with *S. sclerotiorum, F. solani,* and *R*. *solani,* whereas *M*. *phaseolina* was the least virulent. Bolista cultivar was the most compatible with PRD and PTD in all tested pathogenic fungi, whereas Giza-6 showed the lowest compatibility. The highest percentage of root rot infection were obtained in Bolista cultivar in tested fungi ranged from (70-80%) and Narina (70-75%), while the least infection was obtained in Giza-6 (55-60%). Plant oils (Cinnamon, Clove, Spearmint and Lemon) were *in vitro* tested for their antifungal activity against the four tested pathogenic fungi. They significantly reduced the radial growth was obtaining. Spearmint oil exhibited the highest antagonistic effect to the tested fungi followed by Clove and Cinnamon oils, while the least effect was Lemon oil as compared with control. Hyphal growth of *R*. *solani* and *S. sclerotiorum* was completely inhibited by 100% and 75% conc. of Spearmint oil, while *R*. *solani* was completely inhibited by 100% conc. of Cinnamon oil. Also, the biological agents *Trichoderma viride*, *T*. *harzianum*, *T. koningii* and *Bacillus subtilis* were used *in vitro* to evaluate their effectiveness against the four tested pathogenic fungi. Linear growth experiments showed that all biological agents were significantly reduced the linear growth of fungi. *T*. *harzianum* showed highly antagonistic effect, the growth reduction ranged from (75.6 to 77.8%), while *B. subtilis* was the least, growth reduction ranged from (56.7 to 65.6%) to the four tested pathogenic fungi.

Keywords: Antagonistic fungi, Biological agents, Bean seeds, Damping-off pathogens, Plant oils, *Bacillus subtilis, Root*-rot pathogens, *Trichoderma*t spp.

INTRODUCTION

Bean (*Phaseolus vulgaris,* L.) is one of the important legumes grown in Egypt and many parts of the world. Seeds play a vital role for the healthy production of the crop, but can be carriers of important diseases, which causes considerable reduction in yield of plant (EL-Ahmed 1996 and EL-Gali, 2003). Seed-borne fungi associated with bean seed affect plant character and yield and many reports about bean seed-borne diseases were published and the principal pathogens associated were *A. alternata, F. solani ,F. semitictum, F. equiseti, M. phaseolina, Penicillium* sp. and *R. solani,.*

(Lazzaretti, *et al*., 1994 and Ramadan, 1989). Bean plants are commonly exposed to be attacked by many serious soil-borne fungi i.e. *F. semitectum, F. oxysporum, F. solani, Pythium spp., R. solani, M. phaseolina, S. rolfsii, S. sclerotiorum* and *Verticillium* spp. (Lacicowa and Pieto, 1997 and EL-Gali, 2003). Most of them cause damping-off and root rot diseases (Abada *et al*., 1992; Abdel-razek, 2005; El-Samra *et al*., 2006 c), leading to great economic losses in crop yield and quality. However, the modern approach in disease control was directed toward minimizing the fungicidal use to avoid environmental pollution (Oliveira *et al*., 1999). Thus, integrated pest management (IPM) was applied. One important compound of these strategies includes seed or soil treatments with extracts of some aromatic and medicinal plants which proved to be highly efficient in suppressing mycelial growth and spore germination of many plant pathogens (Hassanein and El-Doksch, 1997; El-Samra *et al*., 2006 b). Many of the essential plant oils were proved to be efficient in suppressing different pathogens whether *in vitro* or *in vivo*. Among these oils were Spearmint (El-Korashy, 1997), Clove oil (El-Safwani and Nasif 2002), Cinnamon and Lemon oils (Abdel-razek, 2005; and Youssef, 2008). Sharaf El-Din *et al*., (2007) reported that antifungal activities were appeared by Cinnamon, Clove, Peppermint and Eucalyptus oils against *F. oxysporum* and *Aspergillus niger in vitro*. Also, biological control has succeeded in preventing many plant diseases, offering an attractive alternative or supplement to pesticides, raising the plant growth and yield and reducing density of soil-borne pathogens (El-Samra *et al*., 2006 a). *Trichoderma* spp. and the bacteria *Bacillis subtilis* are among the most promising biocontrol agents who were applied against a wide range of plant pathogenic fungi (El-Kazzaz *et al*., 2002). Abo Dakika and Zen El-Dein (2007) recorded that *T*. *harzianum* inhibited linear growth of *F. oxysporum* (82%).

The objectives of this study were to (1) survey the most common damping-off and root rot fungal agents of bean include their isolation from seeds, purification, identification and inoculation, (2) study the susceptibility of some bean cultivars to infection with damping-off and root rot pathogens, and (3) evaluate the antagonistic effect of some plant oils, fungal and bacterial bioagents on the radial growth of the tested damping-off and root rot pathogens *in vitro*.

MATERIALS AND METHODS

Isolation, purification and identification:

Seed samples of bean (*Phaseolus vulgaris,* L.), were collected from different localities in Egypt to test their mycoflora. Seed-borne fungi were isolated using agar-plate method (El-Ahmed, 1996; and EL-Gali, 2003). Seeds were surfaces sterilized by dipping in 1% sodium hypochlorite for two minutes, then rinsed thoroughly in several changes of distilled water. The seeds were left to dry, then mounted on potato dextrose agar (PDA) medium (5 seeds per dish). The dishes were incubated at 25 ^{0}C and examined periodically. The developing fungi associated with seeds were isolated on PDA medium and kept for purification and identification. Identification of the isolated fungi was verified by the phytopathological staff of Plant Pathology Research Institute, Agricultural Research Center, Alexandria, Egypt. Using characteristics of mycelia and spores of fungi as described by Barnett and Hunter (1972), Booth (1971) and Ellis (1971).

Inoculation and determination of pathogenicity:

Four fungal isolates were isolated from bean seed used in this study. *F. solani, M. phaseolina, R. solani,* and *S. sclerotiorum.* These isolates individually were tested for their pathogenicity four bean cvs.named: Contender, Narina, Bolista and Giza-6 bean cultivars under greenhouse conditions. Pots (20 cm in diameter) were sterilized and filled with autoclaved aerated sandy clay soil (1:1 w/w). Fungal inocula were grown on sterilized barley grains-sand medium (30 gm barley grains, 10 gm sand, 30 ml water) at 25 ^{0}C for 2 weeks. Soil infestation was carried out using the inoculums of each fungus at the rate of 4% of soil weight. Inoculums was mixed thoroughly with the soil in each pot, watered and left for one week to secure establishment of the inoculated fungi. Control pots were filled with the same soil mixed with the same amount of sterilized barley grains-sand medium (non-infested soil). A set of four pots with 10 seeds per pot, was used for each tested fungus. Bean cultivar seeds were surface-sterilized and sown, watered regularly every 3-days. Determination of the number of pre- and post- emergence damping-off, seedling survival and root rot incidence were calculated as percentages and expressed in angular transformed values (Arcsine angular).

Antagonistic effect of some plant oils:

(A) Sources of plant oils

Four plant oils were tested for their antifungal activity against damping-off plus root rot diseases in bean seedlings, named, Cinnamon (*Cinnamomum zylanicum* L.), Clove (*Syzygium aromaticum* L.), Spearmint (*Mentha viridis* L.), and Lemon (*Citrus aurantifolia*). These plant oils were obtained from Horticulture Research Station, Aromatic and Medicine plants, Department of Sabahia, Alex., Egypt.

(B) *In vitro* experiments

Different concentrations of the tested plant oils, i.e., 0, 12.5, 25, 50, 75 and 100% were dissolved using acetone and adding tween 40 plus sterilized distilled water. Petri-plates (9 cm in diameter) with PDA media were used. Five mm disc of 7 days old culture of the tested fungus was placed at the edge of the Petri-plate. On the opposite side 5 mm sterilized filter paper discs (Whatman No. 1) were saturated with 50 µl of plant oils and placed. Control treatment was carried out using sterilized water instead of plant oils. Four replicates were used for each treatment. The plates were incubated at 25 ± 2°C for 7 days, linear growth and the percentage of reduction of the mycelial growth was calculated according to formula proposed by Ferreira *et al*., (1991).

Antagonistic effect of some bioagents:

(A) Sources of bioagents

Certain antagonistic microorganisms, i.e. *Trichoderma viride*, *T. harzianum*, *T. koningii* and *Bacillus subtilis* were used *in vitro* to evaluate their effectiveness against the four tested pathogenic fungi. Pure and identified cultures of *T. viride* from bean seeds, *T. harzianum* from tomato plants, and *T. koningii* from strawberry plants were used. These isolates were verified at Taxonomy Department, Plant Pathology Research Institute, Agric. Res. Center, Giza. The bacterial bioagent *B. subtilis* was obtained from Plant Pathology Dept., Fac. of Agric. Alexandria Univ.

(B) *In vitro* experiments

Antagonistic effect of *T. viride*, *T. harzianum* and *T. koningii* on the linear growth of the four tested pathogenic fungi (*R. solani*, *M. phaseolina*, *F. solani* and *S. sclerotiorum*) were carried out in Petri plates containing PDA medium, each plate was divided into two equal halves, one half was inoculated with a disc (5 mm in diameter) of 5 day-old culture of either *T. viride*, *T. harzianum* or *T. koningii,* whereas the opposite half was inoculated with an equal disc of 7-days old culture of either of the four tested pathogenic fungi (Dhingra and Sinclair, 1985). Plates were then incubated at 25 ± 2°C for 7 days. Control plates were inoculated with discs of PDA medium instead of the bioagents. Four replicates were used for each treatment. In order to study the antagonistic effect of the bacterial isolate of *B. subtilis* on the growth of the four pathogenic fungi, the bioagent was streaked at one side on PDA medium plates and incubated for 24 hrs. at 30°C, then one disc (5 mm in diameter) bearing 7-day old growth of one of the tested fungi was placed on the opposite side at 25 mm distance. Plates were incubated for 7 days at 25 ± 2°C. Control plates were streaked with sterilized distilled water instead of the bioagents. Four plates were served for each treatment. Linear growths of the pathogenic fungi were determined at the end of the experiment (cm) in each treatment and percentage of reduction in the linear growth of the tested fungi was calculated by using the formula proposed by Ferreira *et al.* (1991).

Statistical analysis:

Complete randomized designs with 4 replicates were used in the present study. Percentage data were transformed into arcsine numbers (Snedecor and Cochran, 1981), before carrying out analysis of variance (ANOVA). Least significant difference (LSD) at 5% level of probability was applied for comparing treatment means (Duncan, 1955).

RESULTS AND DISCUSSION

Survey of bean seed-borne fungi:

The most frequently isolated seed-borne fungi were *A. alternata*, followed by *Aspergillus* sp., *R. solani*, and *Penicillium* spp. However, the lowest isolated fungi were *M. phaseolina* followed by *F. solani, S. sclerotiorum, Trichoderma viride, Verticillium* spp*.* Moreover, most of these fungi were recorded as damping-off and root rot pathogens of bean. *F. solani* has bean shown to reduce seed germination and seedling damping-off in bean (Ziedan, 1980 and EL-Gali, 2003).Whereas, *M. phaseolina* cause ashy stem blight and *R. solani* caused *Rhizoctonia* root rot (Godoy *et al*., 1996). Mana Obkura and Christine (2009) reported that certain stains of *R. solani* infected bean in New York and had acquired the ability to infect corn, and a correlation between aggressiveness on corn and bean was observed. Also, most of these fungi were isolated from many vegetable and field crops, other than bean, as damping-off and root rot pathogens, (Ibrahim, 1996; Mao, *et al*., 1998 and El-Samra *et al*., 2006 c).

Pathogenicity and varietals responses:

(A) Pre-emergence damping-off (PRD)

From data presented in Table (1) and Fig.1 (A), the followings could be concluded

(1) All the tested isolates induced significant PRD symptoms on Contender bean cultivar; however, the infection percentage differed according to the tested isolate. Infection values were significantly higher in case of *F. solani* and *R*. *solani* (33.2, 31.0 respectively), when compared with the control (9.1). The least virulent isolates were *M*. *phaseolina* and *S. sclerotiorum* (28.8).

(2) In Narina bean cultivar, the highest infection values were obtained by *M*. *phaseolina*, *F. solani* and *R*. *solani* (41.1, 37.2 and 35.0 respectively), whereas *S. sclerotiorum* treatment gave the least infection values (30.9).

(3) In Bolista bean cultivar, the highest PRD occurred by *M*. *phaseolina* (43.1) followed by *R. solani* (37.2) then both *F*. *solani* & *S. sclerotiorum* (35.0).

(4) Giza-6 bean cultivar was significantly affected by the tested isolates *F. solani* (31.0), *R*. *solani* (28.8) then both *M*. *phaseolina & S. sclerotiorum* (26.6).

Finally, it could be concluded that the most virulent isolates inducing PRD were *F*. *solani*, *M*. *phaseolina* and *R*. *solani,* whereas *S. sclerotiorum* was the least tested virulent isolate. Moreover, Bolista bean cultivar was the most compatible cultivar with PRD agents, especially with *M*. *phaseolina* and *R*. *solani,* as compared with the other tested cultivars, whereas Giza-6 bean cultivar showed the lowest compatibility.

(B) Post-emergence damping-off (PTD)

Data were presented in Table (1) and Fig.1 (A), the obtained results revealed the followings:

(1) The highest levels of infection percentage values of PTD were obtained with *S. sclerotiorum, F. solani* and *R*. *solani,* whereas *M*. *phaseolina* isolate was the least virulent. This was true for all the tested cultivars.

(2) In addition, each of Bolista and Narina cultivars showed relatively higher rates of compatibility to *S. sclerotiorum* (41.1 and 33.2 respectively), *F. solani* and *R*. *solani* (39.2 and 35.2 respectively). Giza-6 bean cultivar showed the lowest compatibility.

Fig. (1) Showed in (A) Symptoms produced by artificial inoculation of bean with (1) *R. solani*; (2) *M. phaseolina*; (3) *F. solani*; (4) *S. sclerotiorum* showed seed decay, decaying of root symptom, lesion on root, stem and cotyledons, dropping of first leaf and wilt of seedling. In (B) Effect of some crude plant oils on growth of *R. solani* where: Cont: Control; (Be 11) Cinnamon; (Be 12) Clove; (Be 13) Spearmint; (Be 14) Lemon.
In (C) Antagonistic effect of some bioagents on growth of *F. solani* where; Cont: Control; (A3) *Trichoderma viride;* (B3) *T. koningii*; (C3) *T. harzianum;* (D3) *Bacillus subtilis*.

Table (1): Infection index of some bean damping-off and root rot pathogens on different bean cultivars.

Fungi	Index values														
	Pre-emergence damping-off					Post-emergence damping- off					Survival				
	Cultivars					Cultivars					Cultivars				
	Contender	Narina	Bolista	Giza-6	Mean	Contender	Narina	Bolista	Giza-6	Mean	Contender	Narina	Bolista	Giza-6	Mean
Rhizoctonia solani	31.0 ^{b}	35.0 ^{b}	37.2 ^{b}	28.8 ^{b}	33.0	31.0 ^{b}	35.2 ^{b}	39.2 ^{bc}	28.8 ^{b}	33.6	43.1 ^{a}	35.2 ^{a}	28.8 ^{a}	46.9 ^{a}	38.5
Macrophomina phaseolina	28.8 ^{b}	41.1 ^{b}	43.1 ^{b}	26.6 ^{b}	34.9	28.8 ^{b}	28.8 ^{b}	30.8 ^{b}	23.7 ^{b}	28.1	49.9 ^{a}	35.2 ^{a}	30.3 ^{a}	52.8 ^{a}	41.3
Fusarium solani	33.2 ^{b}	37.2 ^{b}	35.0 ^{b}	31.0 ^{b}	34.1	33.2 ^{b}	35.2 ^{b}	39.2 ^{bc}	26.6 ^{b}	33.6	39.2 ^{a}	33.0 ^{a}	30.3 ^{a}	46.9 ^{a}	37.5
Sclerotinia sclerotiorum	28.8 ^{b}	30.9 ^{b}	35.0 ^{b}	26.6 ^{b}	30. 3	31.0 ^{b}	33.2 ^{b}	41.1 ^{c}	31.0 ^{b}	34.1	45.0 ^{a}	41.1 ^{a}	28.1 ^{a}	46.9 ^{a}	40.3
Control	9.1 ^{a}	9.1 ^{a}	9.1 ^{a}	9.1 ^{a}	9.1	9.1 ^{a}	9.1 ^{a}	9.1 ^{a}	9.1 ^{a}	9.1	80.9 ^{b}	80.9 ^{b}	80.9 ^{b}	80.9 ^{b}	80.9

*** Values are means of 4 replicates.**
*** Values are the arcsine square root of transformation percentage of data.**
*** Values within the same column and followed by the same letter are not significantly different from each other according to Duncan's multiple range tests ($p \leq 0.05$).**

(C) Seedling survival

Table (1) could be concluded, the following:

(1) The highest survival rates were recorded when Giza-6, Contender bean cultivars were inoculated with all the tested isolates (from 52.8 to 39.2).

(2) The moderate survival rates were recorded when Narina bean cultivar was inoculated with *F. solani* (33.0), *R*. *solani* and *M*. *phaseolina* (35.2).

(3) The least survival rates were recorded in Bolista bean cultivar in all the tested isolates (from 28.1 to 30.3).

(D) Root rot incidence

Results in Fig. (2) Indicated that all the tested fungal isolates could induce root rot symptoms on all tested cultivars. However, root rot index differs according to the tested isolate and the inoculated cultivar. The highest infection percentage were obtained in Bolista cultivar in all tested isolates ranged from 70-85% and Narina cultivar ranged from 70-75%, while the least infection percentage were obtained in Giza-6 cultivar ranged from 55-60%.

The present study showed that *R. solani, F*. *solani* and *S. sclerotiorum* were highly pathogenic agents causing high rates of pre-emergence damping- off and post-emergence damping- off on bean seedling. These findings were similar to those found on bean seedling (El-Farnawany and Shama, 1996). Bilgi, *et al*., 2008 mentioned that Fusarium root rot of bean, caused by *F. solani* is a major yield-limiting disease in North Dakota and Minnesota in USA and most commercial bean cultivars grown in this region are susceptible. Giza-6 cultivar was the most incompatible with many of the tested pathogens, whereas Bolista and Narina cultivars were the most compatible. The detailed symptoms produced due to inoculation with the isolates pathogens were in harmony with those recorded by (EL-Gali, 2003; Shama, 1989).

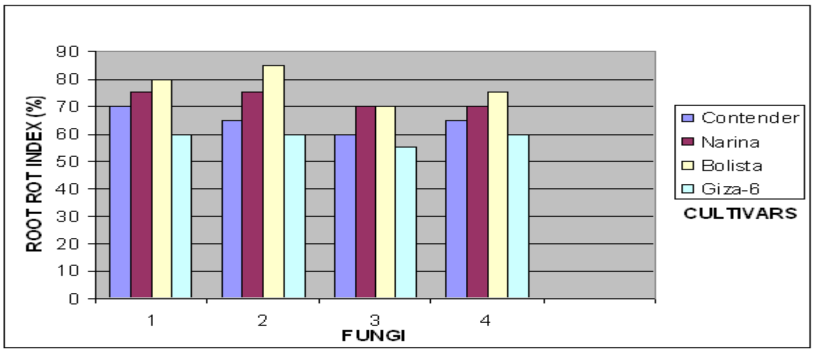

Fig. (2). Root rot index (%) of some bean damping-off and root-rot pathogens on different cultivars named: Contender, Narina, Bolista and giza-6 where: (1) *R. solani*; (2) *M. phaseolina*; (3) *F. solani*; (4) *S. sclerotiorum*.

Antagonistic effect of some plant oils and their concentrations *in vitro*

This investigation was carried out to study the antagonistic effect of four plant oils, namely Cinnamon, Clove, Spearmint and Lemon against bean damping-off and root rot pathogens, (*R*. *solani*, *M*. *phaseolina*, *F. solani* and *S. sclerotiorum*). Linear growth of the tested fungi was determinate in Table (2) and illustrated in Fig.1 (B).

(1) The obtained results showed significant antagonistic effect of Spearmint oil followed by Clove and Cinnamon oils.

(2) Crude Spearmint oil proved to be the most effective against in all the tested pathogens, followed by crude Clove and Cinnamon oils. While the least effect was obtained on crude Lemon oil compared with the control.

Table (2): Effect of different concentrations of four tested oils on the mycelial growth-cm of some bean damping-off and root-rot pathogens.

Treatment (Oils)	Concentration %	*Rhizoctonia solani*		*Macrophomina phaseolina*		*Fusarium solani*		*Sclerotinia sclerotiorum*	
		Mycelial growth (cm)	% Reduction	Mycelial growth (cm)	% Reduction	Mycelial growth (cm)	% Reduction	Mycelial growth (cm)	% Reduction
1- Cinnamon	100	0.1	99.9	6.0	33.3	6.0	33.3	6.0	33.3
	33.3	6.1	32.2	8.0	11.1	6.2	31.1	7.2	20.0
	50	7.1	21.1	8.3	7.8	6.8	24.4	9.0	0.0
	25	7.5	16.7	8.5	5.6	7.6	15.6	9.0	0.0
	12.5	9.0	0.0	9.0	0.0	7.8	13.3	9.0	0.0
	0.0	9.0	0.0	9.0	0.0	9.0	0.0	9.0	0.0
Mean		6.47[ab]	-	8.13[ab]	-	7.2[b]	-	8.2[b]	-
2- Clove	100	3.0	66.7	5.5	38.9	4.5	50.0	4.2	53.3
	75	3.4	62.2	7.7	14.4	5.3	41.1	4.5	50.0
	50	4.1	54.4	8.0	11.1	7.0	22.2	6.0	33.3
	25	5.9	34.4	9.0	0.0	7.3	18.9	6.5	27.8
	12.5	8.4	6.7	9.0	0.0	7.5	16.7	7.0	22.2
	0.0	9.0	0.0	9.0	0.0	9.0	0.0	9.0	0.0
Mean		5.63[a]	-	8.03[ab]	-	6.76[b]	-	6.2[ab]	-
3- Spearmint	100	0.1	99.9	4.5	50.0	3.0	66.7	0.1	99.9
	75	0.1	99.9	5.5	38.9	3.5	61.1	0.1	99.9
	50	4.0	55.6	7.3	18.9	5.3	41.1	4.0	55.6
	25	7.5	16.7	9.0	0.0	7.0	22.2	7.5	16.7
	12.5	8.1	10.0	9.0	0.0	7.5	16.7	9.0	0.0
	0.0	9.0	0.0	9.0	0.0	9.0	0.0	9.0	0.0
Mean		4.8[a]	-	7.38[a]	-	5.88[a]	-	4.95[a]	-
Lemon	100	6.0	33.3	8.4	6.7	5.5	38.9	5.5	38.9
	75	7.4	17.8	9.0	0.0	6.4	28.9	9.0	0.0
	50	8.0	11.1	9.0	0.0	7.0	22.2	9.0	0.0
	25	9.0	0.0	9.0	0.0	7.3	18.9	9.0	0.0
	12.5	9.0	0.0	9.0	0.0	7.5	16.7	9.0	0.0
	0.0	9.0	0.0	9.0	0.0	9.0	0.0	9.0	0.0
Mean		8.06[b]	-	8.9[b]	-	7.12[b]	-	8.42[b]	-

*** Values are means of 4 replicates.**

*** Values within the same column and followed by the same letter are not significantly different from each other according to Duncan's multiple range tests ($p \leq 0.05$).**

(3) In this respect, hyphal growth of both *R. solani,* and *S. sclerotiorum* was completely inhibited by crude spearmint oil. Also crude Cinnamon oil was completely inhibited *R. solani.*

(4) Moreover, it were efficient in reducing the hyphal growth of each of *M. phaseolina (*66.7%), *S. sclerotiorum* (53.3%) and *F. solani* (50.0%) by crude Clove oil, whereas reducing *F. solani* (66.7%) and *M. phaseolina* (50.0%) by crude Spearmint oil.

(5) Highly effect of Spearmint oil at conc.75% to reduce the percentage of hyphal growth of both *R. solani* and *S. sclerotiorum*, it was completely inhibited the growth,

Table (3): Antagonistic effect of three *Trichoderma* species and *Bacillus subtilis* on some bean damping-off and root- rot pathogens.

Treatments	Linear growth of mycelia (cm)							
	Rhizoctonia solani		*Macrophomina phaseolina*		*Fusarium solani*		*Sclerotinia sclerotiorum*	
	Mycelia growth (cm)	% Reduction	Mycelia growth (cm)	% Reduction	Mycelia growth (cm)	% Reduction	Mycelia growth (cm)	% Reduction
T. viride	2.67 b	70.0	2.27 b	74.4	2.0 a	76.7	2.33 a	74.4
T. koningii	2.67 b	70.0	2.87 c	67.8	1.83 a	80.0	2.83 a	64.4
T. harzianum	2.0 a	77.8	2.0 a	77.8	2.0a	77.8	2.17 a	75.6
B. subtilis	3.0 c	65.6	3.93 d	56.7	3.3 b	63.3	3.07 a	65.6
Control	9.0 d	0.0	9.0 e	0.0	9.0 c	0.00	9.0 b	0.00

*** Values are means of 4 replicates.**

*** Values within the same column and followed by the same letter are not significantly different from each other according to Duncan's multiple range tests ($p \leq 0.05$).**

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مقاومة الكائنات الممرضة المصاحبة لبذور الفاصوليا باستخدام الكائنات الفطرية المضادة وبعض المعاملات الاخرى غير المبيدات الفطرية

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تم عزل وتنقية وتعريف عشرة فطريات مصاحبة لبذور الفاصوليا وشملت الترناريا الترناتا وجنس الاسبرجلس وبوتريتس سينريا وفيوزاريم سولانى وماكروفومينا فاسيولينا وجنس البنيسيليوم والريزوكتونيا سولانى وسكليروتينيا سكليروشيورم وتريكودرما فيردى وجنس الفرتيسليوم.

اثبتت اختبارات القدرة المرضية ان اربعة فطريات هى الريزوكتونيا سولانى وماكروفومينا فاسيولينا وفيوزاريوم سولانى وسكليروتينيا سكليروشيورم تحدث مستويات مختلفة من اعراض الذبول الطرى ماقبل ومابعد ظهور البادرات وكذلك اعراض اعفان الجذور وذلك على اربعة اصناف من الفاصوليا هى كونتندر ، نارينا ، بوليستا وجيزه-٦.

وجد ان فطريات فيوزاريوم سولانى وماكروفومينا فاسيولينا وريزوكتونيا سولانى هى اكثر الفطريات قدرة على احداث ذبول ماقبل ظهور البادرات، بينما كان الفطر سكليروتينيا سكليروشيورم اقلها. كذلك وجد ان فطريات سكليروتينيا سكليروشيورم وفيوزاريم سولانى وريزوكتونيا سولانى هى اكثر الفطريات مقدرة على احداث ذبول مابعد ظهور البادرات، بينما كان الفطر ماكروفومينا فاسيولينا هو اقلها.

كان الصنف بوليستا هو اكثر الاصناف اصابة بالذبول الطرى، بينما كان الصنف جيزه-٦ هو اقل الاصناف توافقا مع مسببات الذبول الطرى. ايضا كان الصنف بوليستا هو اكثر الاصناف اصابة بعفن الجذور وذلك على جميع الفطريات المختبرة وتراوحت نسبة الاصابة من ٧٠-٨٥%، يليه صنف نارينا ٧٠-٧٥%، بينما كان الصنف جيزه-٦ هو اقلها ٥٥-٦٠%.

تم اختبار عدد من الزيوت النباتية وهى زيت القرفة، القرنفل، النعناع والليمون فى المعمل لمقاومة الكائنات الاربعة الممرضة السابقة للفاصوليا. ومن النتائج اتضح أن جميع الزيوت المختبرة ادت الى انخفاض معنوي فى النمو القطرى للفطريات المختبرة.

وكان زيت النعناع هو اكثر الزيوت فعالية فى تثبيط نمو الفطريات المختبرة، يليه زيت القرنفل والقرفة، بينما كان زيت الليمون اقلها وذلك بالمقارنة بالكونترول. وكان زيت النعناع بتركيز ٧٥و١٠٠% فعال ضد فطريات الريزوكتونيا سولانى وسكليروتينيا سكليروشيورم حيث ادى الى تثبيط كامل للنمو، وكذلك زيت القرفة بتركيز ١٠٠% ادى الى تثبيط كامل لنمو الفطر ريزوكتونيا سولانى.

تم اختبار عدد من كائنات المقاومة الحيوية وهى تريكودرما فيردى، تريكودرما هرزيانم، تريكودرما كوننجياى وباسيلس ساتلس معمليا لمقاومة الكائنات الاربعة الممرضة للفاصوليا. واوضحت تجارب النمو القطرى ان جميع الكائنات الحيوية المستخدمة ادت الى انخفاض معنوى فى نمو الكائنات الممرضة المختبرة. وكان الفطر تريكودرما هرزيانم أكثر تاثيرا فى الفطريات الممرضة حيث ادى الى انخفاض فى النمو يتراوح من ٧٥,٦-٧٧,٨%, بينما البكتيريا باسيلس ساتلس كانت اقل كائنات المقاومة الحيوية تأثيرا حيث تراوح انخفاض النمو من ٥٦,٧-٦٥,٦%.

قام بتحكيم البحث

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