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SUPPRESSION OF *Fusarium solani* IN VOLVED IN COTTON SEEDLING DAMPING – OFF BY *Trichoderma* SPP.

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ABSTRACT

Five isolates of *Trichoderma* spp., three belonging to *T. harzianum* and two belonging to *T.viride* were isolated from cotton seedlings infected with damping –off or from rotted roots of adult plants. The isolates were evaluated for biocontrol capacity against 14 isolates of *Fusarium solani* involved in seedling damping –off, of cotton under greenhouse conditions. Analysis of variance showed very highly significant effects of *Trichoderma spp*. isolates. *F. solani* isolates, and their interaction on pre-emergence damping- off, post-emergence damping-off, survival, plant height, and dry weight. Responses of *F. solani* isolates to antagonistic effects of *Trichoderma* isolates were different.Some isolates of *F. solani* exhibited response to all *Trichoderma* isolates, which siginifficantly increased the percentage of surviving seedlings, plant height and dry weight. Cluster analysis of *Trichoderma* spp. isolates based on antagonistic patterns showed that isolates were placed in two groups. The first group included isolates of *T. harzianum*, while the second group included isolates of *T. viride*. The results of cluster analysis of *F. solani* isolates,based on their response patterns to *Trichoderma* spp. Isolates. Placed the isolates in three distinct groups;however, grouping the isolates was not related to geographic origins. It is worth noting that isolates of Middle Egypt and Upper Egypt were placed in same group.

Keywords: Biological control, cotton, damping-off, *Gossypium barbadense* L., *F. solani* and *Trichoderma* spp.

ITTRODUCTION

Fusarium solani (Mart.) Sacc. is one of the most ubiquitous soil fungus and destructive plant pathogen of many of hosts (Booth,1971;Domsch *et al* .,1980).It is easily isolated from seeds. The degree of losses caused by *F.solani* has not been determined *F. solani* is one of the organisms contributing to the seedling disease complex of *Gossypium* spp.(Davis *et al*.,1981; Johnson, 1981). Disease symptoms include seed rot, pre-and pot-emergence damping-off, and seedling root rot which,individually or in combination, result in stand reductions and reduced seedling vigor that delays growth and maturity, *F. solani* caused significant reductions in emergence of cotton and increased root discoloration of surviving seedlings (Bastson and Trevathan, 1988). *F. solani* was isolated from cotton plants with severe foot rot in India during 1977, 1978 and 1980(Bharathudu and Rao,1982).Nelson and Windels(1992),This disease occurs as seed decay before germination and as pre-emergence damping-off (Abd-Elsalam *et al* 2007). Many studies demonstrated that some of the isolates of *Trichoderma*

spp. showed biocontrol potentiality against several micro-organtisms involved in cotton damping-off, and root-rot disease Aly *et al*., 2000; Hanson,2000;Haq and Khan,2000 Xueling *et al*., 2003; Asran *et al* ., 2005; Howell and Pukhaber, 2005 , Aly *et al* ., 2007and Asran-Imal *et.al* 2010). *F. solani* has been effectively controlled through Seed and soil treatment with *Trichoderma virens* preparations (Howell,1982 &1991 and Nelson, 1994). The objectives of this study were to : (1) isolate and to identify *Fusarium* spp. and *Trichoderma* spp. from cotton seedlings . (2) to evaluate the biocontrol capacity of isolated *Trichoderma* spp. against *Fusarium* spp. pathogenic to cotton seedlings.

MATERIALS AND METHODS

Isolation,purification and *identification of Fusarium solani* and *Trichoderma spp.* from cotton *(Gossypium barbadense* L.) roots *:*

Isolation, was made from samples collected from several localities in cotton producing areas in ten governorates, *i.e* Beheira, Dakahliya, Damietta, Gharbiya, ,kafr El-sheikh, Minufiya , sharkiya,Minya, Assiute, and Sohag (Table 1&2). Each sample consisted of 5 to 15 seedlings showing a variety of damping-off symptoms or rotted roots of 5 adult plants . Seedling or roots of adult plants were removed from soil and washed thoroughly under running tap water to remove any adhering soil . Small pieces (approximately 0.5 cm long) of necrotic root tissues were surface sterilizes with 10% clorox solution for 2 minutes, and washed several times with sterilized water. The surface sterilized pieces were then blotted dry between sterilized filter papers and plated on potato dextrose agar (PDA) medium amended with streptomycin sulphate or penicillin G and rose bengal to eliminate any bacterial contamination. The plates were incubated at 25±2◌ C for 3-7 days. *Fusarium solani* isolates were identified to species level according to Nelson *et al.* (1983) while, *Trichoderma* spp. isolates were identified to species level according to Rifai (1969). Identification of isolates to species level was kindly verified by Mycological Centre, Assiut University.

Production of *Fusarium solani* inoculum used for soil infestation:

Substrate for growth of isolates was prepared in 500-ml glass bottles. Each contained 50g of sorghum grains and 40 ml tap water. Contents of each bottle were autoclaved for 30 minutes .inocula were taken from one-week old PDA cultures and aseptically introduced into the bottles and allowed to colonize sorghum grains for three weeks.

Production of *Trichoderma* spp. inoculum used for seed treatment (seed coating):

Inocula of *Trichaderma* spp. isolates were prepared as previously mentioned; however antagonist-sorghum mixtures. were air –dried in the greenhouse. The dry mixtures were triturated to a fine powder in a blender (Papaviza and Lewis,1981) .

Interaction between *Trichoderma* spp. and *F. solani* isolates under greenhouse conditions :

Autoclaved clay loam soil was placed on a greenhoused bench and infested with inoculum of each *F. solani* isolate at a rate of 50g/kg soil. After thoroughly mixing, infested soil was dispensed into 15-cm –diameter clay

pots. In the control treatment,soil was infested with sorghum powder at the same rate. Slightly moistened seeds were treated with powdered inoculum of each *Trichoderma* isolate, at rate of 10g/ kg seeds and thoroughly shaken in plastic bags before being planted at the rate of 10 seeds/pot of *F. solani* ifested soil. Pots (4 for each treatment) were randomly distributed on a greenhouse bench under the temperature/ regime of 29-±5°C. Pre-emergence damping- off was recorded 15 days after planting, post-emergence damping-off, survivals, plant height (cm/plant) and dry weight (mg/plant) were recorded 45 days after planting .

Table 1 . Geographic origins of *Trichoderma* spp. used in the study

Isolate No.	Geographic origin	*Trichoderma* spp.
1	Dakahliya	*T. harziaunum*
2	Sharkiya	*T . harziaunum*
3	KafrEl-sheikh	*T . harziaunum*
4	Gharbiya	*T . viride*
5	Beheira	*T . viride*

Table 2.Geographic origins of *Fusarim solani* isolates used in the study

Isolate No.	Governorate	Previous Crops	Host cultivar
1	Beheira	Egyptian clover	Giza 70
2	Kafr El-sheikh	Egyptian clover	Giza 89
3	Dakahliya	Egyptian clover	Giza 86
4	Minufiya	Onion	Giza 86
5	Dakahliya	Faba bean	Giza 86
6	Beheira	Egyptian clover	Giza 70
7	Sharkiya	Egyptian clover	Giza 89
8	Kafr El-sheikh	Egyptian clover	Giza 89
9	Damietta	Faba bean	Giza 88
10	Gharbiya	Faba bean	Giza 89
11	Minya	Faba bean	Giza 83
12	Sharkiya	Pea	Giza 89
13	Sohag	Onion	Giza 83
14	Assiute	Pea	Giza 83

Statistical andalysis of data:

The experimental design of the present study was a randomized complete block design with four replicates. Analysis of variance (ANOVA) of the data was performed with the MSTAT-C statistical package. Least significant difference (LSD) was used to compare treatment means. Percentage date was transformed into arcsine angles before carrying out the ANOVA to produce approximately constant variance. Cluster analysis was performed with the software package SPSS 6.0.

RESULTS

***In vivo* evaluation of *Trichoderma* spp. antagonism against *F. solani* isolates:**

ANOVA (Table 3) showed that *Fusarium solani* isolates and *Trichoderma* isolates was highly significant source of variation in all the tested parameters, the interaction was highly significant source of variation in all the tested parameters except plant height.

Table3. Analysis of variance of the effect of *Trichoderma* spp. Isolates, *Fusarim solani* isolates and their interaction on cotton seedling disease variables (cv. Giza 92) under greenhouse conditions

Parameter and Source of variation	D.f.	M.S.	F .value	P > F
Pre-emergence damping off				
Replication[a]	3	72.613	0.892	0.479
Trichoderma isolates (*T*)	5	728.907	8.326	0.000
Fusarium isolates (*F*)	13	347.844	3.93	0.000
TXF	65	173.652	1.984	0.000
Error	249	87.542		
Post-emergence damping off				
Replication	3	134.312	0.835	0.476
Trichoderma isolates(*T*)	5	2052.318	12.754	0.000
Fusarium isolates(*F*)	13	1333.071	8.284	0.000
TXF	65	532.078	3.307	0.000
Error	249	160.919		
Survival				
Replication	3	222.763	1.848	0.139
Trichoderma (T)	5	661.191	5.487	0.000
Fusarim (F)	13	512.579	4.253	0.000
TXF	65	250.142	2.076	0.000
Error	249	120.510		
Plant height				
Replication	3	186.813	1.461	0.226
Trichoderma isolates (*T*)	5	310.605	2.429	0.004
Fusarium isolates(*F*)	13	836.455	6.543	0.000
TXF	65	141.386	1.106	0.290
Error	249	127.847		
Dry weight				
Replication	3	19058.670	1.600	0.190
Trichoderma isolates (*T*)	5	46262.888	3.883	0.000
Fusarium (*F*)	13	171182.567	14.369	0.000
TXF	65	11913.563	1.836	0.000
Error	249	11913.563		

[a] Replication is random, while each of *Trichoderma* . isolates and *Fusarium solani* isolates are fixed.

Table 4 showed that *Trichoderma* isolates were the most important source of variation in pre-and post emergence damping –off, and survival, while *Fusarium* isolates were the most important source at variation in plant height and dry weight. The interaction was always the least important source of variation. Due to the significant interaction of *Trichoderma* isolate× *Fusarium* isolate in pre emergence damping –off, an interaction LSD was

calculated to compare between *Trichoderma* isolates and the control for each *Fusarium* isolate; these comparisons showed that the difference was not the same for each Fusarium isolate for example, the difference between *T*. *harzianum* and the control was significant for *Fusarium* isolate No. 3, while it was nonsignificant for Fusarium isolate no. 2, another example is the non significant effect of *T. harzianum* no.1 on *Fusarium* no. 11 and the significant effect on *Fusarium* no. 12. The difference between *Trichoderma* isolates may vary depending *on Fusarium* isolate. For example, the difference between T4 and T5 was not significant on *Fusarium* no.1, while this difference was significant on *fusarium* no.5. the same conclusions hold true for post emergence damping-off, survival, and dry weight, where *Trichoderma* × *Fusarium* interaction was significant. Due to the lack of significant *Fus*arium. × *Trichoderma* interaction in the case of plant height, the general means were used to compare between the effects of *Trichoderma* isolates on plant height. These comparisons showed that all the tested *Trichoderma* isolates significantly increased plant height regardless of *Fusarium* isolates.

Table 4. Relative contribution of *Trichoderma* isolates, *Fusarium solani* isolates and their interaction to variation in cotton seedling disease variables (cv. Giza 92) under greenhouse conditions

Source of variation	Relative contribution [a] to variation in				
	Pre- emergence damping-off	Pot – emergence damping-off	Survival	Plant height	Dry weight
Trichoderma isolates(*T*)	55.09	50.65	40.15	21.05	17.91
Fusarium isolates (*F*)	26.29	32.90	31.13	56.70	66.25
*T*x*F* calculated	13.13	13.13	15.19	9.58	8.35

[a] Colculated as percentage of squares of the explained (model) variation .

The comparisons between *Trichoderma* isolates and control within isolates of *F. solani* (Table 8) revealed that efficiency of the tested *Trichoderma* isolate in increasing the plant height of surviving seedlings was varied from one isolate to another. Thus, (T2) was effective against *F. solani* isolate No. 3 and ineffective against No.9 and 14 *Trichoderma* (T1) was effective against *F. solani* isolate No.1 and ineffective against *F. solani* isolate No. 13 *F. solani* isolate responded differrntly to the application of *Trichoderma* isolates for example *F. solani* Nos. 1,2,3,6 & 7 were highly responsive to *Trichoderma* isolates, while isolates Nos. 10,13& 14 had no response to any *Trichoderma* isolate. The majority of *Trichoderma* isolates showed significant effects no dry weight of surviving seedling Table (8*). T . viride* isolates significantly increased dry weight of seedlings regardless of *F. solani* isolate, while, *T. harzianum* showed various significant effects. On the other hand, *Trichoderma* isolates did not show significant effects in improving dry weight of seedling in the case of *F. solani* isolates Nos. 9,13 and 14. *Fusarium* isolates showed variable effects of plant height.

Tabel 5. Effect of *Trichoderma* isolates, *Fusarium solani* isolates and their interaction on pre-emergence damping –off of cotton seedlings (cv.Giza 92) under greenhouse conditions

Fusarium solani	T. harzianum (T1)		T. harzianum (T2)		T. harzianum (T 3)		T. viride (T 4)		T. viride (T 5)		control	
	%	b Trans-formed	%	Trans-formed	%	%	%	Trans-formed	%	Trans-formed	%	Trans-formed
1	10[a]	15.86	17.5	24.53	22..5	27.33	32.5	34.72	30	33..05	27.5	81.39
2	30	32.53	17.5	21.58	20	26.19	27.5	30.87	30	32.83	32.5	33.75
3	15	19.92	0.0	0.0	15	19.55	15	22.50	22.5	26.41	35.0	36.0
4	37.5	37.51	27.5	31.05	15	22.50	27.5	30.80	27.5	31.39	27.5	31.39
5	42.5	40.39	22.5	28.22	30	33.05	17.5	24.16	30	32.31	55	47.88
6	30	33.05	32.5	34.50	32.5	33.75	10	15.86	35	36	30	32.53
7	45	42.05	17.5	17.89	22.5	28.22	5	6.64	35	36	27.5	31.55
8	35	36.06	25	29.89	22.5	28.22	22.5	27.86	30	32.53	37.5	43.49
9	37.5	37.75	35	36.06	27.5	30.87	30	32.31	27.5	3139	50	44.94
10	32.5	34.34	30	32.31	20	23.25	45	42.05	30	32.67	42.5	40.61
11	27.5	31`.39	25	29.36	22.5	27.86	20	25.08	22.5	27.86	25	29.36
12	17.5	21.58	10	15.86	27.5	31.39	25	29.14	37.5	37.51	35	35.94
13	27.5	31.39	22.5	28.22	30	33.05	25	29.89	30	33.05	37.5	33.75
14	27.5	31.39	37.5	37.51	42.5	40.61	22.5	28.22	22.5	38.22	25	29.36

[a] Mean of four replicates.

[b]Percentage date were transformed into drcsine angels before carrying out the analysis of variance to produce approximately constant variance.

LSD (transformed date) for :

***Trichoderma* isolates (*T*)…….. ….= 3.50 (P ≤ 0.05)**

***Fusarium* isolate (*F*) ……=5.34(P ≤ 0.05)**

Interaction *T* x *F* …… …. …….= 13.1(P ≤ 0.05)

Tabel 6. Effect of *Trichoderma* isolates, *Fusarium solani* isolates and their interaction on post-emergence damping –off of cotton seedling (cv.Giza 92) under greenhouse conditions

Fusarim solani	*T.Harzianum* (T1)		*T.Harzianum* (T2)		*T.harzianum* (T 3)		*T.viride* (T 4)		*T.viride* (T 5)		control	
	%	Trans-b formed	%	Trans-formed	%	%	%	Trans-formed	%	Trans-formed	%	Trans-formed
1	27.5[a]	31.63	67.5	55.24	47.5	43.57	50	45	50	45	45	42.13
2	22.5	28.32	32.5	34.76	62.5	52.24	42.5	40.69	37.5	34.76	50	45
3	57.5	49.31	32.5	34.76	65	53.37	52.5	46.43	60	50.77	32.5	34.76
4	30	33.21	32.5	34.76	52.5	46.43	67.5	55.24	55	47.87	55	47.87
5	20	26.56	17.5	24.73	52.5	46.43	37.5	37.76	57.5	49.31	42.5	40.69
6	25	30	42.5	40.69	37.5	37.76	32.5	34.76	50	45	70	56.79
7	25	30	65	53.37	42.5	40.69	37.5	37.76	55	47.87	57.5	49.3
8	52.5	46.43	60	50.77	47.5	43.57	32.5	34.76	40	39.23	42.5	40.69
9	42.5	40.69	60	50.77	52.5	46.43	35	36.27	57.5	49.31	37.5	37.76
10	52.5	46.43	62.5	52.24	77.5	61.68	55	47.87	70	56.79	52.5	46.43
11	45	42.13	65	53.37	75	60	62.5	52.24	52.5	46.43	75	60
12	35	36.27	70	56.79	52.5	46.43	50	45	52.5	46.43	55	47.87
13	72.5	58.37	65	53.37	57.5	49.31	45	42.13	45	42.13	62.5	52.24
14	67.5	55.24	57.5	49.31	50	45	45	42.13	37.5	37.76	65	53.37

[a] Mean of four replicates.

[b]Percentage date were transformed into drcsine angels before carrying out the analysis of variance to produce approximately constant variance.

LSD (transformed date) for:

***Trichoderma* isolate (*T*)…….. ….= 4.107 (P ≤ 0.05)**

***Fusarium* isolate (*F*) ……=6.27(P ≤ 0.05)**

Interaction *T* x *F* …… …. …….= 15.37(P ≤ 0.05)

Trichoderma isolates were divided into two main groups based on their antagonism pattern. The first group included the three isolates of *T. harzianum* and the 2nd group included the two isolates of *T. viride* (Fig.1) *Fusarium* isolates were divided into three groups based on their response pattern to the antagonism of *Trichoderm* isolates. Each group included isolates from different governorates.

Tabel 7.Effect of *Trichoderma* isolates, *Fusarium solani* isolates and their interaction on survival of cotton seedling (cv.Giza 92) under greenhouse conditions

Fusarium solani	*T.Harzianum* (T1)		*T.Harzianum* (T2)		*T..harzianum* (T 3)		*T.viride* (T 4)		*T.viride* (T 5)		control	
	%	Trans-formed [b]	%	Trans-formed	%	%	%	Trans-formed	%	Trans-formed	%	Trans-formed
1	62.5[a]	52.24	15	22.79	30	33.21	17.5	24.73	20	26.56	27.5	31.63
2	47.5	43.57	50	45	17.5	24.73	30	33.21	32.5	34.76	17.5	24.73
3	30	33.21	57.5	49.31	20	26.56	32.5	34.76	17.5	24.73	32.5	34.76
4	32.5	34.76	40	39.23	32.5	34.76	2.5	9.10	17.5	24.73	17.5	24.73
5	35	36.27	60	50.77	17.5	24.73	45	42.13	12.5	20.70	2.5	9.10
6	25	30	25	30	30	33.21	57.5	49.31	15	22.79	0.0	0.0
7	30	33.21	17.5	24.73	35	36.27	57.5	49.31	10	18.44	15	22.79
8	12.5	20.70	15	22.79	30	33.21	45	42.13	30	33.21	10	18.44
9	12.5	20.70	5	12.92	20	26.56	35	36.27	15	22.79	12.5	20.70
10	15	22.79	7.5	15.89	2.5	9.10	0.0	0.0	2.5	9.10	5	12.92
11	27.5	31.63	10	18.44	2.5	9.10	17.5	24.73	25	30	0.0	0.0
12	27.5	31.63	20	26.56	17.5	24.73	25	30	10	18.44	5	12.92
13	0.0	0.0	7.5	15.89	12.5	20.70	30	33.21	25	30	0.0	0.0
14	5	12.92	5	12.92	2.5	9.10	32.5	34.76	40	39.23	7.5	15.89

[a] Mean of four replicates.

[b]Percentage date were transformed into drcsine angels before carrying out the analysis of variance to produce approximately constant variance.

LSD (transformed date) for isolate of:

***Trichoderma* isolate (*T*)…….. ….= 4.71 (P ≤ 0.05)**

***Fusarium* isolate (*F*) ……=7.25(P ≤ 0.05)**

Interaction *T* x *F* …… …. …….= 17.76(P ≤ 0.05)

Table 8. Effect of *Trichoderma* isolates, *Fusarium solani* isolates and their interaction on plant height and dry weight of cotton seedlings (cv. Giza 92) under greenhouse conditions

Fusarim solani	Plant height (cm/plant)							Dry weight (mg / plant)					
	(T1)	(T2)	(T3)	(T 4)	(T5)	control	Mean	(T1)	(T2)	(T3)	(T4)	(T5)	control
1	13.01[a]	24.62	12.31	24.68	22.76	19.95	19.56	204	301.5	314	296.3	179.5	186.8
2	27.40	26.48	23.27	27.22	21.14	18.62	28.56	201	293.3	227.3	318.3	264	136
3	26.33	31.01	23.15	33.14	25.67	20.56	26.64	286	314.3	281.3	244.5	162	152.3
4	22.22	22.92	27.93	26.85	24.38	22.30	24.43	307.3	311.3	280.3	76.8	244.5	128.8
5	23.52	19.95	21.19	29.22	24.33	13.13	21.89	278.3	272.3	234	279.5	174.3	45.8
6	23.59	29.16	20.79	20.52	20.76	0.0	19.14	210.8	268.3	317	257.8	321.3	0.0
7	22.33	20.57	7.13	32.61	21.86	10.89	19.23	280.8	294.3	265	201.3	155	143.3
8	27.94	22.24	20.08	26.89	22.55	21.44	23.52	224.8	238.3	227.3	209.5	304.3	109
9	17.08	13.05	22.01	23.42	21.84	6	17.23	321.5	164.5	219.8	294	163.3	118.5
10	22.67	20.88	24.92	0.0	24.07	17.91	18.41	255.8	235	83.25	0.0	81.5	62.8
11	23.81	25.41	26.09	15.69	23.68	18.69	22.23	183.5	87.5	81	240.5	309.3	0.0
12	23.89	21.64	18.78	24.64	20.67	11.55	20.19	260.5	252.3	239.5	242.5	146.8	63.5
13	0.0	19.64	22.54	23.99	0.0	21.33	14.58	0.0	98.5	249.8	283.8	234.5	0.0
14	23.93	25.32	10.52	24.38	18.17	15.43	19.83	151	164.8	88.8	157.3	123.5	118.3
Mean	21.27	23.06	20.05	23.80	20.85	15.56	----	----	----	----	----	----	----

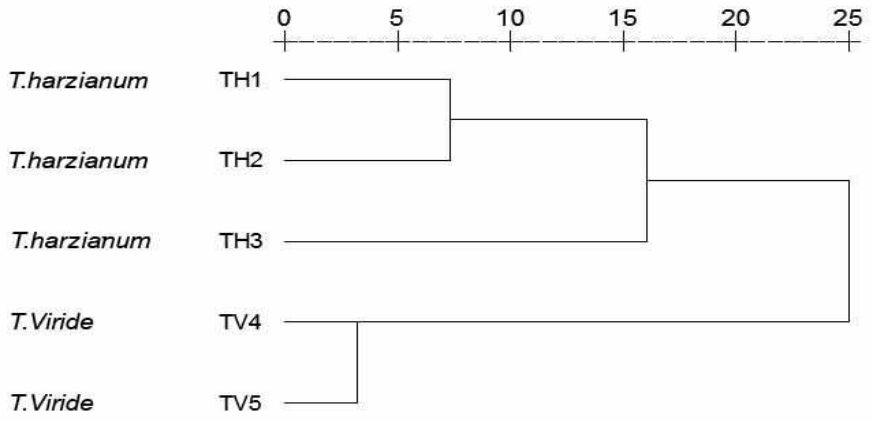
[a] Mean of four replicates.

LSD for:

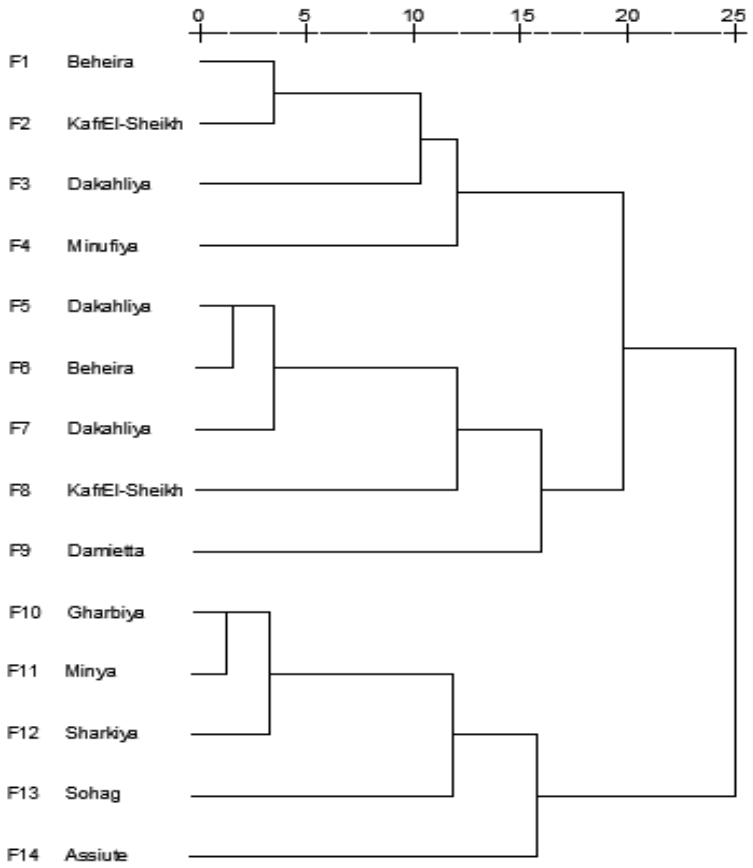
***Trichoderma* isolate (*T*)…….. ….= 4.23 (P ≤ 0.05)**

***Fusarium* isolate (*F*) ……=4.23(P ≤ 0.05)**

Interaction *T* x *F* …… …. …….= 152.82(P ≤ 0.05)



Fig(1) Phenogeram based on average linkage cluster analysis of antagonism patterns for 5 isolates of *Trichoderma* spp. against 14 isolates of *F. solani*.



Fig(2) Phenogeram based on average linkage cluster analysis of response pattern of 14 isolates of *Fusarium solani* to the antagonism of *Tricoderma* isolates.

DISCUSSION

Three isolates of *T. harzianum* and two isolates of *T. viride* were evaluated *in vivo*, to assess their antagonistic potential against *Fusarium solani* implicated in seedling damping-off of cotton. The interaction between *Trichoderma* isolates and *Fusarium solani* isolates was very highly significant source of variation for most of the tested parameters except plant heigh. This interaction implies that a single isolate of antagonist can be highly effective against an isolate of *F.solani*, but may have only minimal effects on the other isolates of *F.solani*. Bell *et al* .(1982) reported similar results when they studied the *in vitro* antagonism of *Trichoderma* spp. against six fungal plant pathogens. The findings of the present study have an important bearing on antagonism testing methods. Isolates of *Trichoderma* spp.should be

tested against as many isolates of *F.solani* as possible, as this will improve the chance of identifying *Trichoderma* spp. isolates effective against several isolates of *F.solani*. The interaction also suggests that it may be more prudent to evaluate blends of *Trichoderma* isolates for wider application against more isolates of *F.solani*. In this investigation, the interaction between *F.solani* and the *Trichoderma* spp. isolates was evaluated under greenhouse conditions in a soil and at temperatures favourable for the growth of both *F.solani* and *Trichoderma* spp. Under field conditions, soil nutrients and temperatures during the different periods of cotton growing season may be more favourable for *F.solani* isolates or for *Trichoderma* isolates. Thus, the results of present work are not expected to be necessarily related to the degree of biological control that may be observed in the field, but should reflect the capacities and genetic variability of the *Trichoderma* isolates and of the various *F.solani* isolates to resist antagonism (Bell *et. al*., I982). The application of cluster analysis has been suggested previously for assessing similarity and/or dissimilarity in gene—for-gene host-parasite relationships (Lebeda and Jendrulek, I987, Priestley *et al*., 1984). The method was also used to express exactly the genetic similarity among 48 physiological races of *Bremia lactucae* Regel (Lebeda and Jendrulek, 1987) and ‘20 isolates of *Macrophomina phaseolina* (Omar, 2005 and Asran-Amal *et.al* 2010). ln this study, cluster analysis divided the tested isolates of *F.solani* into groups based _on their response pattern to *Trichoderma* isolates.However, grouping the isolates was not related to their geographic origin. On the other hand, the cluster analysis of *Trichoderma* spp. isolates based on their biocontrol capacity showed that grouping the isolates was related to their morphological taxonomy (Rifai, 1969). Thus, it seems reasonable to conclude that morphological variations among *T. harzianum* and *T.viride*, the basis of the genus taxonomy, may provide sufficient explanation for the variation in their biocontrol capacity against *F.solani* isolates.

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تثبيط فطر فيوزاريوم سولانى المسبب لمرض موت بادرات القطن بواسطة نوعين من التريكوديرما

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عزلت خمس عزلات من فطر التريكودرما تنتمى الى النوعين هيرزيانم وفيريدى من بادرات قطن مصابة بمرض موت البادرات ومن جذور نباتات بالغة مصابة بمرض عفن الجذور. قيمت قدرة العزلات على المقاومة الحيوية لعدد 14 عزلة من فطر فيوزاريوم سولانى المسبب لمرض موت بادرات القطن, وذلك تحت ظروف الصوبة. اظهرت نتائج تحليل التباين ان عزلات التريكودرما وعزلات فيوزاريوم سولانى والتفاعل بينهما كانت جميعا مصادر عالية المعنوية للتباين فى الصفات التالية : النسبة المئوية للبادرات الميتة قبل وبعد ظهورها فوق سطح التربة والنسبة المئوية للبادرات السليمة الباقية على قيد الحياة والوزن الجاف للبادرات فى حين كان التفاعل غير معنوى فى حالة طول البادرة.

اظهر التحليل العنقودى لعزلات التريكودرما بناء على قدرتها التضادية انقسامها الى مجموعتين رئيسيتين إحداهما تضم عزلات تريكودرما هيرزيانم والاخرى تضم عزلتى تريكودرما فيريدى. كذلك استخدم التحليل العنقودى لتقسيم عزلات فيوزاريوم سولانى الى مجاميع بناء على استجابتها لعزلات التريكودرما فوجد ان العزلات انقسمت الى ثلاثة مجاميع رئيسية الا أن هذه المجاميع لم ترتبط بالأصول الجغرافية للعزلات .