J. Agric. Sci. Mansoura Univ., 27(6): 3767 - 3779, 2002

BIOCONTROL OF SORGHUM DAMPING-OFF BY *Gliocladium* ISOLATES

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ABSTRACT

Biocontrol treatment were conducted under greenhouse conditions to test the efficacy of two isolates of *Gliocladium roseum* [G-17, G-18] and two isolates of *G. penicilloides* [G-1, G-19] on controlling sorghum grain rot and seedlings damping-off [caused by *Drechslera* sp., *Fusarium moniliforme* and *Phoma* sp.]. Soil infestation with such biocontrol fungal isolates were applied either one week before, at the time, or one week after planting. The applications of *Gliocladium* isolates one week before planting significantly ($p \leq 0.05$) increased seedlings stand from 34.2% to 50.4% and reduced mortality percentage from 65.8 to 49.6%. *G. roseum* isolates were more effective at this time. When soil infestation was applied at the same time of planting, G-17 and G-19 gave the highest seedlings stand, however, G-18 was the best in increasing shoot and root fresh and dry weight. The application of the antagonists one week after planting, significantly ($p \leq 0.05$) increased seedlings stand from 50% to 58.8%, and decreased the percentage of mortality from 50% to 41.3%. Isolate G-17 gave the maximum shoot length and 25% increase in shoot dry weight, however, isolate G-1 gave the highest seedlings stand. The results revealed that the proper time for soil treatment was one week before planting.

Keywords: *Gliocladium*, Sorghum, Damping-off , *Drechslera*, *Fusarium*, *Phoma*, Biocontrol .

INTRODUCTION

Fungal antagonists have been used with some success for controlling damping-off disease of plants (Shu-yen and Vaughan, 1965; Kelly, 1976; Lewis and Papavizas, 1991; Abdel-Mageed, 1997 and Shahda, 2000).
Gliocladium spp. considered as effective biocontrol agents against some pathogenic fungi (Tu and Vaartaja, 1981; Howell, 1982; Lewis and Papavizas, 1985; Howell, 1986; Cipriano *et al.*, 1990; Hemeda, 1992; Lewis *et al.*, 1993; Hodges *et al.*, 1994; Burgess and Hepowrth, 1996; Burgess and Keane, 1997; Lacicowa and Pieta, 1997 and Granada *et al.*, 1999).

The antagonistic activity of *Gliocladium roesum* and *G. penicilloides* has been exploited successfully for the biological control of potato wilt disease (Hemeda, 1992). Therefore, the attempts for testing these two species for controlling sorghum damping-off were tried. The objectives of this study were : (1) Estimating the efficiency of two isolates of each of *G. roseum* and *G. penicilloides* as biocontrol agents for controlling sorghum damping-off. (2) Determination of the proper time for soil infestation with the isolates under greenhouse conditions.

MATERIALS AND METHODS

Fungi :

Two isolates of each of *Gliocladium roseum* and *G. penicilloides* (which were previously isolated by Hemeda, 1992 from roots and rhizosphere of wilted potato plants) were used in this study. Sorghum damping-off pathogens i.e., *Drechslera* sp., three isolates of *Fusarium moniliforme* (1, 2, 3) and *Phoma* sp. were previously isolated (Shehata *et al.*, 2002) and tested for their pathogenecity (Shahda *et al.*, 2002).

***In vitro* tests :**

Inocula (7mm diam discs) taken from the growing margin of each of the four isolates of *Gliocladium* cultures were transferred onto malt extract agar medium at the surface edge in 9 cm plastic petri dishes and incubated at 25°C for two days. Inocula (7mm diam discs) taken from the growing margin of the pathogenic fungal cultures i.e., *Fusarium moniliforme* (3 isolates), *Drechslera* sp. and *Phoma* sp. were placed at the centers of the same plates which containing the antagonistic fungal growth of *Gliocladium* isolates. Such prepared cultures were reincubated for 8 days. Inhibition zones between each of the pathogenic fungi and the antagonistic isolates were measured. Four replicates were used for each treatment.

***In vivo* tests :**

Biological control experiment was carried out in greenhouse using *Drechslera* sp., *Fusarium moniliforme* (Three isolates) and *Phoma* sp. as well as the antagonists i.e. two isolates of each of *Gliocladium roseum* (G-17, G-18) and *G. penicilloides* (G-1 & G-19). Soil infestation with the pathogenic fungi was made by growing the fungus on sterilized barley grains for 10 days at 25°C. Twenty cm clay pots, were filled with autoclaved aerated sandy loam soil (1kg. / pot), and 10g of infested grains were added to each pot. These pots were irrigated daily to allow inoculum establishment. After ten days, surface sterilized sorghum grains (with 1% sodium hypochlorite for 5 min.) were sown in each pot at the rate of 10 seeds / pot. The antagonistic fungal suspension of the different isolates of *Gliocladium* were prepared by growing each isolate on Malt Extract Broth (MEB) for 10 days at 25°C in 250 ml conical flask. Fifty g. of the mycelial mat were washed then blended in 500 ml sterilized water. Twenty five ml of hyphal / spore suspension (14×10^6 ml) were added to each pot as soil drench according to the following design: Pots were first divided into three groups according to the time of application of the antagonistic isolates. In group 1, spore suspension was applied one week before sowing, however in group 2, it was added at the time of sowing, and one week after sowing in group 3. Three check treatments were used in this experiment, the first contained untreated, non-infested soil, while the second contained untreated pathogen-infested soil, and the third contained treated non-infested soil. Treatments were arranged in a complete randomized block design (CRBD). Survivors of sorghum plants were recorded after 2, 4 and 8 weeks of sowing. Length of shoots and roots, as well as fresh and dry weight were measured after 8 weeks. Data were statistically analyzed using factorial design according to SAS program (Anonymous, 1980).

RESULTS AND DISCUSSION

***In vitro* tests :**

The two isolates of each of *Gliocladium roseum* Bain and *Gliocladium penicilloides* Corda were evaluated for their antagonistic effect against *Drechsler* sp., three isolates of *Fusarium moniliforme* and *Phoma* sp.. *Gliocladium roseum* (isolate G-17) was effective against *Drechslera* and *Fusarium* I_2 where the inhibition zones were 1.2 and 3.0 cm. respectively. However isolate G-18 was moderately effective against the three isolates of *Fusarium* and *Phoma* where the inhibition zones ranged from 0.20-0.40 cm.. *G. penicilloides* (isolate G-1) was the most effective isolate against *Drechslera* sp. where the inhibition zone was 2.0 cm. (Table 1).

Table (1) : **Antagonistic effect of *Gliocladium roseum* and *G. penicilloides* isolates on the growth of damping-off pathogens of sorghum plants grown on MEA medium for 8 days at 25° C.**

Pathogen	Inhibition zones (cm) *			
	G. roseum		*G. penicilloides*	
	G-17	G-18	G-1	G-19
Drechslera sp.	1.2	0.00	2.10	0.0
Fusarium moniliforme I_1	0.0	0.40	0.00	0.4
Fusarium moniliforme I_2	3.0	0.35	0.23	0.2
Fusarium moniliforme I_3	0.3	0.20	0.30	0.0
Phoma sp.	0.4	0.35	0.15	0.3

*** Mean of four replicates (plates).**

This results supports the work of Whipps, (1987) who found that *Fusarium oxysporum* was inhibited *in vitro* by *G. roseum* and the work of Hemeda, (1992) who reported that *G. penicilloides* and *G. roseum* isolates were effective in inhibiting the growth of *F. oxysporum* and *Verticillium albo-atrum* isolates *in vitro*.

***In vivo* tests:**

Data in Fig 1-c show that, the biocontrol isolates had a beneficial effect when applied to the soil before planting. Only 34.2% of plant stand were grown in untreated pathogen-infested soil ($control_1$) compared with 37% for untreated non- infested soil ($control_2$). Soil treatment with *Gliocladium* isolates increased seedling stand from 34.2 to 50.4%. Isolates G-17 and G-18 increased seedlings stand significantly higher than the untreated infested control. The use of both isolates reduced the percentage of mortality from 65.8% to 49.6% and 54.6 respectively (Table 2). Soil treatment with the antagonistic isolates before planting did not increase the length, fresh and dry weight of shoot and root which were more or less significantly similar to the control (Table 2).

When soil treatment was applied at the time of planting, isolates G-17 (*G. roseum*) and G-19 (*G. penicilloides*) gave the highest seedlings stand, although it was not significantly different than the untreated infested control (Fig. 2-c). Same isolates significantly increased shoot and root length, isolate G-18 (*G. roseum*) was the best in increasing shoot, root, fresh and dry

weight as compared with the control (Table 3).

The application of the *Gliocladium* isolates one week after plants revealed that G-1 (*G. penicilloides*) and G-17 (*G. roseum*) were very effective in increasing seedlings stand where G-1 was significantly different than untreated infested control and similar to the untreated non-infested control (Fig. 3-c). The same isolates were the best in decreasing percentage of mortality from 50% to 41.3% and 42.9% respectively (Table 4). Isolate G-17 gave the maximum shoot length and 25% increase in shoot dry weight.

Table (2) : Effect of soil treatment with antagonistic fungi one week before planting on percentage of mortality, length, fresh and dry weight of shoot and root of sorghum (cv.Giza 15) grown in previously infested soil with damping-off pathogens 8 weeks after planting.

Treatment		Pathogen	% Total mortality	Shoot			Root		
				Lengt h (cm)	F.W. g/p	D.W. g/p	Lengt h (cm)	F.W. g/p	D.W. g/p
G. roseum	G-17	*Drechslera* sp.	47.5	67.0	2.44	0.66	27.5	1.05	0.21
		Fusarium moniliforme I_1	40.0	57.00	1.86	0.41	27.3	1.25	0.20
		Fusarium moniliforme I_2	47.5	45.5	1.19	0.28	17.5	0.37	0.07
		Fusarium moniliforme I_3	45.0	59.8	1.74	0.40	26.0	0.78	0.22
		Phoma sp.	57.5	58.8	3.55	0.87	17.3	1.11	0.28
		Control	60.0	71.0	5.50	2.29	23.8	2.09	0.35
	G-18	*Drechslera* sp.	55.0	56.0	2.46	0.52	15.3	1.06	0.17
		Fusarium moniliforme I_1	47.5	57.8	2.24	0.45	26.3	1.68	0.27
		Fusarium moniliforme I_2	45.0	61.8	2.12	0.51	27.5	1.05	0.25
		Fusarium moniliforme I_3	67.5	62..5	3.32	0.81	22.8	1.94	0.43
		Phoma sp.	45.0	51.5	2.48	0.58	16.8	1.55	0.35
		Control	67.5	61.3	3.86	1.22	25.00	1.82	0.35
G. penicilloides	G-1	*Drechslera* sp.	67.5	65.5	4.91	0.97	26.3	3.02	0.75
		Fusarium moniliforme I_1	50.0	55.8	1.83	0.31	28.5	0.86	0.14
		Fusarium moniliforme I_2	45.0	43.3	0.92	0.28	18.8	0.90	0.14
		Fusarium moniliforme I_3	70.0	57.5	4.03	0.84	25.5	2.50	0.47
		Phoma sp.	55.0	44.5	1.91	0.42	17.8	0.94	0.24
		Control	77.5	44.8	1.59	0.37	9.3	0.56	0.13
	G-19	*Drechslera* sp.	52.5	64.5	2.29	0.62	22.3	1.01	0.18
		Fusarium moniliforme I_1	47.5	57.0	2.55	0.63	25.5	1.27	0.23
		Fusarium moniliforme I_2	52.5	59.3	2.91	0.65	28.0	1.09	0.28
		Fusarium moniliforme I_3	75.0	65.3	4.99	1.17	24.3	1.79	0.56
		Phoma sp.	55.0	73.8	3.73	0.77	23.8	1.29	0.20
		Control	65.0	75.8	4.23	0.61	26.0	1.46	0.31
Control		*Drechslera* sp.	65.0	70.5	4.88	1.22	26.3	1.28	0.24
		Fusarium moniliforme I_1	70.0	48.0	1.70	0.38	15.3	0.51	0.17
		Fusarium moniliforme I_2	57.5	72.0	3.73	0.87	32.5	1.06	0.33
		Fusarium moniliforme I_3	70.0	63.0	3.13	0.83	33.0	1.33	0.33
		Phoma sp.	70.0	69.8	2.74	0.71	32.3	1.01	0.26
		Control	62.5	64.8	3.81	1.09	39.8	1.39	0.35
Mean		*G. roseum* : G-17	49.6	59.83 ^{abc}	2.71 ^{a}	0.82 ^{a}	23.21 ^{b}	1.11 ^{a}	0.22 ^{a}
		G. roseum : G-18	54.6	58.46 ^{abc}	2.75 ^{a}	0.68 ^{a}	22.3 ^{b}	1.51 ^{a}	0.30 ^{a}
		G. penicilloides : G-1	60.8	51.88 ^{c}	2.53 ^{a}	0.53 ^{a}	21.0 ^{b}	1.46 ^{a}	0.31 ^{a}
		G. penicilloides : G-19	57.9	65.92 ^{a}	3.45 ^{a}	0.74 ^{a}	25.0 ^{b}	1.32 ^{a}	0.29 ^{a}
		Control	65.8	64.67 $^{a-c}$	3.33 ^{a}	0.85 ^{a}	29.8 ^{a}	1.09 ^{a}	0.26 ^{a}

- F.W. : fresh weight D.W. : dry weight g/p : gram/plant

-Means with the same letter (s) are not significantly different from each other according to L.S.D (p? 0.05).

Table (3) : Effect of soil treatment with antagonistic fungi at the time of planting on percentage of mortality, length , fresh and dry weight of shoot and root of sorghum (cv.Giza 15) grown in previously infested soil with damping-off pathogens 8 weeks after planting.

Treatment		Pathogen	% Total mortality	Shoot			Root		
				Length (cm)	F.W. g/p	D.W. g/p	Length (cm)	F.W. g/p	D.W. g/p
G. roseum	G-17	*Drechslera* sp.	37.5	57.3	1.94	0.56	26.0	0.54	0.14
		Fusarium moniliforme I_1	47.5	58.3	2.28	0.49	26.0	1.06	0.20
		Fusarium moniliforme I_2	55.0	48.8	1.51	0.52	25.5	0.70	0.13
		Fusarium moniliforme I_3	50.0	53.3	2.39	0.58	30.3	1.26	0.26
		Phoma sp.	40.0	51.3	1.33	0.38	27.5	0.44	0.12
		Control	40.0	42.5	0.77	0.18	26.0	0.39	0.10
	G-18	*Drechslera* sp.	52.5	49.3	1.45	0.90	24.3	0.61	0.24
		Fusarium moniliforme I_1	72.5	58.5	4.39	1.21	39.3	4.16	0.65
		Fusarium moniliforme I_2	30.0	44.0	1.03	0.43	25.3	0.29	0.09
		Fusarium moniliforme I_3	55.0	61.8	2.79	0.64	25.8	0.73	0.13
		Phoma sp.	45.0	56.3	1.63	0.46	27.0	0.95	0.22
		Control	55.0	38.8	1.10	0.29	22.5	0.30	0.14
G. penicilloides	G-1	*Drechslera* sp.	65.0	56.3	2.63	0.90	25.0	0.82	0.22
		Fusarium moniliforme I_1	67.5	52.0	2.34	0.56	33.8	1.19	0.19
		Fusarium moniliforme I_2	45.5	52.5	1.78	0.88	22.8	0.60	0.17
		Fusarium moniliforme I_3	57.5	47.5	1.89	0.40	21.8	0.49	0.13
		Phoma sp.	42.5	50.5	1.36	0.55	24.3	0.68	0.18
		Control	40.0	40.0	0.83	0.22	24.0	0.42	0.10
	G-19	*Drechslera* sp.	45.0	53.0	1.28	0.56	25.0	0.33	0.12
		Fusarium moniliforme I_1	60.0	57.5	2.16	0.47	32.5	0.95	0.16
		Fusarium moniliforme I_2	47.5	53.8	1.69	0.60	21.8	0.37	0.13
		Fusarium moniliforme I_3	27.5	50.0	1.07	0.28	25.8	0.42	0.08
		Phoma sp.	57.5	54.5	1.76	0.60	31.3	0.49	0.13
		Control	40.0	41.3	0.95	0.21	30.5	0.40	0.14
Control		*Drechslera* sp.	52.5	56.0	2.01	1.36	25.0	0.43	0.17
		Fusarium moniliforme I_1	30.0	51.3	1.34	0.45	22.3	0.28	0.10
		Fusarium moniliforme I_2	42.5	46.0	1.03	0.35	23.5	0.28	0.08
		Fusarium moniliforme I_3	62.5	37.5	1.03	0.65	10.25	0.19	0.09
		Phoma sp.	46.5	46.5	1.21	0.38	22.0	0.68	0.11
		Control	30.0	34.5	0.69	0.16	28.3	0.47	0.06
Mean		*G. roseum* : G-17	45.0	51.9 ^{a}	1.70 ^{ab}	0.45 ^{b}	26.9 ^{abc}	0.73 ^{ab}	016 ^{ab}
		G. roseum : G-18	51.7	51.4 ^{ab}	2.07 ^{a}	0.65 ^{a}	27.3 ^{ab}	1.17 ^{a}	0.24 ^{a}
		G. penicilloides : G-1	52.9	49.8 ^{ab}	1.80 ^{ab}	0.58 ^{a}	25.3 ^{abc}	0.70 ^{b}	0.16 ^{ab}
		G. penicilloides : G-19	46.2	51.7 ^{ab}	1.49 ^{b}	0.45 ^{b}	27.8 ^{a}	0.49 ^{b}	0.12 ^{b}
		Control	43.7	45.3 ^{b}	1.22 ^{b}	0.56 ^{b}	22.9 ^{c}	0.39 ^{b}	0.10 ^{b}

F.W. : fresh weight D.W. : dry weight g/p : gram/plant

Means with the same letter (s) are not significantly different from each other according to L.S.D (P? 0.05).

Table (4) : Effect of soil treatment with antagonistic fungi one week after of planting on percentage of mortality, length , fresh and dry weight of shoot and root of sorghum (cv.Giza 15) grown in previously infested soil with damping-off pathogens 8 weeks after planting.

Treatment		Pathogen	% Total mortality	Shoot			Root		
				Length (cm)	F.W. g/p	D.W. g/p	Length (cm)	F.W. g/p	D.W. g/p
G. roseum	G-17	*Drechslera* sp.	27.5	90.0	2.64	0.62	26.3	0.47	0.18
		Fusarium moniliforme I_1	42.5	88.8	0.98	0.47	23.5	0.48	0.12
		Fusarium moniliforme I_2	42.5	96.8	2.83	0.52	21.3	0.50	0.11
		Fusarium moniliforme I_3	35.0	105.0	2.95	0.55	23.5	0.51	0.17
		Phoma sp.	57.5	96.3	3.11	0.70	21.3	0.38	0.18
		Control	52.5	83.8	1.77	0.44	21.0	0.39	0.16
	G-18	*Drechslera* sp.	42.5	112.5	2.23	0.46	21.8	0.52	0.68
		Fusarium moniliforme I_1	52.5	80.0	2.12	0.40	20.5	0.64	0.12
		Fusarium moniliforme I_2	60.0	81.3	2.86	0.50	27.5	0.67	0.13
		Fusarium moniliforme I_3	62.5	50.5	4.77	0.91	24.8	0.74	0.23
		Phoma sp.	72.5	90.0	5.01	0.82	23.8	0.64	0.24
		Control	62.5	75.0	2.67	0.36	26.0	0.99	0.17
G. penicilloides	G-1	*Drechslera* sp.	45.0	71.3	2.63	0.50	30.0	0.55	0.16
		Fusarium moniliforme I_1	37.5	85.0	1.67	0.32	20.5	0.34	0.11
		Fusarium moniliforme I_2	27.5	76.3	1.80	0.35	18.5	0.77	0.22
		Fusarium moniliforme I_3	32.5	86.3	1.62	0.39	23.8	0.23	0.13
		Phoma sp.	52.5	77.5	1.78	0.43	18.8	0.25	0.12
		Control	52.5	77.5	2.13	0.33	19.3	0.38	0.10
	G-19	*Drechslera* sp.	60.0	93.8	2.49	0.60	24.3	0.54	0.21
		Fusarium moniliforme I_1	50.0	97.5	4.54	0.71	24.8	2.84	0.31
		Fusarium moniliforme I_2	52.5	87.5	3.22	0.71	29.5	1.11	0.36
		Fusarium moniliforme I_3	67.5	57.5	2.54	0.48	19.5	0.81	0.22
		Phoma sp.	67.5	48.8	1.72	0.47	16.5	0.55	0.21
		Control	45.0	65.0	1.21	0.36	19.3	0.29	0.11
Control		*Drechslera* sp.	52.5	65.0	2.61	0.68	23.5	1.15	0.27
		Fusarium moniliforme I_1	52.5	73.8	1.81	0.44	23.3	1.08	0.30
		Fusarium moniliforme I_2	57.5	53.8	1.15	0.35	20.0	0.38	0.13
		Fusarium moniliforme I_3	50.0	71.3	1.77	0.41	20.8	0.82	0.19
		Phoma sp.	65.0	58.8	2.06	0.43	22.5	0.64	0.15
		Control	22.5	67.0	1.69	0.35	18.8	1.01	0.15
Mean		*G. roseum* : G-17	42.9	93.4^{a}	2.71^{ab}	0.55^{ab}	22.8^{a}	0.45^{c}	0.15^{ab}
		G. roseum : G-18	58.8	81.5^{ab}	3.27^{a}	0.57^{a}	24.0^{a}	0.70^{abc}	0.26^{a}
		G. penicilloides : G-1	41.3	78.9^{bc}	1.94^{cd}	0.39^{b}	21.8^{a}	0.42^{c}	0.14^{b}
		G. penicilloides : G-19	57.0	75.0^{bcd}	2.62^{abc}	0.55^{ab}	22.3^{a}	1.02^{a}	0.23^{ab}
		Control	50.0	64.9^{d}	1.85^{d}	0.44^{ab}	21.5^{a}	0.85^{ab}	0.20^{ab}

F.W. : fresh weight D.W. : dry weight g/p : gram/plant

Means with the same letter (s) are not significantly different from each other according to L.S.D (p? 0.05).

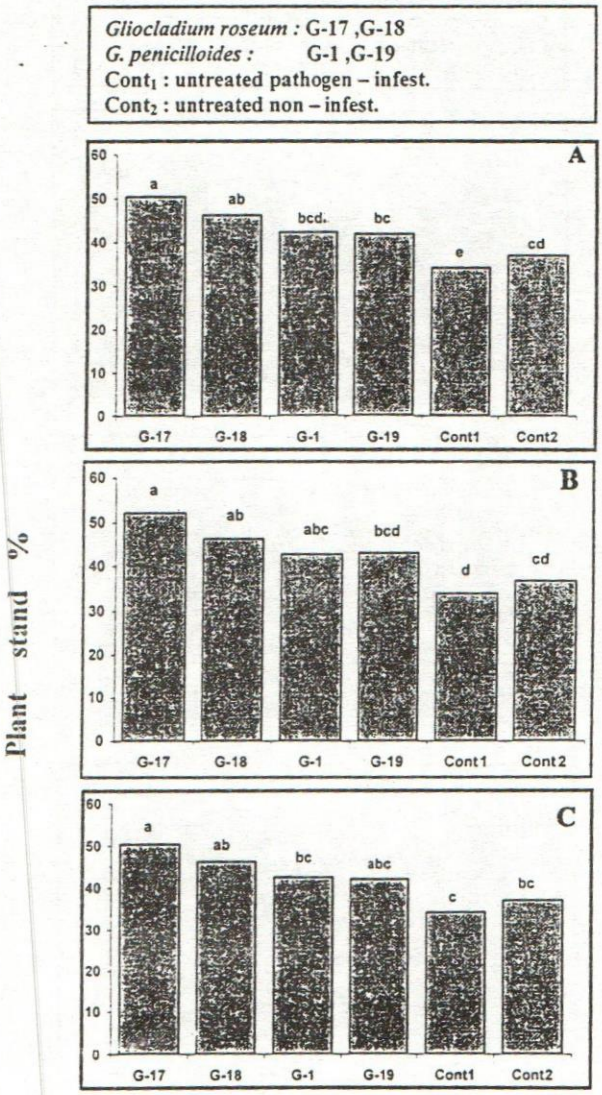

Fig. (1): Effect of soil treatment with different isolates of *Gliocladium* sp. one week before sowing on plant stand in soil previously infested with damping-off pathogens after 2 weeks (A), 4 weeks (B) and 8 weeks (C) of planting. Means with the same letter(s) are not significantly different from each other according to L.S.D ($P \leq 0.05$).

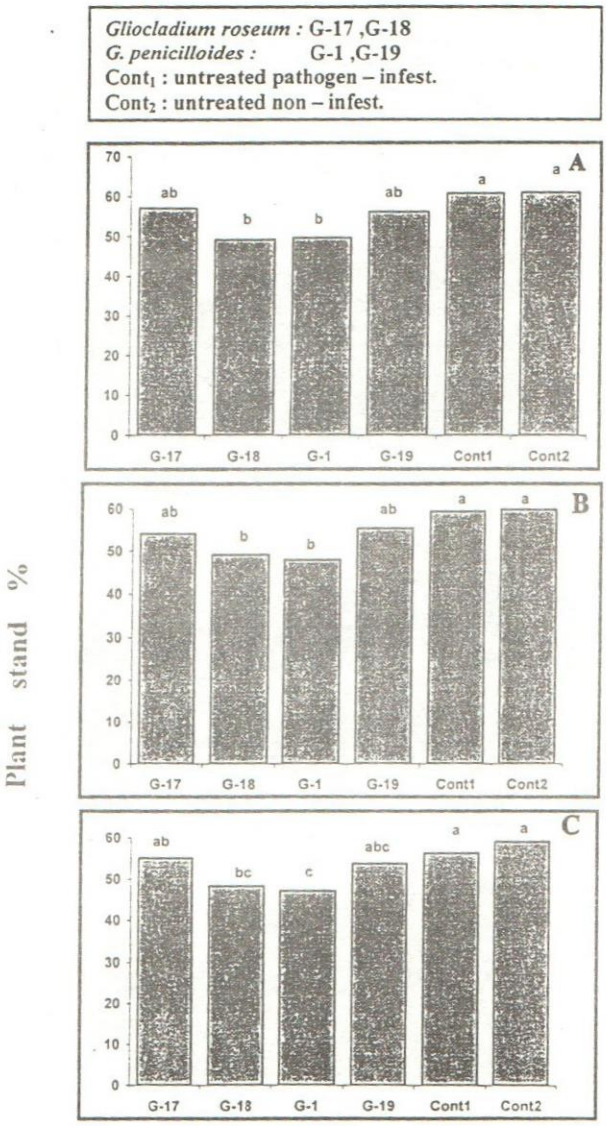

Fig. (2): Effect of soil treatment with different isolates of *Gliocladium* sp. at the time of sowing on plant stand in soil previously infested with damping-off pathogens after 2 weeks (A), 4 weeks (B) and 8 weeks (C) of planting. Means with the same letter(s) are not significantly different from each other according to L.S.D ($P \leq 0.05$).

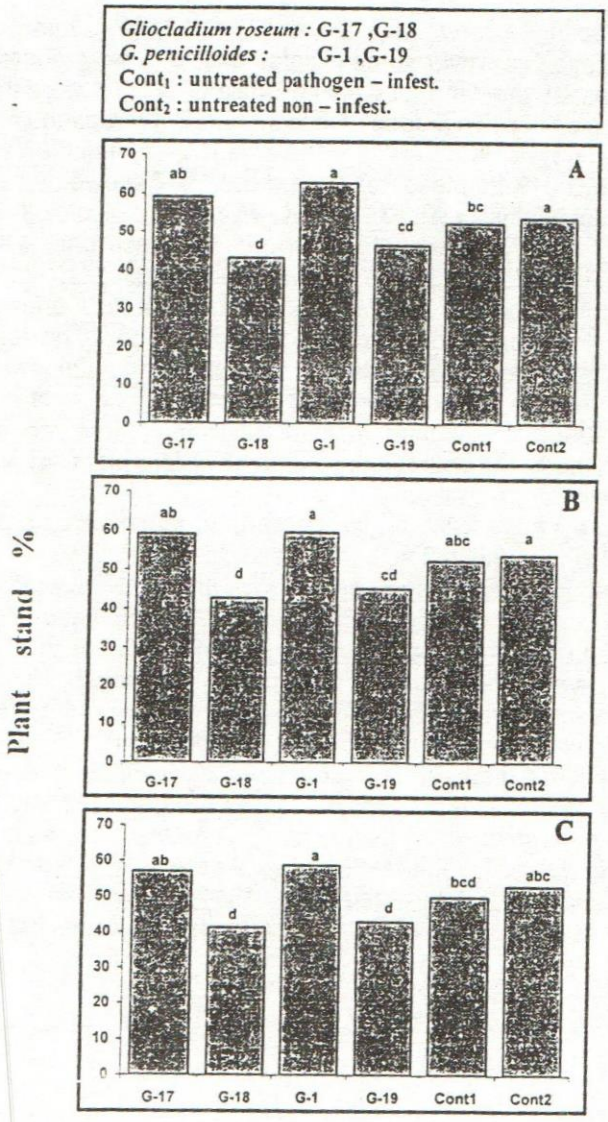

Fig. (3): Effect of soil treatment with different isolates of *Gliocladium* sp. One week after sowing on plant stand in soil previously infested with damping-off pathogens after 2 weeks (A), 4 weeks (B) and 8 weeks (C) of planting. Means with the same letter(s) are not significantly different from each other according to L.S.D ($P \leq 0.05$).

Gliocladium roseum (isolates G-17, G-18) were effective in the first time of application, however same isolates and G-19 were superior when the application was at the time of planting, while G-17, G-1 were the best when applied after planting. This result shows that G-17 was the most effective isolate followed by isolate G-18. The antagonistic effect tests in this study (Table 1) coincide with these results where G-17 showed a clear and wide inhibition zones against *Drechslera* and *Fusarium* I_2. Isolates G-17 & G-18 are belonging to *G. roseum* which proved its effectiveness in controlling sorghum damping-off pathogens under this study conditions.

Application of *Gliocladium* isolates to the soil one week before planting was the proper time for the disease control. This result might be attributed to its secretion of certain substances such as antibiotics (Brian *et al.*, 1951), enzymes (Pachenari and Dix, 1980) and toxins as gliotoxin (Papavizas, 1985) more than mycoparasitism, where the addition was simultaneously with the pathogens (one week before planting) and there was no hyphal growth for parasitism.

The present results are in agreement with the worke of Ebben and Budge (1984) who found that soil drenches with *G. roseum* gave good control against carnation wilt caused by *Fusarium oxysporum*. In greenhouse experiments, Hemeda (1992) reported that *G. roseum* and *G. penicilloides* isolates applied to the soil 10 days before planting were effective in controlling *Fusarium* and *Verticillium* wilt of potato plants and resulted in an increase in the number of healthy plants raised in soil inoculated with *Verticillium albo-atrum*. Castejon-Munoz and Oyarzum (1995) reported that *G. roseum* isolates significantly reduced pea root rot severity and prevented root weight losses caused by *Fusarium solani* f. sp. *pisi* isolate 48. Lacicowa and Pieta (1997) found that *G. roseum* gave the best control in protection of pea seeds against soil pathogenic fungi. Treatment of chickpea seed with isolates of *G. roseum* reduced seedling soft rot by seed borne *Botrytis cinerea* under controlled environmental conditions and in the field (Burgess and Kean, 1997).

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J. Agric. Sci. Mansoura Univ., 27(6), June, 2002

المقاومة الحيوية لمرض الذبول الطرى في نباتات الذرة الرفيعة باستخدام عزلات من فطر *Gliocladium*

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أجريت دراسة علي المقاومة الحيوية لمرض عفن الحبوب والذبول الطري لنباتات الذرة الرفيعة (والذي يسببه الفطريات *Drechslera* sp.، *Fusarium moniliforme*، *Phoma* sp.) باستخدام عزلتين من الفطر *Gliocladium roseum* وهما G-17، G-18 وعزلتين من الفطر *G. penicilloides* وهما G-1، G-19 تحت ظروف الصوبة الزجاجية.

تم معاملة التربة (المعداه مسبقاً بالفطريات المسببة للمرض كل علي حدة) بالعزلات المختلفة في ثلاث مواعيد مختلفة هي قبل الزراعة أو بعدها بأسبوع وكذلك وقت الزراعة وأخذت النتائج علي مدي ٨ أسابيع. دلت النتائج علي أن إضافة العزلات المقاومة قبل الزراعة بأسبوع أدت إلي زيادة النسبة المئوية لظهور النباتات من ٣٤,٢% إلي ٥٠,٤% (أى نقص النسبة المئوية للمرض من ٦٥,٨% إلي ٤٩,٦%) وكانت أكثر العزلات تفوقاً هي عزلات النوع *G. roseum* في هذا الوقت من المعاملة.

عند إضافة العزلات الأربعة وقت الزراعة سجلت العزلات G-17، G-19 أعلي نسبة لظهور النباتات كما كانت العزلة G-18 متميزة في زيادة الوزن الطازج والجاف للساق والجذر.

أدت معاملة التربة بعد الزراعة بأسبوع بالعزلات المقاومة إلي زيادة نسبة ظهور النباتات من ٥٠% إلي ٥٨,٨% (تناقص نسبة حدوث المرض من ٥٠% إلي ٤١,٣%). وقد أعطت العزلة G-17 (*G. roseum*) أعلي طول للساق وكذلك زيادة في الوزن الجاف للساق بمقدار ٢٥% بينما أعطت العزلة G-1 أعلي نسبة ظهور للنباتات.

-من النتائج السابقة يمكن استخلاص أن أفضل الأوقات لإضافة هذه العزلات للتربة هو قبل الزراعة بأسبوع وذلك للوصول إلي أعلي درجات مقاومة المرض وزيادة قوة نمو النباتات.