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EFFECT OF SEED TREATMENT WITH FUNGICIDES COMBINED WITH VA-MYCORRHIZA ON PLANT GROWTH AND ROOT-ROT DISEASES OF BROAD BEAN (*Vicia faba*, L.)

By

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ABSTRACT

Fusarium solani *(Mart.) Appel. & Wollenew. and* ***Rhizoctonia solani*** *Kühn., are reported in this work as broad bean root-rot pathogens, but* ***R. solani*** *is more virulent than* ***F. solani.***

Survival percentage was significantly higher in cv. Giza 2 than cv. Ribaya-40 (R-40). Both cultivars survived best in sterilized and unsterilized soils respectively. In absence of root-rot pathogens, survival produced by the vesicular-arbuscular-mycorrhizal ***Glomus macrocarpum****, (VAM) fungus was increased significantly more than Benlate and Mancoper. In VAM-fungicide combinations, survivals were significantly reduced if compared with VAM-fungus alone. In soils infested with* ***F. solani*** *or* ***R. solani****, the best survival was produced by Benlate alone or its combination with VAM-fungus, respectively. However, VAM-fungus alone increased survival significantly better than Mancoper fungicide when they were used against* ***R. solani****.*

Root-rot disease severity index (DSI) was *significantly higher in sterilized soil than in unsterilized soil and on cv.. R-40 than cv. Giza 2 The DSI reduced significantly by applying fungicides or VAM-fungus as well as by their combinations. The VAM-fungus alone, was effective as or better than Benlate against root-rot disease incited by* ***R. solani*** *on both cultivars and* ***F. solani*** *on cv. R-40, in unsterilized soils. The VAM-fungus, seems to be less effective against* ***R. solani****-infection developed in sterilized soil, especially on cv. R-40. However, VAM-fungicide combinations, in most cases, resulted in significant improvement in disease control if compared with VAM-fungus alone.*

The intensity of VAM-colonization to roots of broad bean plants was higher, in general, on cv. R-40 than cv. Giza 2, especially in unsterilized soil. However, it was negatively affected by the tested fungicides and

*pathogens with few exceptions. In this respect, **R. solani** inhibited VAM-colonization more than **F. solani**, and Mancoper fungicide than Benlate fungicide. Root-rot pathogens occurred in unsterilized soil together with VAM-fungus caused greater increases in VAM-colonization compared with the later fungus alone. Increasing in VAM-colonization and reduction in root-rot incited by **F. solani** seems to be closely related.*

Plant height and root length of plants inoculated with VAM-fungus and grown in soils infested or uninfested with root-rot pathogen, were significantly higher than those of non-inoculated plants: Fungicides alone had no effects or exhibited harmful appearance on both plant height and root length of diseased plants. When fungicides used in combination with VAM-fungus both growth characters were significantly improved.

INTRODUCTION

Broad bean (***Vicia faba*** L.) plants are attacked by many soil pathogenic fungi, including ***Rhizoctonia solani*** and ***Fusarium solani*** which caused damping-off and root-rot diseases and greatly reduced plant growth. These, finally produced great losses in the resultant seed yield (**Aly, 1967 and Sirry *el al.*, 1970**).

Yet, it is known that the vesicular-arbuscular-mycorrhizal (VAM) fungi could enhance growth of shoots and roots of several crops (**Kleinschmidt** and **Gerdeman, 1972; Khan, 1973; Graham *et al.*, 1976**; **Kucey and Paul, 1983; Al-Fasi *et al.*, 1990** and **Ahmed *et al.*, 1994).** This effect was attributed to the improvement in nutritional uptake of mycorrhizal plants (**Gerdeman**, **1964** and **Ross**, **1971)** and may also cause protective effects of roots in these plants against soil invaders making more healthy root system which could absorb additional nutrients causing further growth enhancement.

Some fungicides like Thiram, Captan, Ridomil, Pyroxychlor and Carbendazim apparently do little if any damage and had no adverse effect on mycorrhizal fungi (**Nemec**, **1980; Menge, 1982** and **Vyas** and **Shroff, 1990).** However, some workers reported that,

VAM-fungi appear to be highly sensitive to Benlate, Thiabendazole, Topsin, Calixin and Erthirimol (**Bailey** and **Safir**, **1978** and **Menge, 1982).**

This work was conducted mainly to investigate possible effects of some fungicides on the protective action of this VAM-fungus under stress of root-rot pathogens in sterilized or unsterilized soil. Two broad bean cultivars were included in this work. Relationship between disease severity and VAM-colonization intensity was also determined.

MATERIALS AND METHODS

- **Isolation of causal organism(s):**

The used cultures of root-rot infecting fungi, *i.e.*, ***Fusarium solani*** and ***Rhizoctonia solani*** were isolated from rotted roots of naturally diseased broad bean plants collected from the Farm of Fac. of Agric., Moshtohor, Zagazig Univ. Purification of the isolated fungi was carried out using hyphal tip and/or monosporic culture techniques, then identified according to **Parameter and Whitney (1970)** and **Nelson *et al.* (1983)**.

- **Inoculum preparation and pathogenicity test:-**

The inocula were prepared by growing each of ***Fusarium solani*** (Mart.) Appel & Wollenew. and ***Rhizoctonia solani*** **(Kühn.)** on sterilized sorghum grain medium in glass bottles for 2 weeks at 28°C. A clay loam soil with pH 7.5, unsterilized or sterilized by autoclaving at 15 lb./in^2. for two hours was infested by the prepared inocula separately at the rate of 5% of soil weight. The infested soil was potted in plastic pots (Ø 20 cm), each containing 1.5 kg infested soil. Pots were watered on alternate days and incubated under greenhouse conditions for 7 days to maintain equal distribution of the fungal inoculum. Sterilized, un-inoculated sorghum grain medium was added to control pots. Surface sterilized seeds (with 0.1% mercuric chloride solution for 2 min.)

of Giza 2 and Ribaya-40 (R-40) broad bean cultivars, were planted at the rate of 6 seeds/pot Four pots, were used for each particular treatment.

Pathogenicity tests were carried out under greenhouse conditions in Fac. of Agric., Moshtohor, in a randomized complete block design experiment.

Root-rot diseased plants were counted after 60 days from sowing, plants were carefully removed, washed currently with tap water, then examined for root-rot symptoms. Determination of the root-rot disease severity index (DSI) was carried out, based on a scale from 0 (non-visible damage) to 5 (completely destroyed roots) according to **Salt (1982).**

- **Effect of seed treatment with fungicides and VA-Mycorrhiza on plant growth and root-rot diseases of broad bean:**

The tested micro-organisms:-

A highly virulent isolate from each of ***Fusarium solani*** and ***Rhizoctonia solani*** to the roots of broad bean plants were isolated and identified as mentioned before. The vesicular-arbuscular-mycorrhiza (VAM), *i.e.* ***Glomus macrocarpum*** tested in this study was kindly provided by Dr. Gendia, H., Hort. Dept., Fac. Agric., Moshtohor, Zagazig Univ.,

Cultivars, fungicides and seed treatments:-

Two fungicides namely, Benlate 50 [Methyl l-(butyl carbamoyl) 2-benzimidazole carbamate] and Mancoper (52.5% Mancozeb + 17.5% copper oxychloride) were used at the rates of 1.0 and 1.5 g/kg seeds, respectively, for treating healthy seeds of broad bean cultivars Giza 2 and Ribaya-40 (R-40), both were supplied from Agricultural Research Center, Ministry of Agric., Giza, Egypt.

Inoculum propagation and soil inoculation:

Inocula of the root-rot pathogens (***F. solani*** and ***R. solani***) were prepared and soils were infested as described before.

The VAM-fungus (*Glomus macrocarpum*) was propagated on onion plants using the propagation technique described by **Al-Fassi *et al.* (1990)**. After three months from onion cultivation, the mycorrhizal roots of onion bulbs together with its adjacent soil were collected and used for mycorrhizal infestation. The mycorrhizal inoculum, containing infected onion roots and its rhizospheric soil rich in *G. macrocarpum* spores, was added, just before sowing, at the rate of 10 g/pot (modified from **Fares, 1986**).

Design, replications and measured items:-

A randomized complete block designs each with four replicates (pots) were earned out, under greenhouse conditions, to investigate all possible interactions between soil type (unsterilized or sterilized), cultivars (Giza 2 and R-40) and 18 treatments which were combinations of two root-rot pathogens, VAM-fungus and two fungicides in addition to two controls (untreated). Each pot was sown with six, healthy, fungicide-treated or untreated seeds.

After 60 days from sowing, percentage of survived plants, root-rot disease severity index (DSI) as described by **Salt (1982),** plant height and root length for each particular treatment were determined. For each treatment into which the VAM-fungus was included, the intensity of root colonization with such fungus was determined using the method described by **Phillips and Hayman (1970).** Relationship between VAM-colonization ability to roots and DSI was also investigated. This work was repeated for two seasons (1991 and 1992).

Determined percentages were transformed to the arcsin before carrying out the statistical analysis.

Statistical analysis:

All data obtained were subjected to the proper analysis of variance **(Snedecor and Cochran, 1980).**

RESULTS AND DISCUSSION

The obtained data **(Fig. 1)** proved that, the isolated fungi ***Fusarium solani*** (Mart.) Appel & **Wollenew.** and ***Rhizoctonia solani* (Kühn.),** could infect broad bean plants and cause root-rot disease. Root-rot was relatively higher in sterilized than unsterilized soil and on cv. Ribayz-40 (R-40) than cv. Giza 2. ***R. solani*** was more virulent than ***F. solani***. These results are in agreement with those reported by **Sirry *et al.* (1970)** and **Salt (1982).** They stated that, ***R. solani*** and ***F. solani*** were the most important pathogens causing root-rot disease of bread bean plants.

Data in **Table (1)** show that, survival plants of cv. Giza 2 was significantly higher than those of cv. R-40, either in unsterilized or sterilized soil. However, best survival of both Giza 2 and R-40 cultivars were produced in sterilized soil and unsterilized soil respectively. Whatever, regardless cultivars survivals was not affected significantly by soil type.

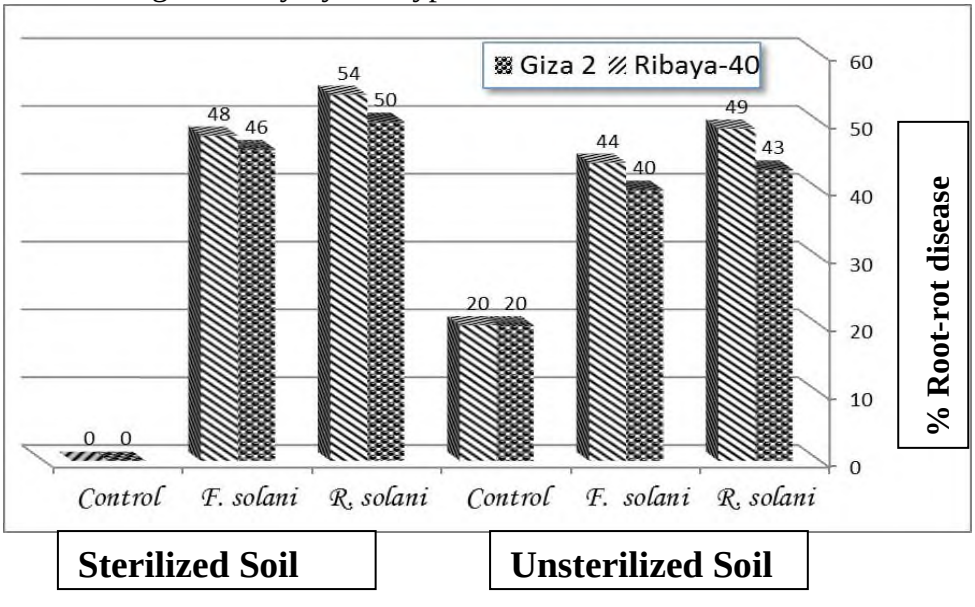

Fig. (1): Pathogenicity of isolated fungi *Rhizoctonia solani* and *Fusarium solani* (as root-rot %) 60 days after sowing broad bean plants in unsterilized and sterilized soils.

Table (1): Effect of ***G. macrocarpum*** (Gl) and seed dressing fungicides and their combination on survivals of two broad bean cvs. infected with root-rot pathogen in unsterilized or sterilized soils, 60-days after sowing.

Cultivar	Soil type / Treatment	Unsterilized soil			Sterilized soil			Mean
		Control	F. solani	R. solani	Control	F. solani	R. solani	
Giza 2	Control	95.8	33.3	52.0	100.0	29.2	20.9	55.2
	Benlate (B)	95.8	100.0	95.8	100.0	91.7	87.5	95.1
	Mancoper (M)	95.8	75.0	50.0	95.8	75.0	66.7	76.4
	G1	91.7	58.4	58.4	100.0	50.0	62.5	70.2
	G1+B	75.0	66.7	75.0	75.0	62.5	91.7	74.3
	G1+M	75.0	46.6	33.3	75.0	66.7	54.2	58.5
Mean		88.2	63.3	60.8	91.0	62.5	63.9	71.6
R- 40	Control	91.7	20.9	16.7	100.0	20.9	16.7	44.5
	Benlate (B)	95.8	91.7	75.0	83.3	87.5	41.7	79.2
	Mancoper (M)	62.5	33.3	16.7	66.7	20.9	20.9	36.8
	G1	87.5	50.0	62.5	100.0	41.7	50.0	65.3
	G1+B	66.7	54.2	66.7	75.3	54.2	75.0	65.4
	G1+M	45.8	66.7	66.7	66.7	20.9	54.2	53.5
Mean		75.0	52.8	50.7	82.0	41.0	43.1	57.5

L.S.D. at 5% for:

Soil type (S)	Cultivar (C)	Treatment (T)	S × C	S × T	C × T	S×C×T
N.S.	0.19	0.52	0.27	N.S.	N.S.	N.S.

As for, merely, treatments, the same data proved that, VAM-fungus, ***G. macrocarpum*** when inoculated alone into clean soil produced the highest percentage of survival followed by Benlate and Mancoper, but all them came next after control treatment. Compared with VAM-fungus alone, survival percentage was greatly reduced when VAM-fungus was combined with fungicides particularly Mancoper. In soil infested with ***F. solani*** or ***R. solani***, applying fungicide, VAM-fungus each alone or in combinations, produced significant increase in survivals compared with any pathogen alone. In this respect, efficiency of the VAM-fungus, was comparable to that of

Mancoper when applied against ***F. solani*** and better than it when applied against ***R. solani***. The harmful effect of Mancoper seems to be decreased as survival was increased when it was combined with VAM-fungus. In general, regarding pathogens only, Benlate alone or combined with the VAM-fungus against ***F. solani*** and ***R. solani***, in this respect, produced the highest increase in survivals compared with these pathogens each alone. These results indicated that, Mancoper may be more toxic to VAM-fungus than Benlate and against ***R. solani*** than ***F. solani***.

Percentage of survivals was not significantly affected by the cultivar/treatment interaction. However, it could be noticed that, in presence of a given root-rot pathogen, Mancoper alone lowered survival of cv. R-40 greatly compared with cv. Giza 2 When VAM-Mancoper combined treatment was applied, survival of cv. R-40 only was greatly improved compared with Mancoper alone.

Data in **Table (2)** prove that, DSI was significantly higher in sterilized soil than in unsterilized soil. However, it was not affected significantly by the interaction between cultivar and soil type *(i.e.* sterilized or not).

The DSI caused by a given pathogen was greatly and significantly reduced by using the VAM-fungus, fungicide seed-treatments each alone or in combination. In this respect, root-rot diseases were controlled better by any fungicide than by VAM-fungus alone. Efficacy of the VAM-fungus against root-rot infections on both cvs. was significantly improved when it was combined with Benlate as seed dressing fungicide. In such combination, DSI was lying in between those obtained by each partner if used alone. While, in case of VAM-Mancoper combination it shows no detectable variations compared with Mancoper alone. This result indicated again that, Mancoper may be toxic against VAM-fungus more than Benlate.

Table (2): Root-rot disease severity index (DSI) as affected by *G. macrocarpum* (Gl) alone or combined with fungicide-seed treatment, in unsterilized or sterilized soils after 60 days from sowing.

Cultivar	Soil type / Treatment	Unsterilized soil			Sterilized soil			Mean
		Control	F solani	R. solani	Control	F. solani	R. solani	
Giza 2	Control	10.0	35.0	43.1	0.0	52.5	52.5	32.2
	Beniate (B)	0.0	11.6	10.0	0.0	10.0	13.3	7.5
	Mancoper(M)	0.0	15.0	13.3	0.0	8.3	11.7	8.1
	G1	10.0	25.0	15.0	0.0	22.5	33.5	17.7
	G1+B	0.0	20.0	16.6	0.0	16.6	11.7	10.8
	G1+M	0.0	16.6	20.0	0.0	10.0	11.7	9.7
Mean		**3.3**	**20.5**	**19.7**	**0.0**	**20.0**	**22.4**	**14.3**
R-40	Control	10.0	43.1	45.0	0.0	82.5	65.0	40.9
	Benlate (B)	0.0	10.3	16.7	0.0	6.7	13.3	7.8
	Mancoper(M)	0.0	15.0	5.0	0.0	3.3	10.0	15.6
	G1	10.0	7.5	7.5	0.0	25.0	55.0	17.5
	G1+B	10.0	15.0	15.0	0.0	10.0	11.7	10.3
	G1+M	0.0	6.7	5.0	0.0	6.7	5.0	3.9
Mean		**5.0**	**16.3**	**15.7**	**0.0**	**22.4**	**26.7**	**14.3**

L.S.D. at 5% for:

Soil type (S)	Cultivar (C)	Treatment (T)	S × C	S × T	C × T	S×C×T
0.98	**N.S.**	**2.60**	**1.20**	**3.60**	**3.69**	**5.20**

This could be supported by data in **Table (3)** which show that, the first fungicide caused the highest reduction in intensity of VAM-colonization. It is interesting to state that, the VAM-fungus was more effective against ***F. solani*** than ***R solani.*** The DSI was reduced from 533% to 20.0% and from 51.4% to 27.7% for both pathogens, respectively. In general, VAM-fungus in uninfested had no significant effect on root-rot infections occurred naturally in unsterilized soil Its protective action was exhibited only under pressure of a given root-rot pathogen (*i.e.* artificial infection). In fact natural unsterilized soil may contain different antagonistic

microorganisms which inhibited the suppressive effect of the VAM-fungus against root pathogens.

The DSI was significantly affected also by the interaction between treatment and cultivar. Disease caused by any pathogen especially ***F. solani*** was higher on cv. R-40 than cv. Giza 2. However, disease due to ***F. solani*** was controlled significantly better on the firs: cultivar than the later one by applying the YAM-fungus alone or in combination with fungicide seed treatment while disease ***R. solani*** was controlled by the VAM-fungus on cv. Giza 7 better than on cv. R-40. In general, VAM-Mancoper combination produced the highest significant decreases in DSI caused by both tested pathogens on cv. R-40 compared with cv. Giza 2.

The same dam stated also that DSI caused by both pathogens especially ***F. solani*** was significantly higher in sterilized soil than in unsterilized soil. Soil sterilization may favour survival of ***F. solani*** and in the same tune eliminate soil microorganisms having antagonistic properties against it. This was in harmony with **Lef and Chaung (1990)** who observed that, some races of ***F. oxysporum f. sp. cubense*** survived better in sterilized soil than in natural unsterilized soil. Root-rot diseases caused by ***F. solani*** and/or ***R. solani*** only were lowered significantly in sterilized soil by applying Mancoper alone. VAM-fungus combined with Mancoper or Benlate, in respective, compared with the same treatments in unsterilized soil. Effectivity of VAM-fungus in controlling root-rot disease was comparable to Benlate and significantly better than VAM-Benlate combination when they were used against ***R. solani*** in sterilized soil In general, fungicides alone or in combination with VAM-fungus lowered DSI in sterilized soil more than unsterilized soil, while VAM-fungus alone controlled it in unsterilized soil better than in sterilized soil.

Data in **Table (3)** indicate that, intensities of VAM-fungus in absence of root-rot pathogens, were higher, in general, in sterilized soil

than in unsterilized soil and in roots of cv. Giza 2 than those of cv. R-40. The tested pathogens, *i.e.* ***F. solani*** or ***R. solani*** (in most cases) and the seed dressing fungicides *i.e.* Benlate and Mancoper each alone decreased VAM-colonization intensity to different extent. However, in case of cv. R-40 grown in unsterilized soil infested with any pathogen especially *R solani* the colonization of root with VAM-fungus showed marked increase compared with the VAM-fungus when introduced into uninfested soil (control). In presence of a root-rot pathogen, reduction in VAM-colonization was successively increased by using fungicides especially Mancoper for seed treatment. In general, applying Mancoper fungicide together with VAM-fungus in non-infested or infested soil with *F. solani* or *R. solani* caused the greatest reduction in VAM-colonization intensity compared with VAM-Benlate combination. In most cases, reduction in VAM-colonization was higher in sterilized soil than in unsterilized one.

The same data proved also that the roots of cv. R-40 grown in unsterilized soil infested with ***F. solani*** or ***R. solani*** exhibited the highest intensity of VAM-colonization and this was reflected in highest reduction in DSI caused by these pathogens. Elevation in VAM-colonization. regardless cultivar and soil type, seems to be associated with improvement in disease control particularly that caused by ***F. solani***. These results indicated that the protective infection of VAM-fungus. ***G. macrocarpum***, against root-rot infections may be affected by several factors including host plant (cultivar), pathogen soil conditions, and may be the interaction; between them. Similar conclusion was reported also by **Perrtin (1985).** Benlate was reported as one of the most effective fungicides against causal organisms of root-rot disease on broad beans and other crops (**Mostafa, 1972 and Eisa and Barakat, 1978**). On the other hand, Benlate could reduce penetration and development of VAM-fungi in roots of different crops **(Jalali and Domsch, 1975; Bailey and Safir, 1978 and Menge,**

1982). In fact, root exudate of VA-mycorrhizal plants may prevent root-rot infections directly through inhibition of disease agent or indirectly changing structure of rhizosphere and stimulating antagonistic microorganisms in growing area of their roots. Effect of root exudates may be increased proportionally with increasing in VAM-colonization. These results and explanation are in harmony with **Baltruschat and Schonbeck (1972)** who observed fewer clamydospores of *Thielaviopsis basicola* were formed on mycorrhizal than on non-mycorrhizal roots of tobacco inoculated with the pathogen. The number of spores were inversely correlated with the amounts of VA-infection. Mycorrhizal root extracts inhibited chlamydospore production on cultivars of *T. basicola.* This was largely attributed to the amino acid arginine which accumulated in the endomycorrhizae **(Baltruschat *et al.*, 1973).** They added also that, VA-Mycorrhizae formed in tobacco roots can increase their resistance to root-knot nematodes.

Data in **Table (4)** show that plant height of cv. Giza 2 was significantly taller than cv. R-40. However, it was not affected by soil type or interaction between soil type and cultivar. Plants grown in soil inoculated only with the VAM-fungus produced the highest significant increase in plant height compared with uninoculated control. Benlate alone had no significant effect on the height of plants infected with ***F. solani*** or ***R. solani***, while plant height of ***R. solani***-infected. plants was decreased significantly compared with pathogens alone. Applying any of these fungicides together with VAM-fungus caused significant increases in plant height compared with fungicide alone. In this respect, plant height in Mancoper-VAM combination was significantly lower than in Benlate-VAM combination. These results indicated that, the harmful effect of the tested fungicides especially Mancoper was greatly decreased and plant height was significantly increased when it was combined with the VAM-

Table (3): Root-rot disease severity index (DSI) and intensity of root colonization with the VAM-fungus, *G. macrocarpum* (GI) as affected by root-rot pathogens and treating seeds with Benlate (B) and Mancoper (M) fungicides, after 60 days from sowing.

Soil type		Unsterilized soil						Sterilized soil					
Cultivar	Treatment	*Control*		*F. solani*		*R. solani*		*Control*		*F. solani*		*R. solani*	
		DSI%	C.I.*	DSI%	C.I.*	DSI%	C.I.*	DSI%	C.I.*	DSI%	C.I.*	DSI%	C.I.*
Giza 2	Control	10.0	--	52.5	--	52.5	--	0.0	--	72.5	--	55.5	--
	G1	10.0	63.3	25.0	34.8	15.0	29.3	0.0	62.5	22.5	48.5	32.5	28.6
	G1+B	0.0	49.6	20.0	18.6	16.6	23.5	0.0	20.0	16.6	30.8	11.7	12.1
	G1+M	0.0	9.1	16.6	11.8	20.0	16.3	0.0	15.0	10.0	9.8	11.7	11.8
R. 40	Control	10.0	--	52.5	--	80.0	--	0.0	--	82.5	--	65.0	--
	G1	10.0	42.6	7.5	51.2	15.0	66.0	0.0	55.4	25.0	41.9	15.0	39.0
	G1+B	10.0	25.9	15.0	30.0	15.0	15.0	0.0	16.6	10.0	14.6	11.7	20.6
	G1+M	0.0	8.1	6.7	17.1	5.0	7.8	0.0	5.8	5.8	15.3	5.0	7.6

*C.I.: Colonization Intensity = $\frac{\text{Total counted No. of VAM-structures}}{\text{Total number of examined root segments}}$

fungus.

As for cultivar/treatment interaction, the same data in **Table (4)** show that plant height of both tested cultivars, was similarly affected by most tested treatments with few exceptions. Plant height of cv. Giza 2 was significantly higher than cv. R-40 in the following treatments: Mancoper alone in uninfested soil, VAM-fungus in soil infested with ***F. solani*** and VAM-Benlate combination in soils non-infested or infested with ***F. solani*** or ***R. solani***.

Regarding soil type/treatment interaction, the same data show that in sterilized soil, applying VAM-fungus alone in soil infested by ***F. solani***, VAM-Benlate combination in soil in non-infested soil or infested by. ***F. solani***, and VAM-Marcoper combination in non-infested soil produced significant increases in plant height compared ith the same treatments in unsterilized soil.

Table (4): Effect of VAM-fungus, ***G. macrocarpum*** **(Gl)** alone or combined with fungicide-seed treatment on plant height (cm)of broad bean plans, grown in unsterilized or sterilized soils, infested with ***F. solani*** or ***R. solani***. after 60 days from sowing.

Cultivar	Soil type Treatment	Unsterilized soil			Sterilized soil			Mean
		Control	F solani	R. solani	Control	F. solani	R. solani	
Giza 2	Control	15.4	12.0	8.0	19.6	12.7	6.5	12.4
	Beniate (B)	19.5	13.0	13.2	18.6	11.9	7.0	13.9
	Mancoper(M)	18.1	10.3	5.9	21.5	6.6	9.3	12.0
	G1	21.5	16.2	23.9	23.5	23.1	23.9	22.0
	G1+B	23.3	17.4	20.9	25.4	26.3	26.4	23.0
	G1+M	12.2	13.3	11.3	22.3	12.6	11.9	13.6
Mean		**17.8**	**13.7**	**13.9**	**22.0**	**15.2**	**14.2**	**16.1**
R-40	Control	19.8	6.3	3.3	28.5	18.6	8.3	11.5
	Benlate (B)	17.5	13.3	6.2	19.3	13.5	8.0	12.5
	Mancoper(M)	12.7	5.0	2.7	12.9	7.6	5.0	17.7
	G1	23.7	14.4	19.8	24.2	16.4	23.1	19.5
	G1+B	13.3	14.1	16.9	13.6	16.3	16.2	14.6
	G1+M	14.3	15.4	9.7	12.7	11.7	11.4	12.6
Mean		**16.0**	**11.4**	**9.8**	**17.2**	**12.2**	**12.0**	**13.1**

L.S.D. at 5% for:

Soil type (S)	Cultivar (C)	Treatment (T)	S × C	S × T	C × T	S×C×T
N.S.	**2.0**	**3.0**	**N.S.**	**3.0**	**4.1**	**4.3**

In general, cv. Giza 2 grown in sterilized soil either infested or non-infested with a given root-rot pathogen and inoculated with the VAM-fungus combined with Benlate, produced the most tallest plants compared with VAM-fungus alone. However, plant height cv. R-40 in non-infested sterilized or was decreased significantly by applying VAM-fungicides combination compared win VAM-fungus alone. Mancoper alone used for treating seeds of CV. R-40 in soils infested with a given root-rot pathogen, particularly *R. solani* caused the greatest reduction in plant height compared with the pathogen alone. The

harmful effect of Mancoper on plant growth VAM-colonization and inhibition of root-rot disease pathogens could be explained depending on toxic action of heavy metals. Increasing uptake of copper ions released during Mancoper degradation, especially in presence of a root-rot pathogens, may lead to inhibition of certain enzymes and vital interactions carried out in host plant and VAM-fungus as well as root-rot pathogens, as a result of this effect plant growth, VAM-colonization and DSI were reduced. These results could be supported by those obtained by several investigators. **Menge (1982)** attributed stunting following fungicides application to phytotoxicity of these compounds. However, some investigators eliminated phytotoxicity of Benlate. It was mainly due to a reduced effectiveness of the VAM-association as a cause of stunting **(Jalali and Domsch, 1975; Boatman *et al.*, 1978; Bailey and Safir, 1978).** As for heavy metal effect, **Graham *et al.* (1985)** reported that, the growth of citrus seedling and colonization by the myconhizal fungus ***Glomus intraradics*** were reduced logarithmically with increasing in copper (Cu) concentration. They added that leaf P-content decreased linearly with Cu for mycorxhizal seedlings. The Cu induced reduction in P uptake of myconhizal plants was more closely related to the inhibition of hyphal development outside of the roots than to development of vesicules and arbuscules in the root.

Data in **Table (5)** show that, root length was not affected significantly by soil type, cultivar and their interactions. Compared with *F. solani*- *or R. solani*-infected plants, the root length was not affected significantly by applying Mancoper alone, while Benlate gave pronounced increase in root length which reached the level of significancy in case of plants infected with *F. solani*. However, the VAM-fungus alone produced the highest root length for both healthy and diseased plants. Benlate alone enhanced root length of healthy plants which was significantly higher in unsterilized soil than in sterilized soil and on cv. R-40 than cv. Giza 2, while Mancoper alone caused significant decrease in root length of plants grown in

unsterilized soil infested with ***R. solani***, compared with those grown in sterilized soil. Healthy plants of cv. Giza 2 treated with Mancoper alone produced the highest increase in root length compared with the same treatment on cv. R-40. In general, applying combination resulted in significant increases in root length of diseased plants compared with fungicides alone.

Table (5): Effect of VAM-fungus, *G. macrocarpum* (G1) alone or combined with fungicide-seed treatment on rco: length (cm) of broad bean plants, grown in unsterilized or sterilized soils, infested with ***F. solani*** or ***R. solani*** after 60 days from sowing.

Cultivar	Soil type Treatment	Unsterilized soil			Sterilized soil			Mean
		Control	*F solani*	*R. solani*	Control	*F. solani*	*R. solani*	
Giza 2	Control	13.4	8.3	10.7	11.2	8.2	8.5	10.1
	Beniate (B)	19.4	12.3	12.8	11.1	7.4	7.7	11.2
	Mancoper(M)	22.8	9.0	6.3	22.0	4.0	10.6	12.3
	G1	1S.5	12.3	15.1	14.4	14.3	16.7	15.4
	G1+B	15.9	19.4	1S.9	15.1	22.3	22.S	1S.3
	G1+M	14.3	11.2	12.8	21.9	18.3	12.7	15.2
Mean		17.6	12.1	12.9	16.0	12.4	13.2	14.0
R-40	Control	10.9	8.3	4.5	13.0	10.0	8.0	9.1
	Benlate (B)	29.0	10.1	6.0	16.5	10.8	8.7	13.3
	Mancoper(M)	11.0	7.3	1.8	17.2	7.6	8.0	8.8
	G1	12.6	13.3	13.3	15.2	10.3	15.3	13.2
	G1+B	17.2	23.4	1S.S	18.2	20.8	12.8	18.7
	G1+M	15.8	15.3	11.6	13.5	16.7	10.8	14.1
Mean		16.1	13.1	9.5	15.6	12.7	10.6	12.9

L.S.D. at 5% for:

Soil type (S)	Cultivar (C)	Treatment (T)	S × C	S × T	C × T	S×C×T
N.S.	**2.0**	**3.0**	**N.S.**	**3.0**	**4.1**	**4.3**

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تأثير إقتران معاملة البذور بالمبيدات مع الميكورهيزا الحويصلية الشجيرية على نمو نباتات الفول البلدي وشدة إصابتها بأعفان الجذور

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تم إجراء هذا البحث بهدف عزل وتعريف بعض الفطريات المسببة لأعفان جذور الفول البلدي والمصابة طبيعياً في الحقل . و دراسة تأثير معاملة بذور الفول البلدي صنفي جيزة ٢ وريباية ٤٠ بالمبيدات بنليت او مانكوبر على فعالية الفطر الميكورهيزي جلومس ماكروكاربوم بالنسبة لبقاء النباتات ودرجة إصابتها بأعفان الجذور التي تسببها الفطريات المعزولة في كل من التربة المعقمة والغير معقمة . كذلك دراسة تأثير هذه المعاملات على أطوال كل من الساق والجذور وكثافة إستعمار الجذور بالميكورهيزا وعلاقة ذلك بشدة الإصابة بأعفان الجذور وذلك خلال الموسمين ١٩٩١، ١٩٩٢ تحت ظروف الصوبة.

تم عزل وتعريف فطريات فيوزاريوم سولاني وريزوكتونيا سولاني من جذور نباتات الفول البلدي والمصابة طبيعياً بأعفان الجذور وتم عملياً إثبات قدرتها على إحداث المرض تحت ظروف الصوبة . وكان الفطر ريزوكتونيا سولاني اكثر ضراوة من الفطر فيوزاريوم سولاني

عند غياب المسببات المرضية ادى استخدام فطر الميكورهيزا بمفرده إلى زيادة معنوية في نسبة البقاء بالمقارنة مع المبيدات (بنليت او مانكوبر) وحدث نقص معنوي في هذه النسبة عند استخدامهما معاً بالمقارنة مع الفطر الميكورهيزي بمفرده.

ادى استخدام المبيد بنليت بمفرده او مصاحباً للفطر الميكورهيزي إلى اعلى نسبة بقاء في التربة الملوثة بـ فيوزاريوم سولاني وريزوكتونيا سولاني على الترتيب . بينما ادى الفطر الميكورهيزي بمفرده إلى نسبة بقاء افضل من المبيد مانكوبر عند استخدام اي منهما في التربة الملوثة بالفطر ريزكتونيا سولاني .

ادى استخدام المبيدات بمفردها او الفطر الميكورهيزي بمفرده او كلاهما معاً إلى نقص معنوي في شدة الإصابة وفي هذا الخصوص تساوى تأثير الفطر الميكورهيزي مع تأثير المبيد بنليت في مقاومة الإصابة بالفطر ريزوكتونيا سولاني على كلا الصنفين وافضل منه في مقاومة الإصابة بالفطر فيوزاريوم سولاني على الصنف ريباية ٤٠ في التربة غير المعقمة.

كانت كثافة إستعمار الجذور بالميكورهيزا اعلى بشكل عام في الصنف ريباية ٤٠ عن الصنف جيزة ٢ خاصة في التربة غير المعقمة هذا وقد تاثرت هذه الكثافة سلبياً بكل من المبيدات والمسببات المرضية المستخدمة عدا الصنف ريباية ٤٠ في التربة المعقمة والتي ادت فيه المسببات المرضية إلى زيادة كبيرة في كثافة استعمار الجذور بالميكورهيزا مقارنة بالنباتات للحقونة بالفطر الميكورهيزي بمفرده . وعموماً ادى الفطر ريزوكتونيا سولاني إلى تثبيط الاستعمار بدرجة اكبر من فيوزاريوم سولاني وكذلك المبيد مانكوبر اكثر من المبيد بنليت . وقد أوضحت الدراسة وجود علاقة بين الزيادة في كثافة استعمار الجذور بالميكورهيزا وزيادة مقاومة الجذور للإصابة بالفطر فيوزاريوم سولاني.

في وجود او غياب المسببات المرضية اظهرت النباتات للحقونة بالفطر الميكورهيزي زيادة معنوية في إرتفاع النبات وطول الجذر مقارنة بغير للحقونة . هذا ولم تؤد المبيدات بمفردها إلى تغير واضح في هذه القياسات في النباتات المريضة او كان لها تأثير عكسي في بعض الاحيان مقارنة بوجود المسببات المرضية فقط . وحدث تحسن معنوي فيها عند إقتران المعاملة بالمبيدات مع الحقن بفطر الميكورهيزا.