RESULTS AND DISCUSSION

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1- Isolation and identification of causal organisms:-

The following fungi were isolated from roots of faba bean (Vicia faba L.) plants, collected from the Farm of Faculty of Agriculture, Moshtohor, Zagazig University, Benha Branch. Roots showed symptoms of root-rot disease during the season 1990-1991.

- (1) Fusarium solani (Mart.) Appel. & Wr.
- (2) Rhizoctonia solani (Kuehn).

These results confirmed those obtained by Abdel-Monem (1969), and Michail et al. (1979).

2- Pathogenicity of isolated fungi and their effect on growth of faba bean plants:-

Data in Table (1) show the effect of the tested fungi (i.e. F. solani and R. solani) on pre-emergence damping-off, root-rot severity and some growth characters of the two cultivars (Giza 2 and Ribaya 40) of faba bean plants in unsterilized and sterilized soils. Rhizoctonia solani was the most virulent in both soils. This fungus caused the highest percentage of pre-emergence damping-off and root-rot disease for the two cultivars.

However, higher level of disease were recorded in the sterilized soil than the unsterilized one. At the same time *Fusarium solani* caused relatively high incidence of damping-off.

In this regard, some researchers working on the same disease reported similar results, Borzini and Picco (1949), Tolba and Moubasher (1969), Diazpalanco and Salasdediez (1973) and Salt (1982). They mentioned that R. solani and Fusarium solani were the most important pathogens causing

Table (1): Pathogenicity of isolated fungi and their effects on growth characters of faba bean plants in unsterilized and sterilized soil.

			Giza 2	a 2							:	¥	Ribaya 40	a 40			
		*Pre-	*	Plant	Root	Shoot	ot	Root	90	*Pre-	* *	Plant	Root	Shoot	0t	Root)t
Soils	Isolated	emerg	Root	height		Fresh	Dry	_ [Dry	emerg	Root	height	length			Fresh	Dry
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Kunci	ence	-rot	(cm)	(cm)	Wt. Wt.	Wt.	Wt.	Wt.	ence	-rot	(cm)	(cm)		Wt.		Wt.
	rgin i	damp-	%			<u>(9</u>	9	(9)	9	damp-	%			9			9
•		ing-off					į		(ing-					į		į
		%								off %							
	R. solani	33.3	65.0	147.2	76.9	47	7.4	15.1	4.6	37.5	45.0	99.3	62.0	55.6	6.2	25.8	8.7
Unsterilized	F. solani	12.5	40.0	120.5	89.5	54.8	8.6	20.1	5.2	16.7	42.4	120.6	69.8	59.6	8.4	27.9	9.3
	Control	4.2	20.0	169.1	97	66.8	9.2	29	8.2	8.3	20.0	137.8	80.3	70.2	11.2	29	10.4
	R. solani	37.5	45.0	87.7	62.5	32.3	6.9	19.7	5.1	42.5	45.1	84.8	62.5	52.8	10.6	21.0	7.2
Sterilized	F. solani	16.7	35.0	98.6	76.7	45.2	6.7	26.9	7.0	20.8	43.2	111.9	70.5	56.6	6.7	25.2	8.2
-	Control	0,0	0.0	138.9	82	61.3	8.5	29	7.8	0.0	0.0	120	100,6	63.4	12.8	28.4	9.6
L.S.D. at	5%	8.2	10.2	6.4	5.1	7.3	1.3	4.3	<u></u>	8.5	9.8	5.8	4.9	6.8	1.2	4.8	<u>.</u> ယ

^{*} Determined after 15 days from sowing.

** Root-rot percentage and averages of growth characters of faba bean plants were determined after 60 days from sowing for 5 plants.

root-rot disease of faba bean plants. For the two cultivars, Ribaya 40 was affected than Giza 2.

'Concerning plant height, only *R. solani* decreased the height of plant significantly, whereas *F. solani* showed no effect. Such effect was more pronounced in the sterilized soil than in the unsterilized one. Ribaya 40 was affected more than Giza 2. With respect to the root length, both *R. solani* and *F. solani* decreased it especially in the sterilized soil and with the cultivar Ribaya 40. Also, *R. solani* significantly decreased the fresh and dry weights of shoots and roots of the two cultivars more than *F. solani*.

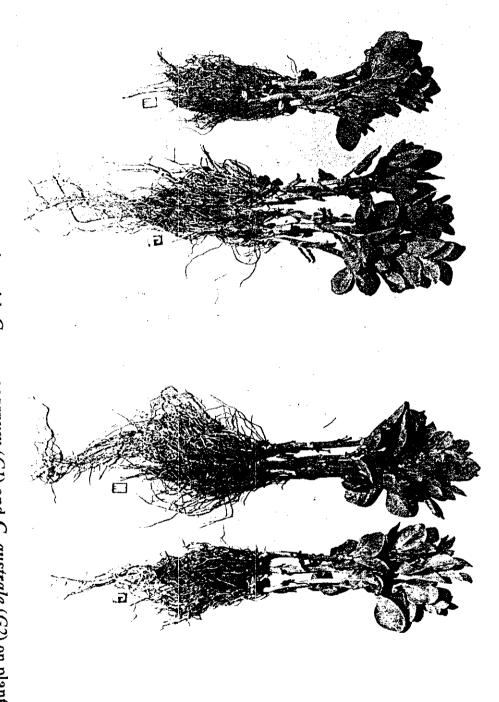
Nofal et al. (1986) found that, infection of faba bean plants by R. solani caused a reduction in the number of nodules/ plant as well as plant dry weight, shoot and root lengths.

3- Effect of inoculating unsterilized and sterilized soil with VA-Mycorrhizae on plant growth and root colonization of faba bean plants with it:-

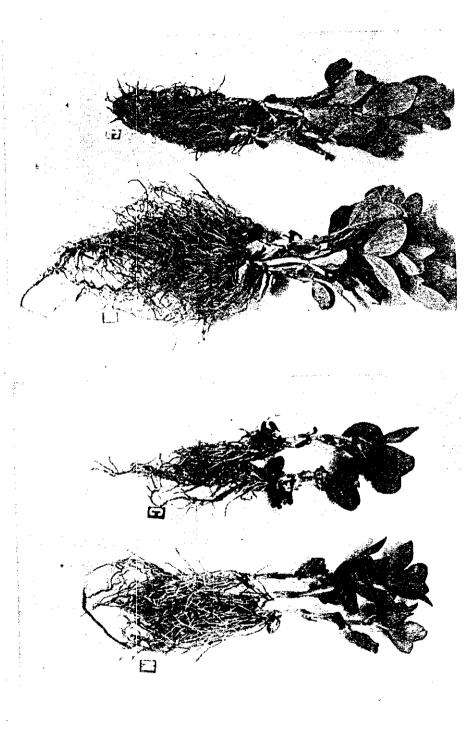
Data in Table (2) and Fig (1, 2, 3 and 4) show that, addition of VA-Mycorrhizae (G. macrocarpum) in unsterilized soil exhibited an increase in plant height, shoot dry weight, root dry weight for the two cultivars and No. of leaves for Ribaya 40 cv. compared with the control. While, addition of G. australe exhibited an increase for root length, shoot dry weight and root dry weight for Giza 2 cv., while it increased all parameters in case of Ribaya 40 cv. compared with control. In this respects, G. australe gave an increase in root length and root dry matter compared with G. macrocarpum in case of Giza 2 cv. and all parameters in case of Ribaya 40 cv. These results are in agreement with Graham et al. (1976), Menge and Zentmayer (1977), and Kucey and Paul (1983).

Table (2): Effect of Mycorrhizae on infection by *F. solani* and *R. solani* as well as some growth characters of faba bean plants in unsterilized and sterilized soil.

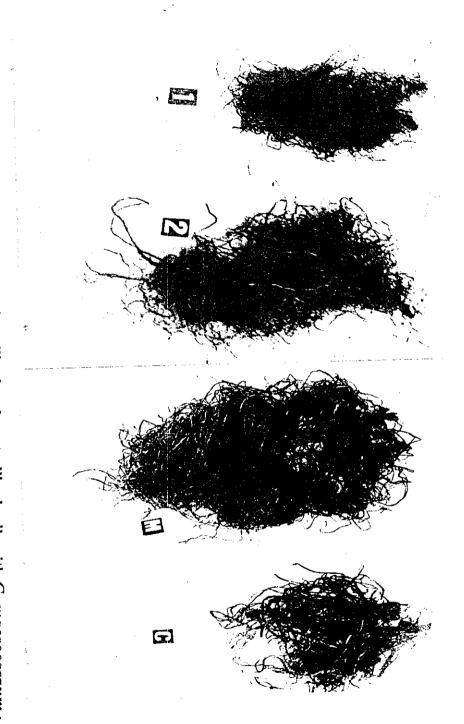
Soil type Cultivars Treatments	L.S.D.			St	er	ili	zec	j					U	ns	te	rili	ze	d			Soils	
(C B A	at 0.05	R. solani + G2	R. solani + G1	R. solani	F. solani + G2	F. solani + GI	F. solani	G. australe (G2)	G. macrocarpum (G1)	Control	R. solani + G2	R. solani + GI	R. solani	F. solani + G2	F. solani + GI	F. solani	G. australe (G2)	G. niacrocarpum (G1)	Control		Treatments	
% Healthy survival plants (A) = N.S (B) = N.S (C) = 0.44 AB = 0.29 AC = N.S BC = N.S ABC = N.S		41.7	58.4	20.9	37.5	58.4	29.2	100	100	100	33.3	62.5	29.2	41.7	50.0	33.3	83.3	83.3	91.7	plants %	Healthy survival	
surviva (A) (B) (C) AB AC AC ABC		53.5	32.5	55.0	25.0	22.5	72.5	0.00	0.00	0.00	71.8	15.0	52.5	50.0	25.0	52.5	15.0	10.0	10.0	%	Root	
al plants N.S N.S N.S 0.44 0.29 N.S N.S N.S		26.52	23.77	19.75	33.97	22.12	19.77	24.70	23.57	19.62	24.72	23.87	12.70	36.60	16.20	17.45	15.67	21.50	15.37	(cm)	Plant height	ଦ
3 0 0 4 0 0 0		19.75	16.70	12.10	20.50	14.32	14.75	23.65	14.37	11.15	20.17	15.12	10.25	20.62	12.25	8.25	22.3	11.05	12.35	(cm)	Root	iza
, b		55.8	14.8	20.6	55.3	14.4	15.2	49.5	15,4	14.7	46.70	18.10	15.60	42.40	27.20	15.70	23.35	31.80	14.90	weight (g)	Shoot dry	12
Root-rot (A) = N (B) = N (C) = 2. AB = N AC = N BC = 12 ABC = N	-	56.78	36.60	52.47	80.00	36.50	29.30	56.12	43.50	78.20	95.60	51.70	32.90	87.09	26.70	34.50	75.00	42.15	35.5	weight (g)	Root	
-rot = N.S =		11.25	8.000	4.500	10.36	8.500	5.500	8.750	9.000	10.75	5.800	10.25	4.500	8.500	10.00	4.750	10.90	11.75	13.00		No. of leaves	
Plar (A) (B) (C) AB AC BC		37.5	50.0	16.7	62.5	58.4	20.9	100	100	100	45.8	62.5	33.3	66.7	20.9	29.2	66.7	83.3	83.3	pianis %	Healthy	
		55.0	15.0	65.0	57.5	25.0	82.5	0.00	0.00	0.00	60.0	15.0	80.0	60.0	7.50	52.5	22.5	15.0	15.0	%	Root	
eight N.S 1.30 2.70 2.70 N.S N.S N.S 2.89		23.20	23.05	17.90	24.07	16.37	19.60	24.10	24.20	20.50	27.70	19.80	18.20	27.02	13.80	15.70	30.40	25.70	22.80	(cm)	Plant height	Rib
		19.45	15.37	13.65	21.40	10:35	10.00	19.25	15.20	13.35	20.37	13.20	14.20	20,77	13,30	12.12	22.30	12.60	10.92	(cm)	Root	
Root (A) (B) (C) AB AC BC ABC		55.0	17.4	11.8	51.5	13.6	19.3	67.7	21.8	24.0	47.7	56.6	41.9	54.6	62.5	36.5	53.9	13.1	14.8	weight (g)	dry	40
		91.00	33.40	58.20	61.50	44.30	55.50	74.50	50.90	28.60	69.70	51.00	33.20	75.10	22.40	33.60	74.30	50.40	41.00	weigh t (g)	dry	,
length = N.S = S.28		10.8	5.00	4.25	9.80	5.00	4.25	8.17	7.25	10.5	10.3	9.75	6.25	9.42	6.10	6.00	9.77	11.0	7.50		leaves	,



growth of faba bean Giza 2 cv. in unsterilized soil. Effect of inoculation with G, macrocarpum (GI) and G, australe (G2) on plant (M: Mycorrhizae C: without Mycorrhizae).



growth of faba bean Ribaya 40 cv. in unsterilized soil. (M: Mycorrhizae C: without Mycorrhizae). Effect of inoculation with G. macrocarpum (G1) and G. australe (G2) on plant



 Sterilized uninoculated
 Sterilized inoculated Effect of inoculation of sterilized and unsterilized soils with G. macrocarpum: (M) unsterilized inoculated

(C) unsterilized uninoculated

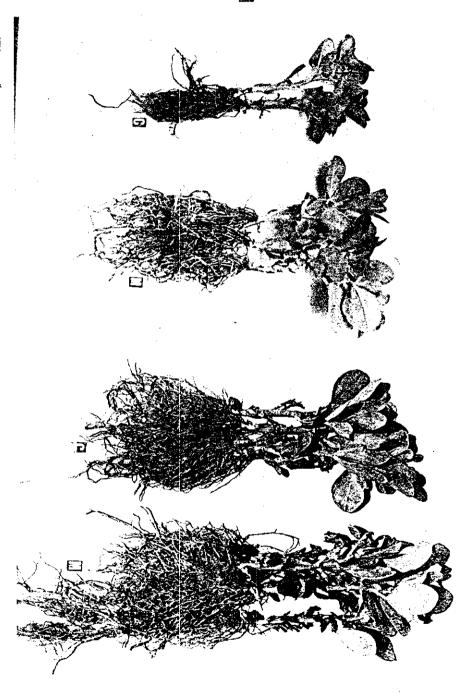


Fig. (4): Effect of inoculation with G. unstrale VA-mycorrhizae on plant growth of Ribaya 40 cultivar in: Unsterilized (1) and sterilized soil (2): The noculated soil (C) and the inoculated soil (M).

Data in Table (3) and Figs (5 and 6) show that, addition of VA-Mycorrhizae increased the colonization of VAM in the root of faba bean plants compared with the control (without Mycorrhizae). In this respect, colonization of roots with in sterilized soil was higher than unsterilized soil. Also, the colonization of roots with *G. macrocarpum* was higher than *G. australe* for the two cultivars. These results are in agreement with Kucey and paul (1983).

4- Effect of inoculation with VA-Mycorrhizae on infection by F. solani and R. solani as well as some growth characters of faba bean plants in unsterilized and sterilized soil:-

Data in Table (2) and Fig. (7) show that, soil inoculated with *R. solani* or *F. solani* gave the least percentage of healthy survival plants and the highest percentage of root-rot, especially in the sterilized soil for the two cultivars Giza 2 and Ribaya 40.

Addition of VA-Mycorrhizae increased the percentage of healthy survival plants and decreased the percentage of root-rot in the presence of *R. solani* or *F. solani* in comparison with those infected with *R. solani* or *F. solani* singly in both soil. This trend was clearly observed when *G. macrocarpum* was used, while *G. australe* was less effective. In this regard, many investigators found that, Mycorrhizal fungi protected the root against infection by root-rot fungi and improved host resistance through plant metabolism (Davis, 1981; Dehne, 1982; Schnôbeck,1987). On the other hand, several authors noted greater damage of Mycorrhizal plants by soil-borne fungi (Ross, 1972; Davis *et al.*, 1978 and Davis and Menge, 1980). Under the direct influence of Mycorrhizal fungi, root tissue would became more resistant to pathogenic attack or would be less suitable for parasitic organisms.

Table (3): Effect of inoculation with mycorrhizae and F. solani or R. solani on root infection with VA-Mycorrhizae for faba bean two cultivars.

			(Culti	vars		
Soil	Treatments	(Giza 2		R	ibaya 4	40
		A	V	M	A	V	M
	Control	0	0	0	0	0	0
pa	G. macrcarpum (G1)	28.3	21.2	13.7	21.5	11.5	10
Unsterilized	G. australe (G2)	14.3	17.1	9.5	23.7	16.2	12
Ē	F. solani + G1	15.8	12	7	24.2	16	11
ste	F. solani + G2	85	44	15.6	77.5	72.7	10.5
n O	R. solani + G1	11.8	11	6.5	27	24	15
	R. solani + G2	15.5	11.25	5.5	7.25	19.7	14.5
	Control	0	0	0	0	0	0
	G. macrcarpum (G1)	27	23	12.6	31.7	15.5	9.15
ਰ	G. australe (G2)	17.5	18.7	12	11.7	17	13.5
Ze	F. solani + G1	19	15.2	14.5	12.7	13.5	15.7
	F. solani + G2	90	26.3	10	54	32.2	8
Sterilized	R. solani + G1	12.3	9.25	7	17.5	12	9.5
<u>\scripts</u>	R. solani + G2	10.7	16.5	19	14.2	18.7	13.7
			<u> </u>		<u> </u>		

A = Arbuscular (Large spores)

V = Vesicular (Small spores)

M = Mycelium



Fig. (5): Colonization of faba bean roots with G. macrocarpum planted in sterilized soil. (1200 X)



Fig. (6): Colonization of faba bean roots with G. australe planted in sterilized soil. (1200 X)

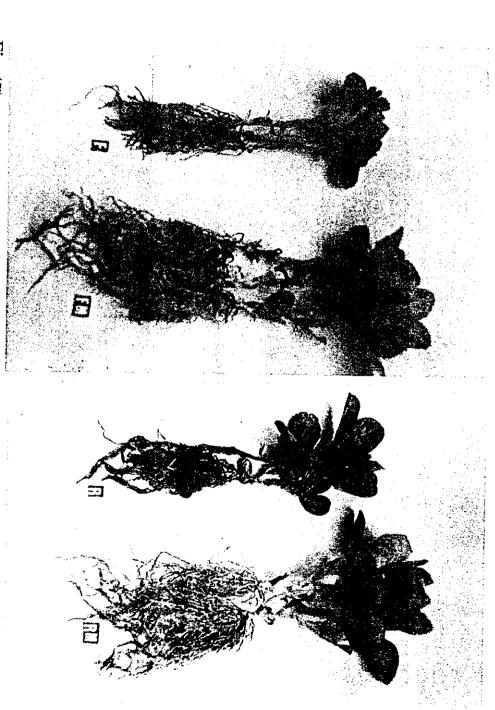


Fig. (7): Effect of inoculation with G. australe VA-mycorrhizae + infection with F. solani (FM) compared with infection with F. solani only (F); infection with R. solani + G. australe (RM) as compared with infection with R. solani only (R).

This included resistance would strictly be limited to the site of the host-endophyte interaction and would only affect soil-borne pathogens. The application of selected VA-Mycorrhizal fungi will not only benefit plant growth and development, but it will offer the possibility of increasing resistance against soil-borne pathogens as well. Also, because VA-Mycorrhizal-fungi and soil-borne fungal pathogen occupy similar root tissue direct competition for space has been postulated as a mechanism of pathogen inhibition by VA-Mycorrhizal fungi (Smith, 1988).

With respect to the effect of infection of faba bean plants by root-rot pathogens (*R. solani* and *F. solani*) and inoculation with VA-Mycorrhizae on plant height, root length shoot and root dry matter, data in Table (2) and Fig. (8, 9, 10, and 11) revealed that infection with root-rot fungi greatly decreased, shoot and root dry weight below the control (uninoculated) in the sterilized and unsterilized soils. At the same time, infection with *R. solani* affected plant height and root length and No. of leaves more than in the case of infection with *F. solani* especially in unsterilized soil whereas, it did not affect plant height and root length.

Addition of VA-Mycorrhizae in the presence or absence of the pathogen caused an increase in plant height, root length, shoot and root dry matter in both soils. The effect of *G. australe* was higher than the effect of *G. macrocarpum*.

Thus VA-Mycorrhizal fungi enhanced plant growth in the absence or presence of the pathogens. It was noted that combined effect of VA-Mycorrhizal fungi and *F. solani* or *R. solani* significantly enhanced the growth of infected plants.

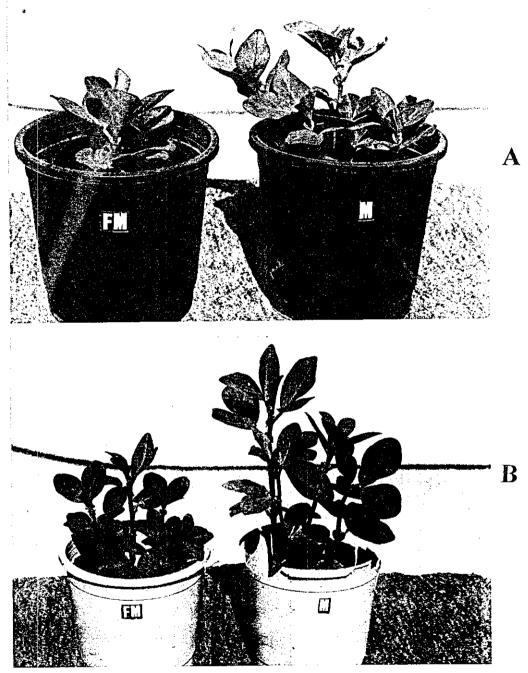


Fig. (3): Effect of inoculation with G. macrocarpum VA-mycorrhizae on plant growth of two cultivars of faba bean Ribaya 40 (A) and Giza 2 (B) in case of infection with F. solani.

(FM: Fusarium + Mycorrhizae M: Mycorrhizae only).

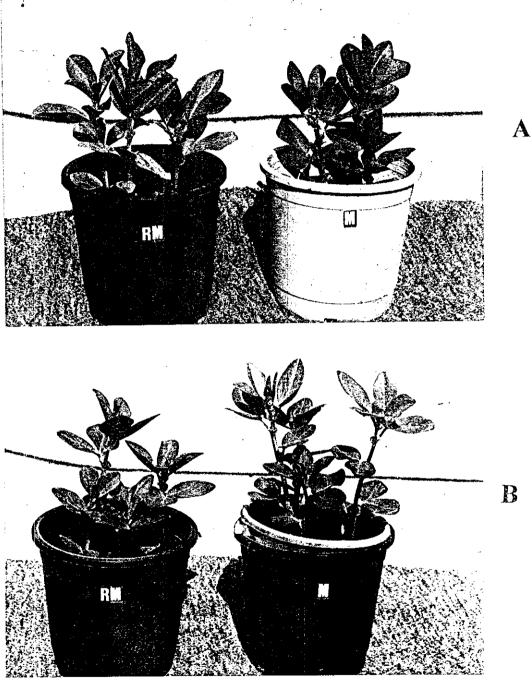


Fig. (9): Effect of inoculation with G. macrocarpum VA-mycorrhizae on plant growth of two cultivars Ribaya 40 (A) and Giza 2 (B) of faba bean in case of infection with R. solani.

(RM: Rhizoctinia + Mycorrhizae M:Mycorrhizae only).

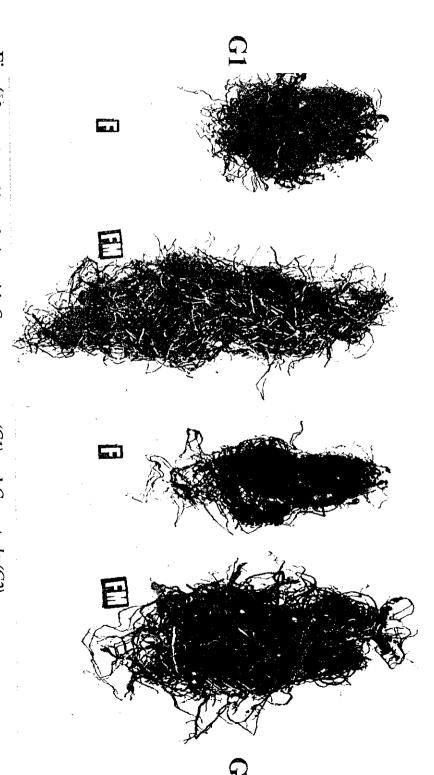


Fig. (40: Effect of inoculation with G. macrocarpum (G1) and G. australe (G2)

VA-mycorrhizae on the growth of the root system of Giza 2cultivar in the presence of infection with F. solani in the sterilized soil.

FM: inoculated with F. solani and Mycorrhizae

F: inoculated with F. solani

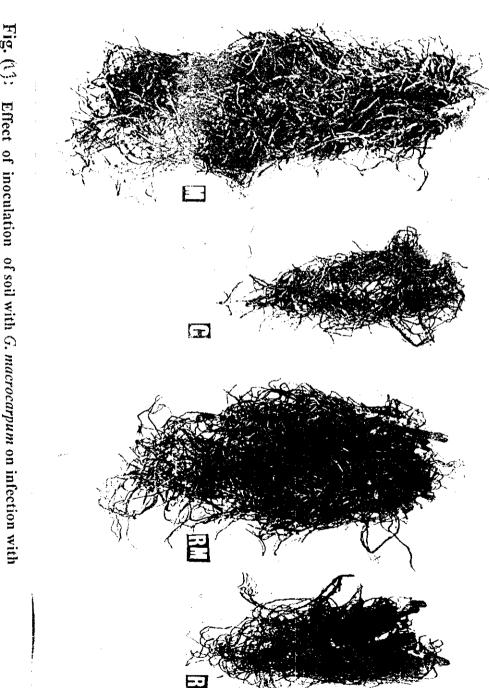


Fig. (1): Effect of inoculation of soil with G. macrocarpum on infection with R. solani for Giza 2 cv. (M) G. macrocarpum (C) Uninoculated soil (RM) R. solani + Mycorrhiza (R) R. solani only.

These results were in agreement with Garcia and Ocampo (1987) and Dehne (1982) who reported that, VA-Mycorrhizae enhanced plant development and growth.

5-Effect of inoculation with VA-Mycorrhizae and F. solani or R. solani on root colonization with VA-Mycorrhizae:-

Data in Table (3) show that, inoculation of soil with VA-Mycorrhizae increased colonization of VA-Mycorrhizae in roots of the two cultivars. This was higher in the sterilized The number of VAunsterilized soil. than the soil Mycorrhizae in case of inoculation with G. macrocarpum was higher than G. australe in the two soils. Infection with R. solani reduced the number of VA-Mycorrhizae colonization in plant roots with the two species of VA-Mycorrhizae. Whereas, the infection with F. solani increased the number of VA-Mycorrhizae especially in case of inoculation with G. These results agree with those of Singh et australe. al. (1937) who found that, roots of faba beans diseased with Fusarium oxysporum had more VA-Mycorrhizal infection than those of healthy ones. Soil samples from the vicinity of the diseased roots contained more endomycorrhizal spore than did those from healthy roots. Also, Zambolium and Schenock (1983) reported that, R. solani reduced the colonization of Mycorrhizal fungi.

6- Effect of Mycorrhizae G. macrocarpum, G. australe and Rhizobium (R. leguminosarum) on infection by F. solani or R. solani as well as growth characters of faba bean plants in unsterilized and sterilized soil:-

Data in Table (4) and (5) show that, percentage of healthy survival plants in the case of inoculation with *R. leguminosarum* was lower than in case of uninoculation especially in sterilized soil, whereas, the percentage of root-rot was not affected by inoculation.

Addition of Mycorrhizae increased the percentage of healthy survival plants and decreased root-rot with the presence of *F. solani* or *R. solani* as compared with those infected with *F. solani* or *R. solani* singly either in presence of *R. leguminosarum* or not in both soils.

Addition of Mycorrhizae and Rhizobium gave an increase in the root length and number of nodules / plant in both soils for the cultivar Giza 2. In Ribaya 40 they exhibited an increase in the root length, root dry matter, No. of leaves and No. of nodules/plant.

Daft et al. (1985) reported that, varieties of crop plants show different response to Mycorrhizal infection and nodulation. These results are in harmony with Sharma et al. (1990) who found that, all such parameters were superior in Acacia nilotica plants inoculated with both Rhizobium and vesicular arbuscular Mycorrhizal fungi (Gigaspora margarita and Glomus fascuculatum), as compared with those inoculated with each organism separately. Gupta and Punj (1990) also reported similar results.

Table (4): Effect of Mycorrhizae G. macrocarpum and Rhizobium (R. leguminosarum) on infection by F. solani and R. solani as well as some growth characters of faba bean plants in unsterilized and sterilized soil.

Soil Cult		!	St	er	ili	ze	d		. <u> </u>			[Jn	st	er	il	iz	ed					Soils		
Soil type = A % Cultivars = B Treatments = C	† 	s. + R	R. s. + R	- + %	F.s. + GI	R. leguminosarum (R)	P solumi (R s.)	F solani (F s)	Control	R.S. + R + GI	ب ا ا	; - + 3 X	+ ·	. + 3	F.s. + GI	R. leguminosarum (K)	R. solani (R. s.)	F. solani (F. s.)	G. macrocarpum (GI)	Control			Treatments		
% Healthy survival piants (A) = 0.17 (B) = 0.18 (C) = 0.40 AB = 0.25 AC = 0.55 BC = N.S ABC = 0.78	58.4	58.4	54.5	62.5 50.0	50.0	79.2	20.9	29.2	2 20	02.2	7 C	7 5	, U	3 U O. 4	58.4	87.5	29.2	33.3	91.7	95.8	%	plants	Healthy		
y survi (A) (B) AB ABC	32.5	25.0	95.0	450	22.5	0.00	55.0	72.5	2 6	20.0	15.0	77 7	70 O	3 10	, i	5	52.5	52.5	10.0	05.0	70				
val piar = 0.17 = 0.18 = 0.40 = 0.25 = 0.55 = N.S = 0.78	18.00	18.14	13.70	14.10	14.30	24.00	12.10	14.70	14.37	11 15	17 40	19.60	13.00	17.17	15.10	13.10	10.25			12.35	 -	(cm)	Root		
ants 7	51.50	42.30	39.20	39.40	36.50	39.20	52.40	29.30	43.50	\$1.70	20.20	24.30	47.10	64 20	1 60	36.30	50.30	34.40	42.20	35.50	(g)	marter -		C1122	
	10.00	19.15	17.15	19.80	23.10	24.80	19.35	19.70	23.80	19 60	15.50	14.70	14.80	16.40	23.90	16.00	17.70	17.40	21.50	15.37	,	(cm)	Shoot	7	ı
	10.0	19.20	17.90	16.15	14.40	07.60	20.60	15.20	15.10	13.80	12.50	09.00	14.30	14.00	18.70	13 10	17.50	15.70	30.70	14.90	<u>(a)</u>	matter	Shoot		
% R (A) AB AC AC AC AC		06.50	07.00	08.50	08.00	09.30	04.50	05.50	09.00	10.80	07.70	09.00	05.00	07.00	10.70	10.00	07.30	2 50	11./5	13.00		Carca	No. of		
% Root-rot (A) = 5.05 (B) = N.S (C) = 7.20 AB = N.S AC = N.S BC = N.S ABC = 2.43		01.17	00.69	00.85		01.20		-			01.07	00.70	00.37	00.37	-		00.80					/plant	nodules		
' A		54.20	54.20	16.60	50.00	79.20	16.70	20.90	91.70	100	41.70	66.70	62,50	50.00	62.50	50.00	79.20	20.20	30.50	91.70		plants	survival	Hglthv	
		30.0	37.5	77.5	82.0)))))	65.0	82.5	10.0	0.00	15.0	15.0	92.5	82.5	07.5	07.5	20.0	07.5	7 6	10.0			TO#		
1.24 1.24 2.78 N.S N.S		21.15	17.60	13.90	05.30	10 14.2	13.60	10.00	15.20	13.35	20.7	18.4	18.5	10.4	13.3	13.3	19.3	13.2	17.1	10.9			length	Root	$\mathbb{R}^{ }$
		65.90	32.20	92.50	38.04	34.00 44.60	58.20	55.50	50.90	28.50	24.4	30.0	52.3	32.1	19.2	40.7	23.3	19,2	33.7	30.9	3 (3)	matter	φŢ	_ Ł	ibaya
		23.50	20.80	11.80	23.05	16.37	17.90	10.60	24.20	20.50	23.5	18.5	20.8	15.8	19.8	14.4	22.3	19.8	15.7	20.7	١	(cm)		oot	a 40
		 	15.00	11.40	17.50	11.50	14.70	20.00	21.90	23.90	14.03	14.02	13.10	13.04	16.20	28.00	13.80	16.20	14.02	13.13	A 19	matter	dry	Shoot	0
Root (A) (B) AB AC BC ABC		╁╼	08.00			05.10	08.20	04.23	07.30	10.50	06.50	08.30	05.80	04.80	09.80	06.00	07.00	09.80	06.25	11.00	25		leaves	No. of	
	-	-	00.90				02.30				01,00	20.70	00.80	00.70		1	01.40	-				/pian	nodules	No. o.	

Table (5): Effect of Mycorrhizae G. australe and Rhizobium (R. leguminosarum) on infection by F. solani and R. solani as well as some growth characters of faba bean plants in unsterilized and sterilized soil.

-			1
Soil Culti Treat	Sterilized	Unsterilized	Soils
type = A vars = B ments = C	(F. S.) nosaru i i i i i i i i i i i i i i i i i i i	Control G. macrocarpum (G1) F. solani (F. s.) R. solani (R. s.) R. leguminosarum (R) F. s. + G1 F. s. + G1 R. s. + R	Treatments
% Healthy survival plants (A) = N.S (B) = 0.26 (C) = 0.58 AB = N.S AC = N.S BC = 0.83 ABC = N.S	100 100 29.2 20.9 87.5 37.5 41.7 41.7 33.3 41.7 50.0	95.80 91.70 33.30 29.20 83.30 41.70 33.30 58.40 50.00 33.30 62.50	Healthy survival piants
ABC (G) (B) (Survi	00.0 00.0 72.5 55.0 00.0 25.0 35.0 70.0 45.0 75.0	05.0 10.0 52.5 52.5 52.5 10.0 50.0 71.8 45.0 30.0 27.5 25.5	Root rot %
val plan = N.S = 0.26 = 0.58 = N.S = N.S = N.S	11.15 23.65 14.75 12.10 24.00 14.32 16.70 14.10 13.70 18.60	12.3 22.3 8.25 10.2 13.1 12.25 15.1 16.5 13.9 19.6	Root length (cm)
3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	51.7 56.17 29.3 52.4 39.2 36.6 39.4 87.7 42.8	35.5 75.0 34.4 32.8 59.3 26.7 42.6 46.2 47.1 24.4 85.3	Giza Root Sh dry he matter (c (g)
-	19.60 24.07 19.70 19.30 24.80 22.12 23.80 19.80 17.15 19.15 23.13	15.3 15.6 17.4 14.7 17.5 46.2 23.8 16.4 17.1 24.7 20.7	Za 2 Shoot height (cm)
	13.80 49.50 15.20 20.60 07.60 14.40 16.15 17.90 19.30 12.90	14.9 23.3 15.7 15.69 16.5 12.3 18.7 14.07 14.07 14.2 24.7	Shoot dry matter
% R. (A) (B) (C) AB AC ABC ABC	10.8 08.7 05.5 04.5 09.3 08.0 08.0 08.5 07.0 06.5	13.0 10.9 4.7 4.5 7.3 10.0 10.7 7.0 5.9 17.78	No. of leaves
% Root-rot (A) = 5.07 (B) = 5.06 (C) = 19.5 AB = N.S AC = 16.03 BC = N.S	11.2 0.2 0.67 11.27 11.17	0.8 0.8 0.3 0.4 9.0	No. of nodules /plant
ω	100 100 20.9 16.7 79.4 66.7 37.5 41.7 50.0 50.0	91.7 91.7 29.2 20.9 79.4 66.7 45.9 50.0 54.2 41.7	Healthy survival plants
Shoot height (A) = (B) = (C) = AB = AC = BC = ABC =	90.0 90.0 82.5 75.0 57.5 57.5 57.5 52.5 32.5	10.0 10.0 52.5 60.0 10.0 80.0 80.0 62.5 30.0 35.5	Root rot %
ght N.S. N.S	13.35 19.25 10.00 19.25 14.50 10.35 15.27 13.90 17.50 47.20 21.15	10.9 22.3 12.12 14.2 19.3 13.3 13.3 10.47 18.05 18.4 20.7	Root length (cm)
	28.50 47.50 55.50 47.50 34.09 61.50 74.40 39.40 25.60 23.90	38.9 74.3 33.7 33.3 74.9 68.9 25.2 33.7 45.09 28.8	Ribay
	20.5 24.0 10.6 24.1 19.2 16.37 23.05 11.87 20.90 18.20 00.00	22.8 30.4 15.7 18.27 22.3 13.8 17.8 11.9 16.6 15.4 22.2	(cm Shoc
	23.90 67.70 60.00 67.70 14.70 51.60 55.00 12.70 18.80 09.09 00.08	41.4 53.9 14.02 14.09 13.8 50.0 59.3 14.5 20.5 10.25	40 t Shoot dry matter (g)
Root le (A) (B) (C) AB AC ABC	7.25 4.25 7.25 6.80 9.80 10.8 5.30 8.10 0.80	7.25 9.77 6.00 6.25 7.00 9.40 10.3 5.50 7.70	No. of leaves
I I I I I I I I I I I I I I I I I I I	2.3 2.3 0.8 0.7 0.8	11.0 0.4 0.5	No. of nodules /plan

7- Effect of inoculation with Rhizobium (R. leguminosarum) on root colonization with VA-Mycorrhizal fungi (G. macrocarpum and G. australe) in present of F. solani or R. solani.

Data in Table (6) show that root colonization with VA-Mycorrhizal fungi (G. macrocarpum) or G. australe in sterilized soil was higher than in unsterilized soil. Combined inoculation with Rhizobium (R. leguminosarum) along with VA-Mycorrhizae increased root colonization with VA-Mycorrhizae more than inoculation with mycorrhizae alone.

Inoculation with VA-Mycorrhizae, Rhizobium and F. solani or R. solani gave an increase in the root colonization with VA-Mycorrhizae and Rhizobium or with any of the pathogenic fungionly. Thus, inoculation with Mycorrhizae G. macrocarpum or G. australe and Rhizobium (R. leguminosarum) increased root colonization with VA-Mycorrhizae in both healthy and diseased plants.

These results are in harmony with those of **Daft** and **El-Giahmi** (1975) and **Ganry** *et al.* (1982).

8- Effect of Mycorrhizae (G. macrocarpum) and seed dressing with fungicides on the infection with F. solani and R. solani, also effect on some growth characters of faba beans:-

The use of fungicides to control soil-borne pathogens is common. Concern is developing among agriculturists about the effects of the use of fungicide on the beneficial Mycorrhizal fungi. The benefits of fungicides (in increasing crop growth via destruction of pathogenic organisms) may be reduced because they also destroy Mycorrhizal fungi and thereby reduce nutrient uptake by crops. The purpose of these experiments was to illustrate

Table (6): Effect of inoculation with Rhizobium (R. leguminosarum) on root infection with mycorrhizae (G. macrocarpum or G. australe) and F. solani or R. solani for two cultivars of faba bean.

			(Culti	vars		
Soil	Treatments	G	iza 2)	R	ibaya 4	0
		A	V	M	A	V	M
	Control						
	G. macrcarpum (G1)	17	13	12.26	21.5	11.7	10.7
,	G. australe (G2)	14.3	17	9.5	17.5	18.7	12
g	Rhizobium + G1	29.2	25.6	11.5	36.5	28.3	16.7
Unsterilized	Rhizobium + G2	17	13.2	10.3	20.3	19.2	17.4
≒	F. solani + G1	15.7	12	7	18.3	12	9.2
te.	F. solani + G2	85	44	15.8	90	26.3	9.8
nS1	R. solani + G1	16.7	11	6.5	12.8	13.5	15.8
	R. solani + G2	15.5	11.2	5.5	10.7	16.5	19
	F. solani + R + G1	11.7	7. 5	1.5	11.7	7.5	1.5
	F. solani + R + G2	17	30.8	9	15.6	26.3	9.8
	R. solani + R + G1	11.5	33.2	17.8	19.5	33.2	17.8
	R. solani + R + G2	57.5	86.5	14.8	10.7	16.5	19
	Control						
	G. macrcarpum (G1)	28.3	21.3	13.7	31.7	15.5	0.8
	G. australe (G2)	23.7	16.7	12	31.7	15.5	9
ا 🚐	Rhizobium + G1	39.3	28	9.2	45.3	34.2	19.1
rilized	Rhizobium + G2	34.5	26.3	17.1	42.3	33.4	20.5
iz	F. solani + G1	19	15.2	14.5	27	2.4	15.2
=	F. solani + G2	77.5	72.5	10.5	54	32.3	8
er	R. solani + G1	12.2	9.3	7	24.3	16	11.1
Ste	R. solani + G2	7.2	19.3	14.3	7.25	19.7	14.5
	F. solani + R + G1	78.7	78.2	13.5	36.3	21.8	15
1	F. solani + R + G2	27.3	19	12	28.3	27	17.8
	R. solani + R + G1	29.7	27.5	11.5	34.8	28.5	19.7
	R. solani + R + G2	28	39.8	9.5	32.5	39.8	21.5

A = Arbuscular (Large spores)

V = Vesicular (Small spores)

M = Mycelium

the interaction between Mycorrhizal fungi and fungicides in the presence or absence of the pathogenic fungi F. solani or R. solani.

Data in Table (7) show that, the highest percentage of healthy survival plants was obtained in the uninoculated sterilized soil in the case of The lowest percentage was G. macrocarpum and Benlate 50 treatments. obtained in the case of R. solani and F. solani treatments. Seed dressing with Benlate 50 gave an increase in the percentage of healthy survival plants especially in the sterilized soil. Similar results were obtained by Abdel- Gallel (1977), Hassanien (1978) and Venkalasubboiah and Muthapa (1981) who reported that, Benlate 50 reduced disease incidence of R. solani. Addition of Mycorrhizae to soil and seed dressing with fungicides, Benlate 50 and Mancoper decreased the percentage of healthy survival plants and increased root-rot infection in comparison with the same treatments without adding The effect of Benlate 50 on Mycorrhizae was higher than the Mycorrhiza. Bootman et al. (1978) reported that, Benomyl was effect of Mancoper. especially toxic to VA-Mycorrhizal fungi and caused stunt to onions and strawberries by reducing Mycorrhizal infection and ultimately P uptake.

Data in Table (8) and Figs (12, 13 and 14) show that, Benlate 50 reduced plant height and root length and the number of leaves especially in the sterilized soil. On the other hand, Mancoper exhibited an increase root length and shoot height with Giza 2 cv. only. Seed dressing with fungicides caused an increase in root and shoot dry matter of both healthy and diseased plants especially in the case of Ribaya 40. Harfoush (Dorrya) (1975) reported that, Benlate at the low rate of 0.59/kg seeds or below stimulated shoot and root length of healthy in comparison with diseased plants with an increase of its weight.

Table (7): Effect of Mycorrhizae G.macrocarpum and seed treatment with some fungicides on infection by F. solani and R. solani as well as some growth characters of faba bean plants in unsterilized and sterilized soil.

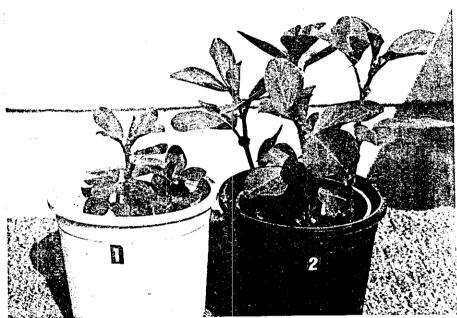
Soil type Cultivars Treatments	L.S.D.			(St	er	·il	iz	e	d	mier PAP	-				1	U	u s	te	er	il	iz	e	d				0	Soils		
type = A vars = B nents = C	L	$R \times +GI + M$	$R_{S}+M$	F. s. + M	Mancoper (M)	R. s. + GI + B	F. s. + GJ + B	F.s. + B	R. solani (R. s.)	F. solani (F. s.)	Benlate 50 (B)	G. macrocarpum (GI)	Uninoculated	R. s. + GI + M	+ 6/ +	R. s. + M	01 + N	Mancoper (M)	R, s , $+GI+B$	F (+G)+B	F.s. + B	R. solani (R. s.)	F. solani (F. s.)	GI + B	G. macrocarpum (G1)	Uninoculated			Treatments		Stermzen som
% Healthy survival plants (A) = N.S (B) = 0.19 (C) = 0.52 AB = 0.27 AC = N.S BC = N.S ABC = N.S		% %	66.7	75.0	95.8	91.7	5 %	91.7	20.9	29.2	75.0	100	100	33.3	46.6	70 O	75.0	95.8	75.0	2 2	100	52.0	33.3	75.0	8.50	95.8	%	plants	Healthy		
surviv (A) AB AC AC AC ABC		111.7	11.7	8.30	6.70	11.7	16.6	10.0	43.1	35.0	2 9	0.00	0.00	20.0	16.6	13.5	0.00	13.3	16,6) 0.0 0.0	11.6	52.5	52.5	000	3 5	10.0	è	۶ ۾	Root		
al plants = N.S = 0.19 = 0.52 = 0.27 = N.S = N.S		12.70	10.60	4,000	22.00	22.90	77.30	7.400	8.500	8.200	7110/	14.37	11.15	12.80	11.16	6.300	14.27	22.80	19.90	0.36.0	12.30	12.70	8.250	15.90	19.30	13.35	,	(cm)	Root	G	
S S S 7 2 9 S is		71 # 22 7	71.4	43.0	27.6	34 5	19.1	60.0	44.4	58.8	11 8	43.5	78.2	61.50	45.10	38.80	40,00	39.10	23.15	18.50	45.40	73.10	50.00	23,40	77.50	35.50	(a)	, J	Root	iZa	
A		11.90	9.300	6.600	21.50	26.40	26.26	1.900	6.500	2.700	26.40	23.50	19.60	11.30	23.30	5.900	12.16	18.13	26.90	17.40	13.00	7.950	12.00	20.26	10.50	15.37		(cm)	Shoot	2	
% Root-rot (A) = 0.9 (B) = 0.8 (C) = 2.6 AB = 1.2 AC = 3.6 BC = 3.6 ABC = 5.2		45.80	33.30	20.00	30 40	19.00	26.00	40.00	37.50	60.00	5 260	15.40	14.70	11.64	21.80	00.00	20.10	11.30	12.80	13.50	77.70	47,60	80.00	12.60	51.90	14.90	(g)		Shoot		
t-rot = 0.98 = 0.83 = 2.60 = 1.20 = 1.20 = 3.60 = 3.69 = 5.20		6.50	4.16	5.33	3.50	8.90	8.90	7.10	2.50	3.50	9.26	9.90	10.7	6.10	5.30	4.70	10.5	8.50	7.20	9.20	5.30	5.80	5.00	6.60	6.80	13.0		Jeaves	No. of		
Shoot (A) (B) (C) AB AC AC BC ABC		54.2	20.9	20.9	66.7	75.0	54.2	87.5	16.7	20.9	75.3	9 00	100	66.7	66.7	16.7	45.8	62.5	66.7	公 ;;	91.7	16.7	20.9	66.7	95.8	91.7	*	plants	Healthy		
		5.00	10.0	3.30	00.0	11.7	10.0	6.70	65.0	82.5	00.0	3.0	0.00	5.00	6.70	5.00	7 20	16.7	15.0	15.0	10.3	45,0	43.1	10.0	00.0	10.0		\$ \$	Root		
height = N.S = 2.0 = 3.0 = N.S = 3.0 = 4.1 = 4.3		10.80	08.00	07.60	17.20	12.80	20.80	16.50	08.00	10.00	18.20	15.20	13.35	11.60	16.30	00.80	73 15	11.03	19,80	23.40	01.10	01.50	08.20	17.20	29.00	10.92		(CIT)	Root	Ribay	
		 	1 1 2 2 6 2	72.70	70.00	31.30	17.30	32.30	78.40	55,50	19.90	71 00	28.60	76.0	55.8	57.1	80.0	43.9	21.2	19.5	25.0	21.4	28.6	14.2	7.60	41.0	(g)	matter	Root)ava	
Re Al		11.36	11.70	07.60	12.70	16.20	16.30	98.00	06.30	10.60	13.80	10.70	20.50	9.66	15.4	2.70	5.00	12.7	16.9	14.1	6.16	3.30	6.30	10.3	17.5	20.7	<u> </u>		Shoot	-1	,
Root length (A) = 1.28 (B) = 1.28 (C) = 3.30 (AB = N.S AC = 4.70 BC = 7.30 ABC = 6.70		20.0	53.0 21.7	85.0	12.7	22.6	10.7	42	69.8	19.3	10.1		24.0	12.2	30.8	33.3	33.3	25.0	13.8	22.7	53.8	37.5	55.5	33.3	8.40	1 A	íg)	matter	Shoot		
ength = 1.28 = 1.28 = 3.30 = N.S = 4.70 = 7.30 = 6.70		07.96	07.06	26.00	07.08	11.10	10.00	03.50	04.00	04.25	07.66	07.10	10.50	10.00	07.86	01.30	16.00	10.56	10.80	8.060	2.660	2.500	2.500	2.300	5.600	11.00			No. ol		

Table (8): Effect of Mycorrhizae G. australe and seed treatment with some fungicides on infection by F. solani and R. solani as well as some growth characters of faba bean plants in unsterilized and sterilized soil.

L.S.D. at Soil type Cultivars Treatments	Sterilized	Unsterilized	Soils
= B C 0.05	Unin G. an Benh G. an R. so R.	Uninoculated G. australe (G2) Beniate 50 (B) G2 + B F. solani (F. s.) R. solani (R. s.) F. s. + B R. s. + B R. s. + G2 + B Mancoper (M) G1 + M F. s. + G2 + M R. s. + G2 + M	Treatments
% Healthy survival plants (A) = N.S (B) = 0.19 (C) = 0.50 AB = 0.27 AC = N.S BC = N.S ABC = N.S	100 100 45.8 20.9 16.7 75.0 62.5 50.0 45.8 79.2 20.9 04.2 50.0	95.8 91.7 95.8 87.5 23.3 25.0 95.8 91.7 62.5 50.0 45.8 62.5 20.9 20.9	Healthy survival plants
surviv (A) (B) (C) AB AC AC ABC	0.00 0.00 0.00 37.5 35.0 45.0 14.2 16.5 05.0 12.5 08.8 30.8 55.0	00.0 00.0 05.0 112.5 40.0 65.0 00.0 110.0 37.5 37.5 72.5 72.5 72.5 73.8 62.5	Root rot %
al plants = N.S = 0.19 = 0.50 = 0.27 = N.S = N.S = N.S	11.15 20.30 12.10 20.30 08.50 09.70 08.50 13.20 15.40 15.40 03.80 115.80 115.80	12.5 12.2 03.8 16.2 08.5 11.7 12.0 12.4 21.2 13.5 19.6 09.3 05.5	Root length (cm)
3 3 7 7 9 9 5 8	78.20 79.20 73.00 79.20 50.60 46.40 58.80 69.20 78.90 73.30 73.30 66.60 69.40	35.50 20.70 71.00 75.70 43.70 38.80 50.00 73.10 68.05 74.60 70.90 69.09 52.90 37.50 64.50 73.20	Giza t Root h dry matter (g)
% Ro (A) (B) (C) AB AC ABC	19.6 34.7 18.4 34.7 02.8 07.9 02.7 06.5 13.2 18.5 30.9 23.9 7.50 09.0 92.8	18.10 16.20 19.10 29.70 115.20 10.50 11.50 07.95 31.70 18.90 33.50 20.60 19.90 04.50	Shoot height (cm)
0	14.70 69.50 75.80 69.50 60.00 47.50 60.00 37.50 60.40 70.60 63.20 71.30 88.90	20.20 27.20 51.20 51.20 76.80 79.00 69.50 80.00 47.60 70.30 86.50 84.70 79.08 26.08 55.40 72.60	Shoot dry matter
= N.S	10.70 08.10 04.80 08.10 03.60 02.90 35.00 02.70 06.30 06.30 06.30 06.00 05.67	9,0 10,0 6,6 7,3 6,1 5,0 5,0 5,0 5,0 7,5 7,5 7,5 9,8 9,8	No. of leaves
Shoo (A) (B) ABC ABC	100 100 100 62.5 08.3 04.1 62.5 54.2 29.2 29.2 25.0 58.4 25.0 20.9 20.9 25.0	91.7 87.5 91.7 91.7 25.0 20.9 20.9 20.9 20.9 20.9 20.9 20.9 20	Healthy survival plants %
₹ 1	00.0 06.0 16.8 43.2 45.1 32.5 51.0 60.0 45.0 65.0 65.0 65.0	12.5 10.0 00.0 04.5 42.4 45.0 09.0 12.5 51.0 32.5 14.2 16.8 07.3 00.5	Root rot %
theight = 1.69 = 1.90 = N.S = 6.33 = 6.33 = N.S	13.3 20.5 17.9 20.3 09.6 08.5 08.5 13.7 18.0 20.8 25.9 07.5 08.5	10.9 22.3 29.0 13.3 08.1 02.0 00.8 06.0 17.3 15.1 14.2 52.6 60.0 60.0	Root Root length (cm)
	28.60 67.70 52.08 06.17 60.60 78.40 91.80 51.30 66.90 61.80 74.07 47.40 95.10	41.0 74.3 60.6 77.0 28.0 20.1 28.6 21.4 08.0 61.7 80.3 25.0 05.0 02.0 23.8	Ribaya Root Root dry (cm) matter (g)
π p	20.5 23.7 20.9 20.9 23.7 11.6 09.3 10.2 08.3 20.0 20.5 27.6 07.8 05.3 277.2	22.8 30.1 13.12 30.40 06.50 03.50 03.30 06.30 29.90 22.80 25.00 05.00 02.00 25.80	40 Shoot height (cm)
Root length (A) = N.S (B) = N.S (C) = N.S AB = N.S AC = N.S BC = N.S ABC = N.S	24.00 49.18 49.18 49.50 19.50 60.80 69.70 61.20 51.20 51.20 58.18 51.70	53.9 48.3 55.8 55.5 37.6 33.3 55.5 55.8 55.8 55.8 55.8 55.8 55.8	Shoot dry matter (g)
H H H H ZNS	10.50 06.30 06.30 04.50 03.50 05.50 04.00 15.30 15.30 05.50 05.50 05.50 05.50 05.50 05.50 05.50	7.50 9,77 4.90 7.90 3.50 2.50 2.150 7.15 7.70 5.28 6.10 2.00 2.00 4.50	No. of leaves



- 1- Sterilized soil + untreated seeds
- 2-Sterilized soil treated with G. macrocarpum

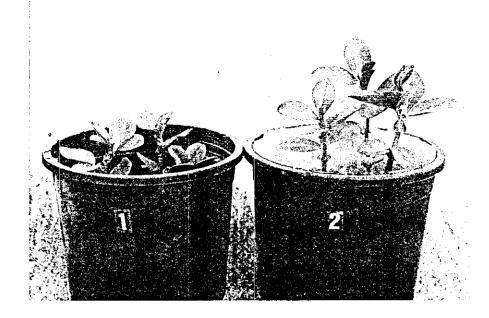


- 1- Sterilized soil + treated seeds with Benlate
- 2- Seeds treated
 with Benlate +
 Soil treated
 with
 G. macrocarpum



- 1- Sterilized soil + treated seeds with Mancoper
- 2- Seeds treated with Mancoper + Soil treated with G. macrocarpum

Fig. (12): Effect of seed treatment with fungicides and Mycorrhizae on plant growth of Ribaya 40 cv.



- 1- Sterilized soil + untreated seeds
- 2- Sterilized soil inoculated with F. solani + G. macrocarpum



- 1- Sterilized soil + treated seeds with Benlate
- 2- Seeds treated with Benlate + Soil inoculated with F. solani + G. macrocarpum

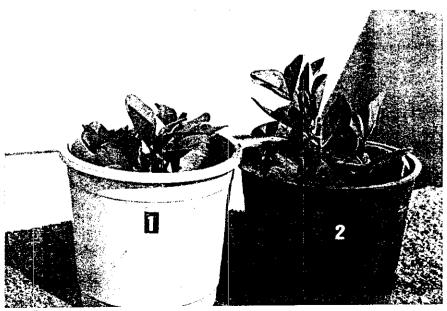
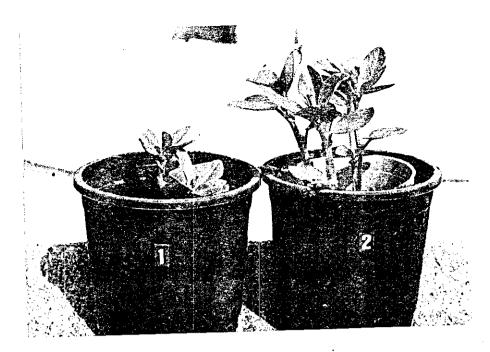
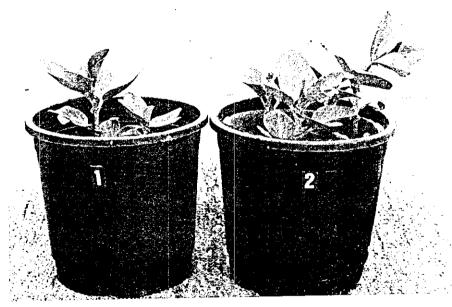


Fig. (13): Effect of seed treatment with fungicides and soil inoculation with *F. solani* and *G. macrocarpum*.

- 1- Sterilized soil + treated seeds with Mancoper
- 2- Seeds treated
 with Mancoper +
 Soil inoculated
 with F. solani +
 G. macrocarpum



- 1- Sterilized soil + untreated seeds
- 2- Sterilized soil inoculated with R. solani + G. macrocarpum



- 1- Sterilized soil + treated seeds with Benlate
- 2- Seeds treated
 with Benlate +
 Soil inoculated
 with R. solani +
 G. macrocarpum



- 1- Sterilized soil + treated seeds with Mancoper
- 2- Seeds treated with Mancoper + Soil inoculated with R. solani + G. macrocarpum

Fig. (124): Effect of seed treatment with fungicides and soil inoculation with R. solani and G. macrocarpum.

Seed dressing with Benlate 50 using Mycorrhizae G. macrocarpum in the absence of pathogens exhibited a decrease in root length and shoot height and increased root and shoot dry matter yield, while Mancoper gave reverse results, similar results were obtained in concerning the percentage of pathogens especially R. solani in sterilized soil. Menge (1982) mentioned that, stunting following fungicides applications would normally be attributed to phytotoxicity and such compounds would be a landed in field screening procedures and therefore would never become commercially available. Also, Boatman et al. (1978) reported that, soil drenches with the systemic fungicides "Benomyl" and "Topsin" caused a stunt to onions and strawberries. He added that, "Benomyl" increased growth of nonmycorrhizal onions, thereby indicating that, it decreased growth of Mycorrhizal plants by inhibiting Mycorrhizal symbiosis and not through Phytotoxicity.

Bailey and Safir (1978) eliminated phytotoxicity as a cause for stunting which they induced on Mycorrhizal soybean with soil drenches of "Benomyl". They attributed the stunting to a reduced effectiveness of the Mycorrhizal association. Stunting in both cases was achieved with soil drenches. "Mancoper "as a non-systemic fungicides was less effective on plant growth than the systemic fungicide "Benlate 50". This may be due to the non-systemic fungicides causing a possible postponement of infection with Mycorrhizae rather than total elimination of infection (Menge, 1982).

Data in Table (8) show that, the Mycorrhizae "G. australe" was not affected by fungicides to the same extent as the Mycorrhizae G. macrocarpum. So, its effect on increasing plant growth was continuos especially in the case of the sterilized soil.

Menge (1982) reported that, some species of Mycorrhizae were more sensitive to some fungicides than others. Also, in sterilized soil, seed dressing with fungicides did not affect on the simulative effect of *G. australe* on plant growth for healthy and diseased plants. On the other hand, *G. australe* stimulated plant growth of Ribaya 40 cv. more than it did with Giza 2 cv. especially in the unsterilized soil.

9- Effect of inoculation with VA-Mycorrhizal fungi and seed dressing with some fungicides on root colonization with Mycorrhizae:-

Data in Table (9) and (10) show that, unsterilized soil, faba bean root colonization with Mycorrhizae G. macrocarpum was higher in case of Giza 2 cv. than in Ribaya 40 cv. Seed dressing with Benlate and Mancoper decreased root colonization with VA-Mycorrhizae for the two cultivars and in the presence of infection with the pathogenic fungi.

In the sterilized soil, seed dressing with fungicides affected root colonization with Mycorrhizae more than in the unsterilized soil. Comparing infection with *R. solani* to infection with *F. solani* and seed dressing with Benlate showed that the first caused more reduction of root colonization with Mycorrhizae. This may be shows a greater inhibition effect of *R. solani* on the plant growth than *F. solani* (Table 8).

Data in Table (9) and (10) show similar results. Root colonization with Mycorrhizae G. australe was higher in the case of sterilized soil than unsterilized soil. Also, colonization of Ribaya 40 cv. with G. australe was higher than in case Giza 2 in unsterilized soil, the reverse was true in the sterilized soil. Soil inoculation with F. solani or R. solani and seed dressing with Benlate 50 or Mancoper exhibited a decrease in root colonization with

Table (9): Effect of seed dressing with some fungicides on root infection with mycorrhizae (G. macrocarpum or G. australe) and F. solani or R. solani for two cultivars of faba bean in unsterilized soil.

			(Cult	ivar	S	
Soil	Treatments	(iza 2	2	R	ibaya -	40
		A	V	M	A	V	M
	Control						
	G. macrcarpum (G1)	28.3	21.25	13.7	21.5	11.15	10
	G1 + Benlate	17.5	21	11.3	11.8	7.8	6.3
	G1 + Mancoper	3.3	3.5	2.3	3.8	2	2.3
7	G. australe (G2)	15.8	12	7	23.7	16.25	12
e.	G2 + Benlate	10	12.3	8.3	9	10	3.5
sterilized	G2 + Mancoper	2.5	11.3	4.5	1.8	1.5	1.8
ı.ı	F. solani + G1 + B	13.8	1	3.8	15	6	9
ste	F. solani + G1 + Mn	5.5	5	1.3	7.3	8.5	1.3
=	F. solani + G2 + B	11.5	10	3.8	12.5	3.3	7.3
D	F. solani + G2 + Mn	8.8	5	1	3	7.3	1
	R. solani + G1 + B	15.5	6	2	1.5	11.5	2
	R. solani + G1 + Mn	9.3	6	1	1.8	5.5	5
	R. solani +G2 +B	11.3	6.5	1.8	6.66	11	1.8
	R. solani + G2 + Mn	4.3	3	3.5	3.3	3,3	3.8

A = * buscular (Large spores)

V = Vesicular (Small spores)

M = Seelium

R = Profese

Min - Mancoper

Table (10): Effect of inoculation with Rhizobium (R. leguminosarum) on root infection with mycorrhizae (G. macrocarpum or G. australe) and F. solani or R. solani for two cultivars of faba bean in sterilized soil.

			(Culti	var	S	
Soil	Treatments	G	iza 2	2	R	ibaya	40
		A	V	M	A	V	M
	Control						
.	G. macrcarpum (G1)	17	13	12.6	31.7	15.5	9.15
	G1 + Benlate	11.5	5	3.5	8	5.3	3.3
	G1 + Mancoper	6.5	5	3.6	1.5	3.3	1
	G. australe (G2)	17.5	18.7	12	11.7	17	13
e	G2 + Benlate	7.3	3.8	2.5	6	2.3	2
iZ	G2 + Mancoper	4.3	4	2	1.8	1.5	2
ij	F. solani + G1 + B	15	10	5.8	8.6	3.5	2.5
er	F. solani + G1 + Mn	5.3	3.5	1	6.5	5.5	3.3
Sterilize	F. solani + G2 + B	11.3	8.5	4	2.8	2	3.9
	F. solani + G2 + Mn	4.3	3.5	1	6	3.8	2.3
	R. solani + G1 + B	4.5	5.8	1.8	6.3	7.5	6.8
	R. solani + G1 + Mn	3.5	5	3.3	5.3	1.3	1
	R. solani + G2 + B	4	6.8	1.3	2.8	1.5	2
	R. solani + G2 +Mn	3.5	3.2	2	5	2	1

A = Arbuscular (Large spores)

V = Vesicular (Small spores)

M = Mycelium

B = Benlate

Mn= Mancoper

G. australe Mycorrhizae for the two cultivars as shown in Table (9) and (10) for G. macrocarpum. As for the difference between the effect of sterilization and unsterilization of soil.

Hirrel and Gerdemann (1980) reported that, it frequently, appears that Mycorrhizal infection was more vigorous and abundant in fumigated or sterilized than in unsterilized soil. Soil sterilization may be reducing hyperparasites, predators, and compacting plant parasites and thereby encouraging rapid reproduction of VA-Mycorrhizal fungi.

Jalali (1990) reported that, the effect of fungicides on the root colonization with Mycorrhizae, VA-Mycorrhizal development was considerably inhibited by seed treatment with Bavistin [Carbendazin], Captful and Thiram. Nutrient uptake and consequently plant growth were also reduced. Also, fungicides do not usually have adverse effects on VA-Mycorrhizae at the recommended rates. He found that, systemic fungicides were more damaging than non-systemices.

10- Effect of inoculation with VA-Mycorrhizae and fertilization with super phosphate or rock phosphate on infection by *F. solani* and *R. solani* and some growth characters of faba bean plants in unsterilized and sterilized soil:-

Data presented in Table (11), (12) and Fig. (15, 16, 17, 18 and 19) show a comparison between faba bean plant inoculated with VA-Mycorrhizae and fertilized with rock phosphate or super phosphate as a source phosphate. Generally, the percentage of healthy survival plants increased in both Mycorrhizal inoculation and phosphate fertilization treatments compare with plants infected with *F. solani* or *R. solani*, whereas, the percentage of root-rot infection was decreased.



Table (11): Effect of Mycorrhizae and fertilization with super or rock phosphate on infection by F. solani and R. solani as well as some growth characters of faba bean plants in unsterilized and sterilized soil.

Soil t Cultiv Treatm	Sterilized	Unsterilized	Soils
ype = A ars = B ents = C	Contr G. ma R. sol R. s. R. s.	Control G. macrocarpum (GI) F. solani (F. s.) R. solani (R. s.) F. s. + GI R s. + GI GI Rock phosphate F. s. F. s. + GI R. s. + GI R. s. + GI R. s. + GI R. s. F. s.	Treatments
% Healthy survival plants (A) = 0.47 (B) = 0.50 (C) = 0.13 AB = 0.60 AC = 0.10 or - vic	95.8 37.5 20.9 45.8 41.7 69.2 41.7 75.0 66.0 25.0 41.7 75.0 25.0 66.5	l	Healthy survival plants
Surviva (A) AB	00.0 00.0 72.5 55.0 22.5 55.0 00.0 7.50 10.0 63.8 47.5 00.0 32.5 35.0 42.5		Root rot
= 0.47 = 0.47 = 0.13 = 0.10 = 0.10	24.37 14.70 12.10 14.30 12.10 14.30 12.10 30.0 10.8 7.50 20.0 19.8 33.1 9.80 6.30 23.0		Root length (cm)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	43.5 29.3 52.4 36.5 52.4 48.7 40.0 17.3 21.6 63.8 28.16	35.5 42.15 29.3 52.4 26.7 51.7 13.0 31.5 32.7 35.7 19.7 11.9 72.6 75.0 31.3	↓
%	23.57 19.7 19.7 19.7 22.12 19.7 20.0 9.00 9.00 28.9 23.8 23.8 48.3 86.2 20.6	15.3 21.5 19.77 19.77 16.2 23.8 27.6 9.50 12.3 24.1 26.4 10.5 10.5	Shoot beight (cm)
% Root-rot (A) = (B) = (C) = AB = AC = RC =		14.9 15.2 20.6 27.2 18.1 26.0 28.0 10.7 04.5 9.25 9.25 32.6 6.06	Shoot dry matter (g)
rot = N.S = N.S = 11.03 = N.S = 15.59		13.00 11.70 5.5 4.5 10.0 10.25 8.00 8.00 9.70 110.5 110.5 110.5 9.9	
1 % " & .	91.7 33.3 16.7 58.3 50.0 33.3 25.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 7	91.7 29.2 20.9 54.2 62.5 58.4 33.3 41.7 45.9 75.0 45.8 29.2 37.2 66.7 83.3	Healthy survival plants
Shoot (A) (C) AB	00.0 82.5 62.0 25.0 15.0 16.3 27.3 40.5 26.3 27.3 60.0	00.0 52.5 60.0 7.50 7.50 00.0 35.5 35.8 00.0 15.0 25.0 40.0	_1
Shoot height (A) = N.S (B) = N.S (C) = N.S AB = N.S AC = N.S AC = N.S	15.20 10.00 10.30 10.30 15.37 31.30 18.00 11.60 11.60 11.60 11.60 11.60 11.60 11.60 11.60 11.60	12.6 12.12 14.2 13.3 13.2 14.9 20.4 21.6 16.8 27.9 14.5 7.60 17.3 13.3	Rib Root length (cm)
ે જે જે જે જે જે	50.9 55.5 58.2 44.3 33.4 7.30 50.9 46.8 11.1 11.1 42.0 48.4 114.9		Root dry dry (g)
	24.2 10.6 17.9 16.3 23.05 23.8 5.50 10.3 24.3 22.4 21.4 10.5 9.80 19.9	20.7 15.7 18.3 13.8 19.8 20.6 7.80 10.3 15.3 14.5 18.8 13.3 8.50	Shoot height (cm)
Roc	21.8 11.8 13.6 13.6 5 17.4 41.6 5 31.7 31.7 31.7 31.7 31.7 31.7 31.7 31.7		Shoot dry matter (g)
Root length (A) = N.S (B) = N.S (C) = N.S AB = N.S AC = N.S BC = N.S	0 8 0 0 0 0 0		No. of leaves

Table (12): Effect of Mycorrhizae and fertilization with super or rock phosphate on infection by *F. solani* and *R. solani* as well as some growth characters of faba bean plants in unsterilized and sterilized soil.

Soil type Cultivars Treatments			S	tei	ril	iz	e d	 			T			τ	Jn	S	te	ri	li	ze	d					SHOC	2	
at 0.05 ype = A /ars = B nents = C	R.s.	R. s. + G2	G2 Super phosphate	F. s. + G2 R. s. + G2	R. s	G2 Rock phosphate	R. s. + G2	F. s. + G2	F. solani (F. s.)	G. australe (G2)	Control	F. s. + GZ	R. s.	F. S.	G2 Super phosphate	R s + 62	3 20 21	F. S.	G? Rock phosphate	7: s + G2	R. solani (R. s.)	F. solani (F. s.)	G. australe (G2)	Control	-	Treatments	Tunatananta	
% Healthy survival plants (A) = N.S (B) = 0.19 (C) = 0.53 AB = 0.27 AC = N.S DC = 0.73	62.5	33.3 62.5	79.2 33.3	45.8	45.8	91.7 46.7	29.2	37.5	37.5	95.8	1 8	58.4	41.7	25.0	70.9	4) (i	75.0	33.3	79.2	33.3	25.0	33.3	91.7	95.8	%	_	-1	
survivi	20.0	12.5 12.5	00.0 15.0	15.0	12.5	00.0 15.0	12.5	35.0	77.0	8.0	9.00	10.0	22.5	25.0	7.50	12.5	12.5	20.0	<u>1</u> 0.0	37.5	35.0			8.0	%		Root	
val plan = N.S = 0.19 = 0.53 = 0.27 = N.S	28.40	6.000	25.50 14.00	22.30	12.80	18.40 10.80	19.70	20.50	12.10	14.37	11.15	25.70	9.50	12.50	24.30	27.70	15.80			20.18				12.35	(cm)	_	Root	G
\$	22.40	61.30	40.60 22.20	50.60	20.40	50.30 30.20	43.80	51.30	52.40	43.50	78.20	45.80	3.50	93.30	32.40	78.90	47.90	69.60	14.80	82.90	3 2	29.30	42.15	35.50	(g)		Root	Giza
2	14.02	12.80 15.40	13.50 10.30	13.80	12.80	8.800 8.800	26.60	32.90	19.70	23.50	19.60	12.70	9.00	7.00	11.28	14.50	13.50	4.00	12.30	24.70	36.76	19.70	21.50	15.30	(can)	height	Shoot	2
% Root-rot (A) = (B) = (C) = AB = AC	35.20	32.10 37.90	7.400 14.70	74.90	28.30	48.10	89.98	62.20	20.60	15.40	14.70	76.40	10.00	46.70	50.80	48.70	78.00	6.70	78.70	53,40	93.10	15.20	31.80	14.90	(g)	2	Shoot	
t-rot (A) = N.S (B) = 2.16 (C) = 6.13 AB = N.S AC = 8.6	3.500	4.090	3.400	3.900	3.100 4.400	3.500	11.30	8.800	4.500	9.000	10.75	3.600	4 200	3.300	4.080	3.800	39.80	7.500	3,900	3.800	4 900	4 500	11.70	13.00		leaves	No. of	
55 S S	41.7	45.8 29.2	33.3	45.8	37.5 25.0	41.7	37.5	66.7	16.7	91.7 33.3	100	45,40	25.00	37.50	45.80	54.20	58.40	37.50	66.70	45.90	66.70	20.20	87.50	91.70	%	plants	Healthy	
Shoot height (A) = 1.1: (B) = N.5 (C) = 3.6 AB = N.5 AC = N.5 BC = 5.2	20.0	40.0	40.0	30.0	45.0 25.0	40.0	37.5	37.5	65.0	82.0 90.0	00.0	10.0	25.0	27.5	5.00	20.0	27.5	42.2	6.30	32.5	32.5	60.0	3 8	8.0	٤	₹ 3	Root	
neight = 1.10 = N.S = 3.69 = N.S = N.S	20.70	19.05	3.50	16.5	22.9	12.3	19.4	21.4	13.6	15.2	13.3	19.80	19.20	29.40	24.20	13.90	29.40	13.00	26.80	20.30	20.70	14.20	12.60	10.90	311	(cm)		Rib
	88.9		4.37	62.6	90.5	23.1	34.3 91.0	61.5	58.2	55.5	28.6	57.0	63.4	13.5	72.3	90.6	40.5	33,3	78.7	68.4	75.3	33.2	3 .5 . 4	1.0	(g)	<u> </u>	Root	aya
	10.02	9.34	8.50	10.3	8.80	6.40	31.0	24.07	17.9	24.2 10.6	20.5	8.800	8.600	7.290	10.80	10.90	7.290	3.45	11.97	27.07	27.03	18.20	20.70	22.80		(cm)	Shoot	40
Root I (A) (C) AB AC BC	33.5	60.8	48.8	59.7	61.4	34.8	21.6	51.6	11.8	19.3	24.0	46.40	56.18	48.08	50.00	46.80	46.80	36.95	49.70	58.50	50.00	41.90	X 5	14.50	(g)	matter	Shoot	
length) = N.S) = 1.52) = 4.30 B = N.S C = 5.14	4.50	3.76	3.30	3.73	3.34	4.00	21.8	9.40	4.25	4.25	70.5	3.60	3.80	2.30	9.	4.00	3.10	3.30	3.37	10.3	9.40	6.25	ŝ :	7.50		leaves	No. of	





Fig. (15): Effect of inoculation with G. macrocarpum VA-mycorrhizae and fertilization with (A) superphosphate and (B) rock phosphate on plant growth of Giza 2 cv.

(1- Unsterilized soil 2- Sterilized soil).

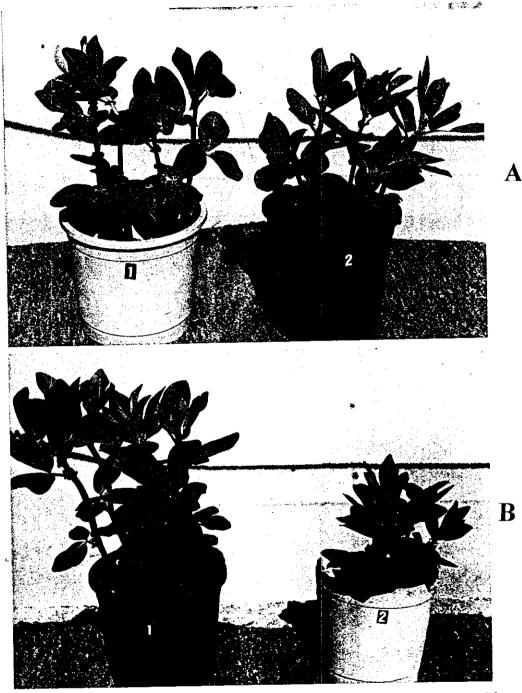


Fig. (1-6): Effect of inoculation with G. macrocarpum VA-mycorrhizae (G1) and fertilization with (A) superphosphate and (B) rock phosphate on infection with F. solani and plant growth of Ribaya 40 cv. (1= Unsterilized soil 2= Sterilized soil).



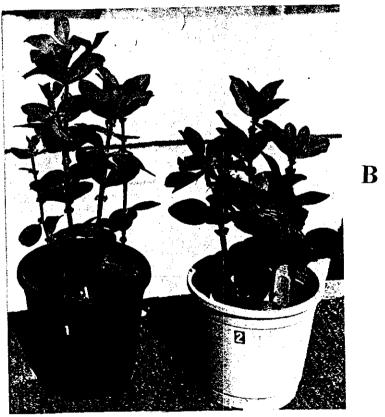


Fig. (17): Effect of inoculation with G. macrocarpum VA-mycorrhizae (G1) and fertilization with (A) superphosphate and (B) rock phosphate on infection with F. solani and plant growth of Giza 2 cv. (1= Unsterilized soil 2= Sterilized soil).





Fig. (1.8): Effect of inoculation with G. macrocarpum VA-mycorrhizae (G1) and fertilization with (A) superphosphate and (B) rock phosphate on infection with R. solani and plant growth of Ribaya 40 cv. (1= Unsterilized soil 2= Sterilized soil).

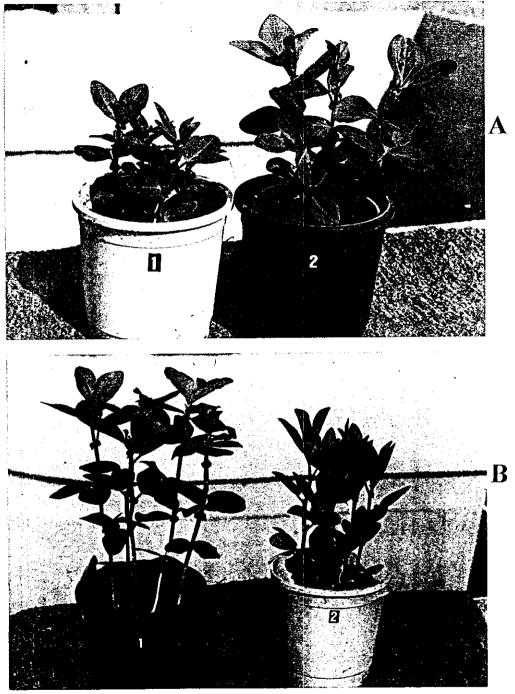


Fig. (19): Effect of inoculation with G. macrocarpum VA-mycorrhizae (G1) and fertilization with (A) superphosphate and (B) rock phosphate on infection with R. solani and plant growth of Giza 2 cv. (1= Unsterilized soil 2= Sterilized soil).

In this respect, the effect of fertilization with super phosphate was similar to that of rock phosphate. Also, the effect of *G. macrocarpum* did not differ from the effect of *G. australe*.

Several reports indicated that, application of phosphate reduced take-all disease of wheat (Reis et al.,1981 and Slope et al.,1978).

Davis and Menge (1980) reported that, when soil phosphate was limiting, the increased tolerance of Mycorrhizal citrus to *Phytophthora parasitica* root-rot gad an indicate effect due to VAM improvement of host **P** nutrition.

Mycorrhizal plants without added phosphate increased plant height, root length and number of leaves to a greater extent than in the non-Mycorrhizal plants.

Infection of beans with *F. solani* or *R. solani* decreased its plant height, root length, number of leaves, root and shoot dry matter, whereas inoculation with Mycorrhizae increased all of these parameters. On the other hand, phosphate fertilization and Mycorrhizae inoculation in the presence of infection with *F. solani* or *R. solani* increased the aforementioned parameters compared with non-inoculation with Mycorrhizae. The effect of super phosphate was the same as that of rock phosphate in the presence of inoculation with VA-Mycorrhizae.

The effect of *G. australe* on plant growth was higher than *G. macrocarpum* and this was obvious in the two faba bean cultivars. Thus, Phosphate along with Mycorrhizae was more effective on the infection with *F. solani* or *R. solani* and plant growth was higher than phosphate alone.

Smith (1988) concluded that, with few exceptions the primary Mycorrhizal symbiosis effect on the host-pathogen relationship is related to improved P nutrition.

Several studies with sedentary endoparasitic nematodes provide the most convincing evidence that VAM fungi may affect the host-pathogen relationship differently from P.

10- Effect of inoculation with VA-Mycorrhizae and phosphate fertilization on root colonization with Mycorrhizae:-

Data in Table (13) and (14) showed that, soil inoculation with VA-Mycorrhizae (G. macrocarpum) or (G. australe) without adding rock or super phosphate fertilization exhibited an increase in the root colonization with VA-Mycorrhizae. Adding rock phosphate gave an increase in the root colonization with Mycorrhizae more than adding super phosphate. Root colonization with Mycorrhizae increased in the case of fertilization of the infected plants with the rock phosphate more than with the super phosphate.

In the connection **Dfvi** and **Sitaramaish** (1990) reported that, inoculation with *G. fasciculatum* in combination with **P** increased percentage Mycorrhizal root colonization, dry weight of root and shoot and some chemical constituents of *Vigna munga* as compared with plants receiving **P** alone and uninoculated. Increased application of **P** decreased the percentage of root colonization. Superphosphate was a better **P** source than rock phosphate for both Mycorrhizal and non-Mycorrhizal plants.

Ames and Linderman (1978) reported that, more Mycorrhizal infection occurred to Easter lily (*Lilium longiflorm*) in the low-fertilizer treatment than in the high-or no-fertilizer treatments at both high and low inoculum levels; but more *F. oxysporum* root-rot occurred in the high-inoculum, high-fertilized treatment.

Table (13): Effect of fertilization with supper phosphate and rock phosphate on root colonization of faba bean. with mycorrhiza (G. macrocarpum) and F. solani and R. solani for two cultivars

	-	Ste	Sterilized Soil	ed S	0il			Unsteri	-	ized Soil	Soil	
Treatments	9	Giza 2	2	Rib	Ribaya 40	40		Giza 2	2	Ril	Ribaya 40	40
	Α	V	M	Α	V	M	Α	V	M	A	V	M
Control	i	1	-	-			-	1	-		1	1
G. macrocarpum (G1)	17	13	12	31.7	15.5	9.1	28.3	21.3	13.7	21.5	11.3	10
F. solani (F. s.)	ŀ	1	1		*		-	1	-	1	1	1
R. solani (R. s.)	ţ	ł	1				İ	ł	ļ	<u> </u>	1	1
F. s. + GI	19	15.3	14.5	12.7	13.5	15.7	15.8	12	7	24.2	16	11
R. s. + GI	12.3	9.3	7	17.2	12	9	16.8	11	6.5	27	24	15
Rock phosphate												
GI	20.5	29.5	1.5	25	30.5	2.5	16.8	32	3.3	17.5	32.5	4.3
F. s.	1	!	-	1		1	1	1		1		1
R. s.	i		1	1	1	 	1	1	1	1	1	
F. s. + GI	7.5	15.3	10.7	7.5	15.8	1.5	15.5	17.5	1.5	17	18	1.5
R. s. + GI	12.3	12.8	2.3	12.3	10.5	1.8	15.5	15	1.3	16.5	14.8	1.8
Super phosphate												
GI	9	6.2	4.3	6.5	5.1	3.2	7.5	12.8	10.5	10.7	17	2
F. s.	ļ	1	1	1	!	i	1	I	l	1	1	1
R. s.	1	l	1	1	1	I	1	ì	1	i		1
F. s. + GI	4.5	21.3	1.5	6	17	4.5	14.8	8.5	75	13.7	15	2
R. s. + GI	6.3	7	1.7	5.5	5	2.3	13	2	1	16	64	1.3
	ŀ								ı			ŀ

A = Arbscular (Large spores)

V = Vesicular (Small spores) M = Mycelium

Table (14): Effect of fertilization with supper phosphate and rock phosphate on root colonization with mycorrhiza (G. australe) and F. solani and R. solani for two cultivars of faba bean.

	İ										,	
		Ster	Zili:	Sterilized Soil	0:1			Unsi	Unsterilized Soil	zed	Soil	
		Ci79 7		R S	Rihava 40	6		Giza 2	2	Rit	Ribaya 40	5
Treatments		<	<u> </u>		<	3	A	V	M	Α	V	X
	7	•	1	;							1	1
Control		:	13.1	31,7	15 15	9 15	25.2	31.6	13.7	20.8	10.6	9
G. australe (G2)	17	13	12.0	31./	10.0	Į.	-			1	!	l
F. solani (F. s.)	1		1	1	1	-		!		1	!	1
R. solani (R. s.)	1	1	;	1	2) 	10.8	ж Л		10.3	8.7	<u> </u>
F. s. + G2	5.8	9.3	2.8	` '	2.3	1 6	13.5	7 6	1.3	11	9.2	17
R. s. + G2	4	4.3	1.3	4.2	0.1	-	10.0					
Rock phosphate		1	ـــــــــــــــــــــــــــــــــــــ	n n	7	1 /ነ	<u>7</u>	30.8	2.5	16.5	29.7	5.25
G2	16.8	25.5	1.5	20.0	10.0	;			1		1	!
F. s.	ł	1	1	ŀ				1	!		i	-
R. s.		1	i	1	3	<u>.</u> 1	3	300	2	19.7	25.8	2
F. s. + G2	12	15	10.3	12.8	2	- i	10.2	2 20.0	٦ ٦	23	21.7	_
R.s. + G2	14	20.3	2.3	10.0	7.5.7	1.0	10:2	27.00	-	1		
Super phosphate	<u> </u>	ρ h	> ×	٦ ٥	7.7		8 5	16	0.8	13	19	0.7
G2	۰	٠			-				1	1	1	1
F. s.			-	1	_ 		<u> </u>		1	ļ		1
R. s.	ŀ	1	<u> </u>	:		٠ ا	144	×	ר ⊃		1	1
F + G2	.5. 8.	18.8	1.8	10	10.7	2.5	14.5	, 0		12 7	17	0.3
B 2 + C3	<u>م</u>	4	2	8.25	4.7	2	13.3	1:0	0.0	TOOU		
K . S. $\pm GL$	100	-		ŀ								

A = Arbscular (Large spores)

V = Vesicular (Small spores) M = Mycelium