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STUDIES ON SEEDLINGS DAMPING-OFF AND ROOT-ROT DISEASES OF PEA
II. BIOLOGICAL CONTROL

BY

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ABSTRACT

The biological agents *Trichoderma viride, T. harzianum, T. koningii* and *Bacillus subtilis* were tested both *in Vitro* and *in Vivo* against *Pythium debaryanum*, *Rhizoctonia solani* and *Fusarium solani*, the pea damping-off and root-rot pathogens. Linear growth experimenta showed that *F. solani* was the most sensitive to the applied bioagents, followed by *R. solani*, whereas, the least effect was exhibited against *P. debaryanum*.

In Vivo studies showed that all the tested bioagents significantly reduced pre-(PRD) and post-emergence (PTD) damping-off and root-rot incidence and increased % of survived seedlings (SS). Moreover, soil application with bioagents was more effective in reducing disease incidence than seed treatment. Treatment with *T. viride* or *T. harzianum* significantly reduced PRD and PTD incited by *P. debaryanum* and increased number of survival seedlings. PTD incidence incited by the tested disease pathogens was markedly decreased, where reduction rates ranged from 21% to 82% according to the applied bioagent and the tested pathogen. In general, *Pythium* was more sensitive than the other tested pathogens. Reduction in disease incidence was more in Sinnary pea cultivar, than Lincoln cv. Root-rot incidence was significantly reduced from 20 to 40% than control due to the application of the biocontrol agents.

INTRODUCTION

Pea plants are commonly exposed to infection with damping-off disease agents, i.e. different species of *Pythium*, *Rhizoctonia solani* and different species of *Fusarium* (Abada *et al.*, 1992; Chen and McBeath, 1993; King and Parke, 1993), leading to great economic losses in crop yield and quality.

The modern approach in plant disease control is directed toward minimizing the fungicidal use to avoid environmental pollution. Biological control succeeded to prevent many plant diseases, offering an attractive alternative or supplement to pesticides, raising the plant growth and yield and reducing density of soil borne pathogens (Kommedahl and Mew, 1975; Kommedahl and Windels, 1978; Muchlchen *et al.*, 1990; Wolffhechl and Funckjensen, 1992 and Silosuch *et al.*, 1994). *Trichoderma* spp. And the bacteria *B. subtilis* are among the most promising biocontrol agents which applied against a wide range of plant pathogenic fungi (Papavizas, 1985; Chet, 1987; El-Samra *et al.*, 2001; El-Kazzaz *et al.*, 2002 a, b). However, little informations are available about controlling pea damping-off and root-rot diseases by *B. subtilis.*

Therefore, the aim of this study was to evaluate the antagonistic effect of some fungal bioagents, i.e., *Trichoderma viride* and *T. harzianum*, and one bacterial isolate of *Bacillus subtilis* against some pea damping-off and root-rot agents, i.e., *Pythium debaryanum*, *Rhizoctonia solani*, *Fusarium solani*, both in laboratory and under greenhouse conditions.

MATERIALS AND METHODS

Source of disease agents

Among 6 fungal isolates isolated from damping-off and root-rotted pea seedlings, purified, identified and tested for pathogenicity by the authors (under publishing), three fungal isolates only; namely, *Pythium debaryanum*(PD), *Rhizoctonia solani* (RS) and *Fusarium solani* (FS) were used throughout this study.

Sources of bioagents

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

I. *In Vitro* experiments

Antagonistic effect of the fungal bioagents were carried out in petri dishes 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 *T. viride* or *T. harzianum* or *T. koningü,* whereas, the opposite half was inoculated with an equal disc of 7-days old culture of any 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. The linear growth of the tested pathogenic fungi were calculated at the end of the experiment (mm).

Percentages of reduction in linear growth of the tested fungi were calculated by using the following formula as proposed by Ferreira *et al.* (1991).

$$R = \frac{A - b}{A} X 100$$

Where: R= Percentage of growth reduction; A= The distance of mycelial growth of the pathogenic fungus apart from the bioagent; B= The distance of mycelial growth of the pathogenic fungus toward the bioagent.

In order to study the antagonistic effect of the bacterial isolate *B. subtilis* on the growth of the tested pathogens, 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 made for each treatment.

II. *In Vivo* experiments

Sterilized soil was infested with the pathogenic fungi grown on barley grains-sandy water medium at the rate of 4% and dispensed one week before sowing in pots (20 cm in diameter). Lincoln (more compatible) and Sinnary (relatively incompatible) pea cultivars were used throughout these experiments. The antagonistic fungus was applied by seed coating or soil drenching.

1. Seed coating

Conidia of *Trichoderma* were harvested from a culture grown on PDA plate by adding 10 ml of sterile distilled water to the plate and gently rubbing the surface with a soft brush. The conidial suspension was adjusted to 10^6 conidia/ml by haemocytometer. Talc powder formula was prepared by adding 0.5 g carboxymethyl cellulose (CMC) to 50 ml of conidial suspension and mixed with 100 g of talc powder. This formula was used to coat pea seeds at the rate of 4 g/kg seeds and allowed to dry. Ten coated seeds were sown in each pot. Pots inoculated with the tested pathogen and sown with surface sterilized seeds were served as control.

Seed coating with *B. subtilis* was carried out by preparing cell suspension of the bacterium through growing *B. subtilis* in PDA plates for 3 days at 30°C. The resulting growth was washed from plates with sterile water. Concentration of viable cells was adjusted to be 10^8-10^9 CFU (colony forming units) per milliliter (Baker, 1962). Pea seeds were left with bacterial suspension for one hour to be fully covered with such bacteria and dried at laminar flow.

2. Soil treatment

The antagonistic fungi were grown on barley grains-sandy water medium. The infested soil with one of the tested fungi was thoroughly mixed with the inoculum of the antagonistic fungus at the rate of 4%, one week before sowing. Pots inoculated with the tested pathogen only was served as control. Ten surface sterilized seeds were sown per pot (Amer and El-Desouky, 2000). Soil treatment with bacteria was achieved by adding the suspension of the antagonistic bacteria as soil drench at the rate of 100 ml/pot. Pre-, post-emergence damping-off and root-rot incidence were calculated as percentages and expressed in angular transformed values (Arcsine angular).

Statistical analysis

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

RESULTS AND DISCUSSION

1. *In Vitro* experiments

Data obtained on the antagonistic effect of the bioagents against the tested damping-off and root-rot pathogens were presented in Table (1). It was evident that more antagonistic effect on *Fusarium solani* was induced by *T. viride*, where growth was reduced by 77.78%. *R. solani* proved to be less sensitive to the effect of *T. viride* than the other tested pathogens. Similar results on the effect of *T. viride* on different soil-borne fungi were recorded (Tahvonen, 1982; Delgado *et al.*, 1990; Abdel-Sattar *et al.*, 1996; Ismail, 1998 b; Hassanein *et al.*, 2000 and Amer and El-Desouky, 2000).

Table (1): Antagonistic effect of three *Trichoderma* species and *Bacillus subtilis* on some pea damping-off and root- rot pathogens.

Treatment	Linear growth					
	P. debaryanum		*R. solani*		*F. solani*	
	Mycelial growth (mm)	% Reduction	Mycelial growth (mm)	% Reduction	Mycelial growth (mm)	% Reduction
T. viride	27.66[a]	69.27	35.00[d]	61.11	20.00[a]	77.78
T. koningii	35.00[b]	61.11	27.33[a]	69.63	25.00[b]	72.22
T. harzianum	28.33[a]	68.52	30.00[b]	66.67	23.33[b]	74.08
B. subtilis	40.00[b]	55.56	32.33[c]	64.08	29.33[c]	67.41
control	90.00[c]	0.00	90.00[e]	0.00	90.00[d]	0.00
$LSD_{0.05}$ (Pathogens)	5.1241		2.2537		2.5295	

$LSD_{0.05}$ (Interaction): 1.4102

* values are means of 4 replicates.

* values within column followed by the same letter(s), are not significantly different at (P = 0.05).

Trichoderma koningii also showed significant antagonistic effect on all the tested fungi, however, growth reduction was more on *F. solani* (72.22%), whereas it was less effective on *Pythium debaryanum* (61.11%). Although *Trichoderma harzianum* effectively reduced the growth rates of all the tested fungal pathogens (66.67-77.04%), however, reduction was more pronounced in *F. solani* than the other tested pathogens. The least antagonistic effect was exacted against *R. solani* was (66.67%). *T. harzianum* exerted considerable antagonistic effect against the tested damping-off pathogens. These findings assured similar results published by several authors (Dennis and Webster, 1971 a, b; Abdel-Moity *et al.*, 1982; Inbar *et al.*, 1996; El-Sharkawy *et al.*, 1998; Abd El-Aal 2001; El-Samra *et al.*, 2001 and El-Abd, 2002).

The bacterial bioagent *Bacillus subtilis* exhibited more antagonistic effect on *F. solani*, compared with the other tested pathogens. Moreover, *Pythium debaryanum* growth was greatly the least affected (55.56%).

The antagonistic effect of *Trichoderma* spp. against fungal pathogens may be attributed to the fast growth and better saprophytic activity which suppressed the growth of the host (Iqbal and Akhtar, 1987). Moreover, this effect may be due to substances secreted in the growth media by *Trichoderma* spp. (Wright, 1954 and Wu, 1980), or toxic compounds such as viridin (Turner, 1971), which were identified as antifungal and antibacterial compounds, i.e., viridin, sesquiterpen, gliotoxin, gliovirin, gliocladic acid, heptelidic acid, viridiol and valinotricin (Smith *et al.*, 1990). El-Kazzaz *et al.* (2002 a & b) found that *T. harzianum* produce the antibiotic gliotoxin. Such antibiotic proved an inhibition action against *F. oxysporum*, *F. solani*, *Pythium aphanidermatum* and *R. solani*. Peptide antibiotics, acetaldehyde and other acidic volatiles were found to be also produced by *Trichoderma* spp., which inhibit the growth of several fungi (Dennis and Webster, 1971 a & b). Antagonistic effect of *B. subtilis* was suggested to be due to secretion of dipeptide compounds namely, bacilysin and fengymycin (Loeffler *et al.*, 1986), or cyclic peptide antibiotics mycobacillin, bacillomycin, mycosubtilin, fungislatin, subsporin, bacilysin and fengimicin (Schreiber *et al.*, 1988).

II. *In Vivo* experiments

A. Damping-off incidence

1. *Pythium debaryanum*

From data presented in Table (2), PRD index was greatly reduced due to the application of bioagents, compared with the untreated infested control. Differences in PRD index values among the tested bioagents were mostly insignificant, except Lincoln/*T. harzionum* seed treatment. PTD values were significantly decreased in all treatments, compared with the infscted control. Differences among treatments were mostly insignificant.

However, seed of Lincoln pea cultivar treated with *T. viride* or *T. harzionum* showed relatively lower rates of PTD. Seedling survival percentages were greatly affected in all treatments of the tested bioagents, reaching maximum values (75.08), compared with those of the untreated infested control (20.75).

Table (2): Effect of three *Trichoderma* species and *B. subtilis* on controlling damping-off incited by *Pythium debaryanum* on the two pea tested cultivars.

Bioagents	Index values (*Arcsine angular*)																	
	Pre-emergence						Post- emergence						Survivors					
	Cultivars																	
	Lincoln			Sinnary			Lincoln			Sinnary			Lincoln			Sinnary		
	Methods of applications																	
	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean
T. viride	21.14	26.57	23.86	21.14	21.14	21.14	23.86	21.14	22.50	20.25	21.14	20.70	54.09	54.78	54.44	59.21	59.21	59.21
T. kaningii	28.78	28.78	28.78	18.43	23.86	21.15	23.86	23.86	23.86	18.43	12.21	15.32	50.77	50.77	50.77	63.43	63.43	63.43
T. harzianum	28.78	30.99	29.89	20.75	14.92	17.84	18.03	21.14	19.59	14.92	9.10	12.01	54.99	50.77	52.88	63.43	75.08	69.26
B. subtilis	26.57	26.07	26.32	23.86	21.14	22.50	14.92	26.07	20.50	18.03	15.32	16.68	59.21	50.77	54.99	59.21	63.43	61.32
Infested control	39.23	39.23	39.23	30.79	26.57	28.68	50.77	50.77	50.77	54.99	54.99	54.99	9.097	9.097	9.097	14.92	20.75	17.84
Uninfested control	12.21	12.21	12.21	9.097	9.097	9.097	9.097	9.097	9.097	9.097	9.097	9.097	77.79	77.79	77.79	80.9	80.9	80.9
Mean	26.12	27.31		20.68	19.45		23.42	25.35		22.62	20.31		50.99	48.996		56.85	60.47	
$L.S.D_{0.05}$ (Treatment)	4.094						4.903						4.341					
$L.S.D_{0.05}$ (Method)	2.363						2.831						2.506					
$L.S.D_{0.05}$ (Varieties)	2.363						2.831						2.506					
$L.S.D_{0.05}$ (Interaction)	4.987						5.973						5.289					

* values are means of 4 replicates. * Values are the arcsine square root of transformation percentage of data.

2- Rhizoctonia solani

Results presented in Table (3) showed that all treatments with the four tested bioagents significantly reduced PRD index values both in Lincoln and Sinnary cultivars and wether the application was carried out by seed coating or soil treatment. Reduction rate percentages ranged from 32.20% in Lincoln/*B. subtilis* or *T. koningii* treatments to 57.0% in Sinnary/*T. koningii* treatment. Mean index values, generally indicated that *T. harzianum* and *T. viride* were more effective in controlling PRD in Lincoln cv., whereas, in Sinnary cv. all the tested *Trichoderma* species were more effective than the bacterial bioagent *B. subtilis*.

All the tested bioagents proved to be effective in reducing PTD incited by *R. solani* in both Lincoln and Sinnary cvs. Reduction rate % ranged from 21% in Lincoln/ *T. harzianum* seed treatment to 82% in Sinnary/*B. subtilis* seed treatment.

According to the index values, *B. subtilis* was more effective in reducing PTD than the other tested species of *Trichoderma*. This was true in both tested cultivars. Moreover, seed coating gave more positive results than soil treatments. Percentages of survival seedlings increased parallel to the application of all the bioagents, attaining maximum levels in Sinnary/*B. subtilis* seed treatment (75%), compared with that of the infected control (39.23%). However, the least survival seedlings values were obtained in Lincoln or Sinnary/*T. koningii* treatments (55.39 and 57.10, respectively), compared to infested control (26.57 and 37.12, respectively). It is evident from the obtained results that the relatively incompatible cultivar was more sensitive to the biocontrol treatments than the less compatible Lincoln pea cultivar. *T. viride* significantly inhibited the growth of *R. solani in vivo*, decreased seed decay and increased seedling survivals.

The obtained results on the positive antagonistic effects of *Trichoderma* species on *Rhizoctonia* damping-off were in agreement with those found by El-Zayat *et al.* (1993), Belanger *et al.* (1995), Elad and Shtienberg (1995) and El-Gali (2003). A mechanism of biological control by *T. virens* of cotton seedlings damping-off incited by *R. solani* was suggested by Howell *et al.* (1999). They concluded that control was achieved thorough the induction of host resistance by the peroxidase activity and terpenoid synthesis in seedlings roots by the biocontrol agent.

Table (3): Effect of three *Trichoderma* species and *B. subtilis* on controlling damping-off incited by *Rhizoctonia solani* on the two pea tested cultivars.

Index values (*Arcsine angular*)

Treatments	Pre-emergence						Post- emergence						Survivors					
	Cultivars																	
	Lincoln			Sinnary			Lincoln			Sinnary			Lincoln			Sinnary		
	Methods																	
	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean
T. viride	18.43	23.86	21.15	15.32	18.03	16.68	18.43	23.86	21.15	21.15	18.03	19.59	63.43	54.99	59.21	63.43	63.43	63.43
T. koningii	26.57	26.57	26.57	12.21	23.86	18.04	26.32	28.78	27.55	17.84	14.92	16.38	57.99	52.78	55.39	63.43	50.77	57.10
T. harzianum	15.32	28.78	22.05	18.03	21.14	19.59	24.51	30.99	27.75	20.95	23.86	22.41	66.14	50.77	58.46	63.43	50.77	57.10
B. subtilis	26.57	26.57	26.57	26.57	14.92	20.75	12.01	9.097	10.55	14.92	9.097	12.01	61.22	63.43	62.33	59.21	75.08	67.15
Infested control	39.23	39.23	39.23	28.78	28.78	28.78	40.19	39.23	39.71	50.77	50.77	50.77	26.57	26.57	26.57	35.01	39.23	37.12
Uninfested control	12.21	12.21	12.21	9.097	9.097	9.097	9.097	9.097	9.097	9.097	9.097	9.097	77.79	77.79	77.79	80.9	80.9	80.9
Mean	23.06	26.20		18.33	19.30		21.76	23.51		21.93	20.96		58.86	54.39		60.90	60.03	
$L.S.D_{0.05}$ (Treatment)	4.480						4.635						3.473					
$L.S.D_{0.05}$ (Method)	2.587						2.676						2.005					
$L.S.D_{0.05}$ (Varieties)	2.587						2.676						2.005					
$L.S.D_{0.05}$ (Interaction)	6.905						7.142						5.352					

* values are means of 4 replicates. * Values are the arcsine square root of transformation percentage of data.

3- Fusarium solani

According to the data presented in Table (4), all the tested treatments significantly reduced PRD incited by *F. solani*. Reduction rate percentages ranged from 20% in Lincoln/*T. koningii* seed treatment to 65.76% in Lincoln or Sinnary/*T. viride* or *B. subtilis* soil or seed treatment. Generally, seed and soil treatment with *T. viride* or *B. subtilis* gave the highest PRD reduction rates, followed by *T. koningii* and then *T. harzianum*.

PTD incidence was significantly decreased both in seed coating or soil treatment. *T. harzianum* and *T. viride* were the most active among the tested bioagents in reducing PTD values both in Lincoln or Sinnary cultivars. Survival seedlings values in all treatments significantly increased. Moreover, increase was more in Sinnary than Lincoln cultivar. The least increasing rates were recorded in Lincoln cultivar seed treatments with *T. koningii*, *T. harzianum* and *B. subtilis*. Obtained results assured that *T. viride* was the most effective bioagent in Lincoln cv. treatments, whereas soil treatment with *B. subtilis* was more effective in reducing PTD and increasing SS values in Sinnary cv., than Lincoln cv.

According to the obtained results, Soil application with bioagents was more effective in reducing PRD, PTD and root-rot incidence, if compared with seed treatment. These results on pea were in agreement with those obtained on faba bean (Khalifa, 1997), soybean (Nazim *et al.*, 1999) and bean (Amer and El-Desouky, 2000). They concluded that biocontrol agents were able to establish in soil, proliferate and have a potential to produce some propagules which remain viable.

Obtained results on the reduction of PRD and PTD due to application of bioagents realized the strategies hypothesis suggested by Cook (1993), considering biological control with microorganisms, i.e., to reduce the population of the pathogen, prevent the pathogen to infect the plant; and limit disease development after infection.

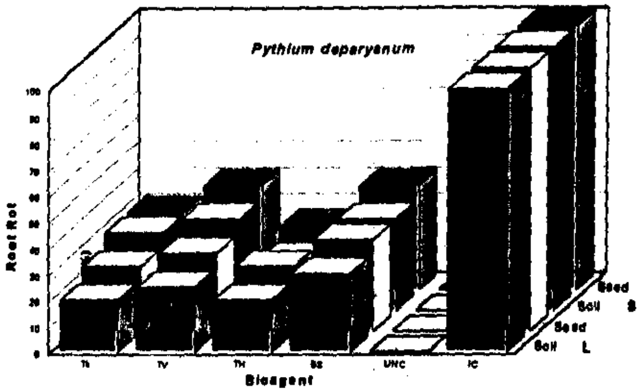
Table (4): Effect of some bioagents on controlling damping-off incited by *Fusarium solani* on the two pea tested cultivars.

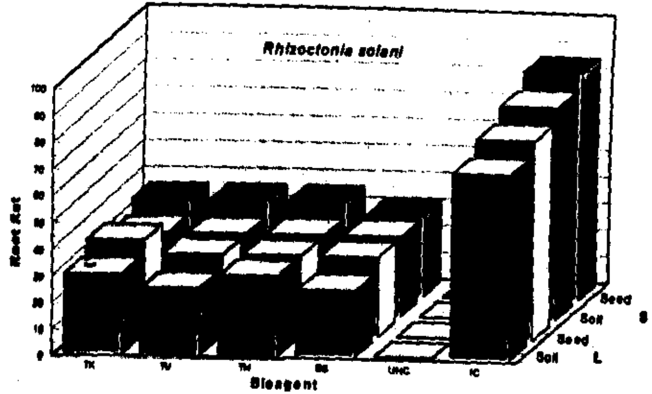
Treatments	Index values (*Arcsine angular*)																	
	Pre-emergence						Post- emergence						Survivors					
	Varieties																	
	Lincoln			Sinnary			Lincoln			Sinnary			Lincoln			Sinnary		
	Methods																	
	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean	Soil	Seed	Mean
T. viride	15.32	9.097	12.21	9.097	9.097	9.097	21.14	23.86	22.50	26.57	26.57	26.57	63.43	66.14	64.79	63.43	63.43	63.43
T. kaningii	23.86	26.57	25.22	15.32	21.14	18.23	26.57	26.57	26.57	21.14	26.57	23.86	52.78	50.77	51.78	63.43	54.78	59.11
T. harzianum	18.43	26.57	22.50	18.43	18.43	18.43	26.57	26.57	26.57	18.43	18.43	18.43	56.79	50.77	53.78	63.43	63.43	63.43
B. subtilis	18.43	18.43	18.43	9.097	9.097	9.097	18.43	33.21	25.82	23.86	26.57	25.22	63.43	50.77	57.10	66.14	63.43	64.79
Infested control	39.23	33.21	36.22	26.57	26.57	26.57	37.22	43.08	40.15	39.23	39.23	39.23	28.78	28.78	28.78	39.23	39.23	39.23
Uninfested control	12.21	12.21	12.21	9.094	9.094	9.094	9.097	12.21	10.65	9.097	9.097	9.097	77.79	77.79	77.79	80.9	80.9	80.9
Mean	21.25	21.01		14.60	15.57		23.17	27.58		23.05	24.41		57.17	54.17		62.76	60.87	
L.S.D$_{0.05}$ (Treatment)	2.305						1.986						2.449					
L.S.D$_{0.05}$ (Method)	1.331						1.146						1.414					
L.S.D$_{0.05}$ (Varieties)	1.331						1.146						1.414					
L.S.D$_{0.05}$ (Interaction)	3.552						3.060						3.775					

* values are means of 4 replicates. * Values are the arcsine square root of transformation percentage of data.

B- Root-rot incidence

According to the data shown in Figure (1), roots of the uninfested control proved to be healthy with no sign of root-rot incidence, whereas, roots of the control infested with root-rot agents showed different degrees of root-rot incidence ranged from 55-100% according to the cultivar and the applied pathogenic agent. *P. debaryanum* proved to be the most virulent among the applied pathogens, followed by *R. solani*. Moreover, no differences in root-rot % were detected between Lincoln and Sinnary pea cultivars. This was true for the all tested pathogens, except *F. solani*, in which Sinnary showed relatively less root-rot symptoms. Moreover, *T. harzianum* was more effective against *P. debaryanum* and *F. solani* compared with the other tested bioagents, whereas, *B. subtilis* was relatively more effective against *R. solani*. Reduction in root-rot incidence in soil treatment was 20% more than that of seed treatment and this was true with most treatments. Khalifa *et al.* (1997) and Amer and El-Desouky (2000) reorted similar results on faba bean and bean, respectively. Most of these results were in agreement with those obtained by Sahan (1989); Beshir *et al.* (2000); Abd El-Aal (2001) and Amer and El-Desouky (2000).





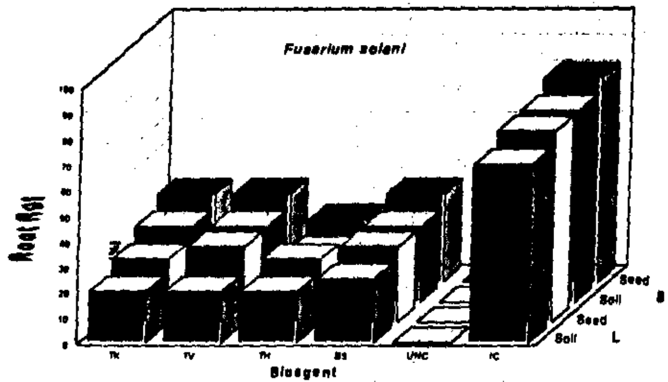


Fig. 1: Effect of soil and seed treatment with *Trichoderma* spp. and *Bacillus subtilis* on the incidence of root-rot incidence in Lincoln (L) and Sinnary (S) pea cultivars.
TK : *T. koningii*; TV : *T. viride*; TH : *T. harzianum*; BS : *Bacillus subtilis*; UNC : *Uninfested control*; IC : Infested control.

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الملخص العربـــى

دراسات عن أمراض الذبول الطرى وأعفان الجذور فى بادرات البسلة
II. المقاومة الحيوية

إبراهيم السمرة[1] ، ماهر الفرنوانى[1] ، نادية الصفوانى[2] و ليلى عبد الرازق[2]
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تـــم إختبار عدد من كائنات المقاومة الحيوية وهى تريكودرما فيريدى و تـــريكودرما هـــرزيانم و تريكودرما كوننجياى و باسيلس ساتلس فى المعمل وفـــى الصـــوبة لمقاومة الكائنات المسببة للذبول الطرى وأعفان الجذور فى البســـلة وهـــى بيثيوم ديباريانم و ريزوكتونيا سولانى وفيوزاريوم سولانى. أوضـــحت تجـــارب الـــنمو الخطـــى أن الفطر فيوزاريوم سولانى كان أكثر الفطـــريات المختـــبرة تأثـــراً بكائـــنات المقاومة الحيوية المختبره يليه الفطر ريزوكتونيا سولانى. بينما كان الفطر بيثيوم أقلها تأثراً.

أوضـــحت الدراسات التى تمت فى الصوبة أن المعاملة بأى من كائنات المقاومـــة الحـــيوية المختبرة قد أدت إلى إنخفاض معنوى فى النسبة المئوية للذبـــول قـــبل و بعد ظهور البادرات وأعفان الجذور وإلى زيادة واضحة فى النســـبة المئوية للبادرات السليمة. و كانت معاملة التربة بالكائنات المستخدمة فـــى المقاومة الحيوية أكثر كفاءة عن معاملة البذرة. ولقد أدت المعاملة بكل مـــن تـــريكودرما فيريدى و تريكودرما هرزيانم إلى خفض معنوى فى ذبول الـــبادرات قـــبل ظهور المتسبب عن الفطر بيثيوم كما زادت نسب البادرات السليمة. ووجد إنخفاضاً ملحوظاً فى ذبول البادرات قبل الظهور المتسبب عن الفطر فيوزاريوم سولانى بإستخدام البكتيره باسلس ساتلس (٦٥%).

وأظهـــرت النـــتائج إنخفاضـــاً معنوياً فى حدوث ذبول البادرات بعد الظهـــور المتسبب عن أى من الفطريات المختبرة نتيجة للمعاملة بكائنات المقاومـــة الحـــيوية المختبرة وتراجعت النسبة من ٢١% إلى ٨٢% وفقاً لـــنوع كائـــن المقاومة الحيوية المستخدم والفطر المختبر. و عموماً كان الفطر بيثيوم أكثر حساسية لمعاملات التربة بكائنات المقاومة الحيوية عن بقية المسببات المرضية المختبرة. و كان تأثير المعاملات أكثر كفاءة فى صـــنف البســـلة سنارى عن الصنف لنكولن . و النتائج المتحصل عليها تظهـــر إنخفـــاض حـــدوث أعفان الجذور بنسبة من ٢٠-٤٠% بتطبيق المقاومة الحيوية بالكائنات المختبرة.