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Efficiency of *Trichoderma* Species on Control of Fusarium-rot, Root Knot and Reniform Nematodes Disease Complex on Sunflower

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Abstract: The effect of *Trichoderma* species in control of root- rot fungus, *Fusarium solani,* root-knot nematode, *Meloidogyne javanica* or reniform nematode, *Rotylenchulus reniformis* disease complex and on growth of sunflower plant was studied under greenhouse conditions. Treating two weeks old sunflower seedlings cv. Giza 1 with *Trichoderma harzianum, T. viride, T. koningii, T. reesei* or *T. hamatum* gave highly significant effect in control of fusarium-rot disease incidence and nematodes infection on sunflower roots. Infection of *F. solani* was highly increased in *M. javanica* infested soil than *R. reniformis.* Treatments of. *Trichoderma* species led to decrease *Fusarium* cfu counts in soil infested with either *M. javanica* or *R. reniformis* and also significantly improved the plant growth parameters. *T. hamatum, T. harzianum* and *T. koningii* gave the greatest reduction in disease incidence caused by *Fusarium, M. javanica* or *R. reniformis* infestation. Generally, there was highly significant reduction ($p<0.01$) in the number of fusarium-wilt disease and nematode population and increases in plant growth parameter of sunflower when treated with *Trichoderma* species.

Key words: Fungi, *Fusarium solani, Meloidogyne javanica,* Nematodes, Root-rot disease, *Rotylenchulus reniformis,* Sunflower, *Trichoderma*

Introduction

Sunflower plants, *Halianthus annus* L. attack by a number of infections microorganisms mostly fungi, bacteria and nematodes, which significantly reduce the yield quantity and quality (Amin and Youssef, 1997).

Root-rot diseases are still the most important diseases-affecting sunflowers. *Fusarium solani* is the main pathogen of these diseases (Bhutta *et al*., 1997). Fusarium-nematode interaction are known to decrease the quantity and quality of major world crops included tomato (Stephan *et al*., 1996), cotton (Colyer *et al*., 1997), vegetables (Ghaffar, 1995) and soybean (Mousa, 1994). Because of hazards involved in the use of pesticides, biological control of plant disease has received increasing attention as a promising supplement and now capturing the imagination of plant parasitic nematodes and plant pathogen (Amin, 1999). Of the various bio-agents, fungi of *Trichoderma* species have been known to suppress many soils borne fungi and nematode diseases under greenhouse and field conditions. *T. harzianum, T. hamatum* has been found to antagonize fungal plant pathogen and parasitic nematodes (Siddiqui *et al*., 1999).

The present study aimed to study the effect of *Trichoderma* species in control of *F. solani-M. javanica* or *R. reniformis* disease complex and on plant growth of sunflower seedlings.

Materials and Methods

The fungus, *Fusarium solani* (Mart.) was isolated from diseased sunflower plants and cultured on Potato Dextrose Agar (PDA). Spore suspension of the fungi was harvested and adjusted to 3×10^3 spores /mi. Seeds of sunflower *(Hellanthus annus* L.) cv. Giza 1 were sown in 15 cm diam., pots filled with one kg sandy loam soil (1:1 v/v) free of plant pathogen and parasitic nematodes. After germination (about two weeks), the plants in each pot were thinned to one plant/pot. The pots were divided to two groups, one for root-knot nematode, *Meloidogyne javanica* (Treub) Chitwood, 1949 and the other group for reniform nematode, *Rotylenchulus reniformis*. Two days before nematodes inoculation pots were infested with 3×10^3 colony forming units (cfu) g^{-1} soil of mixed population of *F. solani ,* as assessed soil dilution technique. Ten ml of spores suspension was pipetted around seedling roots in pots. Each pot was inoculated with 2000 infective stages of either *M. javanica* (eggs and juveniles) or *R. reniformis* (juveniles and unswollen females). Lin-inoculated - untreated four pots were served as check plants and other four pots inoculated -untreated served as check nematode. Two days after nematode inoculation seedlings were treated with conidia suspension of *Trichoderma harzianum* (Raifi), *T. viride* (Pers.), *T. koningii* (qudem), *T. reesei* (Simmons) and *T. hamatum* (Bon.) at a rate of 10 ml (5×10^5 cfu/g soil /seedling). There were four replicates of each treatment. The pots were arranged in a completely randomized design in a greenhouse at 30 ± 5°C. The pots were watered daily. After nine weeks of nematodes inoculation, sunflower plants were carefully uprooted and nematodes in roots were counted. Disease incidence caused by *F. solar),* during growth period was recorded. The incidence of *Fusarium* pathogen and *Trichoderma* species in soil rhizosphere was recorded as cfu/g soil and population counts respectively. The number of galls, females and egg-masses as compare to untreated pots was calculated for root-knot nematode and the number of females and egg-masses for *R. reniformis.* Length and weight of shoots and roots and flowering disc weight were recorded. Data was statistically analyzed using New Least Significant Difference (New LSD).

Results

The effect of *Trichoderma* species in control of fusariumrot in infested soil with nematodes on sunflower data in (Table 1) indicated that, percentages of root-rot disease caused by *F. solani* alone were 48%, while it was 88 and 68.6% in case of presence of *M. javanica* or *R. reniformis* respectively after 9 weeks of inoculation. Data also

Table 1: Effect of *Trichoderma* species in control of fusarium root-rot in infested soil with *Meloidogyne javanica* and *Rotylenchulus reniformis* on sunflower

	Fusarium disease incidence							
	Week after treatment							
	Meloidogyne javanica				*Rotylenchulus reniformis*			
Treatment	2wk	4wk	6wk	9wk	2wk	4wk	6wk	9wk
Fusarium solani (F.s)	16.6	24.0	40.0	48.0	16.6	24.0	40.0	48.0
Nematode +*Fusarium solani*	28.3	49.0	53.3	88.0	18.4	31.6	48.6	68.6
Trichoderma harizarum (T.h.)+ F.s)	0.0	2.4	3.6	5.4	0.0	2.4	3.6	5.4
Trichoderma viride (T.v)+ (F.s)	3.6	5.4	6.3	9.6	3.6	5.4	6.3	9.6
Trichoderma koningii (T.k)+(F.s)	2.3	4.6	6.2	9.6	2.3	4.6	6.2	9.6
Trichoderma reesei (T.r)+(F.s)	4.3	6.6	8.6	11.4	4.3	6.6	8.6	11.4
Trichoderma hamatum (T.ha) + (F.s)	0.0	0.3	0.3	0.3	0.0	0.3	0.3	0.3
(T.h) + (F.s) + Nematode	6.0	8.0	9.6	12.4	0.0	0.3	1.3	1.3
(T.v) + (F.s) +Nematode	8.6	9.4	12.3	18.6	2.3	3.3	4.6	5.6
(T.k) + (F.s) + Nematode	7.2	8.0	11.2	14.7	1.6	2.3	2.3	3.3
(T.r) + (F.s) + Nematode	9.3	11.6	14.6	20.4	3.6	5.6	6.3	9.6
(T.ha) + (F.s) + Nematode	5.3	3.4	6.6	8.4	1.3	1.6	2.3	2.3
New L.S.D 0.5	0.9	1.3	1.6	3.6	1.2	1.9	2.3	3.0
New L.S.D 0.01	1.4	3.3	2.9	6.3	2.9	3.3	4.2	5.6

Table 2: Effect of *Trichoderma* species in control of *Meloidogyne javanica* and *Rotylenchulus reniformis* in infested soil with *Fusarium solani* on sunflower

	Meloidogyne javanica					*Rotylenchulus reniformis*		
	Number of					Number of		
Treatment	Galls	Immature stages	Female	Eggmass	%female reduction	Female	Eggmass	%female reduction
Check Nematode (N)	78	41	86	66	0.0	115	84	0.0
Nematode *(N)*+*Fusarium solani*	41	23	34	31	55.1	65	61	43.5
Trichoderma harlzanum (T.h) +IN)	41	24	39	28	50.4	10	8	90.5
Trichoderma viride (T.v) + (N)	64	27	62	46	29.9	35	22	73.5
Trichoderma koningil (T.k) + (N)	48	30	33	17	50.4	41	21	75.0
Trichoderma reesei (T.r) +(N)	47	31	40	35	44.1	62	48	42.9
Trichoderma hamatum (T.ha) + (N)	32	20	26	25	63.8	38	24	71.4
(T.h)+*Fusarium solani* (F.s) + (N)	54	22	53	44	40.9	61	51	39.3
(T.v) + (F.s) + (N)	28	18	27	19	64.6	71	68	19.0
(T.k) + (F.s) + (N)	30	19	28	21	63.0	74	68	19.0
(T.r)+ (F.s) + (N)	58	31	50	45	36.2	71	69	17.9
(T.ha) + (F.s) + (N)	53	29	51	44	37.0	42	38	54.8
New L.S.D 0.5	9	10.3	12.8	6.6	-	12.3	10.5	-
New L.S.D 0.1	11.7	13.4	16.9	8.8	-	15.8	13.5	-

Table 3: Effect of *Trichoderma* species in the growth of *Fusarium solani* in soil rhizophere of sunflower grown in infested soil with *Meloidogyne javanica* or *Royenchulus reniformis*

	Cfu* 10^3/Weeks after treatment							
	Meloidogyne javanica				*Rotylenchulus reniformis*			
Treatment	1wk	3wk	6wk	9wk	lwk	3wk	6wk	9wk
Fusarium solani (F.s)	3.3	5.2	6.6	9.4	3.3	5.2	6.6	9.4
Nematode +*Fusarium solani*	4.3	9.2	14.6	24.4	3.8	5.3	11.2	18.6
Trichoderma harizarum (T.h.) + (F.s)	0.3	0.6	1.6	1.3	0.3	0.6	0.6	1.3
Trichoderma viride (T.v) + (F.s)	1.3	2.6	2.3	2.8	1.3	2.6	2.3	2.8
Trichoderma koningil (T.k) +(F.s)	0.6	1.3	1.8	1.5	0.6	1.3	1.8	1.5
Trichoderma reesei (T.0+ (F.s)	1.6	2.8	2.6	3.3	1.6	2.8	2.6	3.3
Trichoderma hamatum (T.ha)+ (F.s)	0.3	0.3	0.6	0.6	0.3	0.3	0.6	0.6
(T.h)+(F.s) +Nematode	0.6	1.3	1.6	2.3	0.6	1.3	1.6	2.3
(T.v)+ (F.s) + Nematode	2.3	3.0	3.3	3.6	2.0	2.8	3.0	3.3
(T.k)+ (F.s) + Nematode	1.6	2.6	2.8	2.6	1.3	1.6	2.3	2.3
(T.r) + (F.s) + Nematode	2.6	3.3	3.6	4.2	2.3	3.3	3.0	3.6
(T.ha) + (F.s) +Nematode	0.6	1.0	1.3	1.3	0.6	0.6	1.0	1.0
New L.S.D 0.5	1.3	1.6	1.8	2.2	1.2	1.4	1.7	2.0
New L.S.D 0.01	2.6	2.9	3.3	5.6	2.4	2.6	3.0	4.9

showed that, application of antagonistic microorganisms Trichoderma species resulted in decrease of *Fusarium* infection. A complete control of fusarium root-rot infection was observed in case of *T. hamatum* treatment. *T. harzianum* was highly effective in controlling fusarium root-rot , while *T. viride* and *T. reesei* were less effective. Data also showed that, the effect of *Trichoderma* species on fungi-nematodes interaction. It means that the percentage

Table 4: Populatin Count of *Trichoderma* species in soil rhizosphere of sunflower grown in infested soil with *Fusarium sawn', Meloidogyne javanica* or *Rotylenchulus reniformis*

	Population counts (cfu*10^4/Weeks after treatemt							
	Meloidogyne javanica				*Rotylenchulus reniformis*			
Treatment	2wk	4wk	6wk	9wk	2wk	4wk	6wk	9wk
Trichoderma harzianum (T.h)	4.6	8.4	14.6	22.3	4.6	8.4	14.6	22.3
Trichoderma viride (T.v)	2.6	5.6	7.5	9.6	2.6	5.6	7.5	9.6
Trichoderma koningii (T.k)	3.6	7.8	9.1	11.6	3.6	7.8	9.1	11.6
Trichoderma reesei (T.r)	3.0	4.2	5.2	7.6	3.0	4.2	5.2	7.6
Trichoderma hamatum (T.ha)	8.6	10.4	16.4	32.3	8.6	10.4	16.4	32.3
(T.h.) + (*Fusarium solani* (F.s)	5.9	9.5	16.6	28.6	5.9	9.5	16.6	28.6
(T.v) + (F.s)	3.8	6.8	9.4	13.6	3.8	6.8	9.4	13.6
(T.k) + (F.s)	3.6	8.6	11.1	15.6	3.6	8.6	11.1	15.6
(T.r) + (F.s)	4.3	7.2	8.6	10.4	4.3	7.2	8.6	10.4
(T.ha) + (F.s)	9.5	14.6	22.6	48.6	9.5	14.6	22.6	48.6
(T.h) 4- Nematode (N)	11.6	18.6	24.3	31.6	9.3	13.4	21.6	23.7
(T.v) + Nematode	8.6	14.6	20.4	26.7	6.7	10.4	16.4	18.2
(T.k) + Nematode	9.7	16.4	18.6	26.0	7.1	12.1	14.4	20.2
(T.r) + Nematode	6.2	7.6	9.4	14.6	4.6	5.4	6.4	11.7
(T.ha) + Nematode	16.6	20.4	36.6	56.6	11.4	17.8	24.6	48.8
(T.h.) + (F.s) + (N)	12.4	22.6	34.0	41.6	10.6	18.6	29.0	29.9
(T.v) + (F.s) + (N)	10.6	16.4	21.3	34.2	8.0	15.0	21.4	24.6
(T.k) + (F.s) + (N)	14.6	18.7	26.6	30.3	9.0	16.4	28.0	30.1
(T.r) + (F.s) + (N)	7.6	8.6	10.8	18.6	5.1	6.8	10.6	14.6
(T.ha) + (F.s) + (N)	19.1	26.0	41.6	64.0	16.4	23.0	37.0	53.6
New L.S.D 0.5	2.6	3.5	9.4	13.6	2.3	3.0	7.2	11.4
New L.S.D 0.01	5.8	6.8	12.4	16.5	5.1	5.8	10.3	15.7

Table 5: Effect of *Trichoderma* species in the growth of sunflower in infested soil with *Fusarium solani* and/or *Rotylenchulus reniformis*

	Plant length (cm)		Plant fresh weight (g)		Plant dray weight (g)		Flower disc weight(g)	
Treatment	Root	Shoot	Root	Shoot	Root	Shoot	Fresh	Dray
Trichoderma hazrianum (T.h)	13.6	84.1	3.9	11.5	0.6	3.0	1.6	0.4
Trichoderma viride (T.v)	12.5	80.0	2.0	10.6	0.5	2.8	1.2	1.4
Trichoderma koningii (T.k)	13.1	81.2	3.2	10.8	0.5	2.9	1.3	0.4
Trichoderma reesei (T.r)	12.9	76.2	3.0	9.0	0.4	2.7	1.3	0.4
Trichoderma hamatum (T.ha)	14.0	85.0	3.7	11.5	0.6	3.3	1.6	0.4
(T.h) + *Fusarium solani* (F.s)	11.9	80.6	3.5	10.9	0.9	2.8	1.3	0.4
(T.v) + (F.s)	10.9	70.4	2.4	8.2	0.4	2.4	1.1	0.3
(T.k) + (F.s)	11.2	75.0	3.1	8.4	0.4	2.6	1.1	0.3
(T.r) + (F.s)	10.0	69.5	3.0	7.0	0.4	2.0	1.0	0.3
(T.ha) + (F.s)	11.8	81.3	3.4	10.8	0.4	2.8	1.4	0.5
(T.h) + *Rotylechulus reniformis* (R.r)	12.9	83.3	3.5	11.2	0.5	2.9	1.3	0.4
(T.v) + (Rr)	12.0	79.4	2.9	11.4	0.4	2.7	1.1	0.3
(T.k) + (Rr)	12.6	82.1	3.6	10.7	0.5	2.8	1.3	0.4
(T.r) + (Rr)	11.4	71.6	2.8	9.5	0.4	2.4	1.0	0.4
(T.ha) + (Rr)	12.3	86.6	3.9	11.0	0.5	2.9	1.5	0.4
(T.h) + (F.s) + (Rr)	12.3	81.6	3.2	10.0	0.5	2.8	1.3	0.4
(T.v) + (F.s) + (Rr)	11.6	79.4	2.7	7.9	0.4	1.9	1.0	0.3
(T.k) + (F.s) + (Rr)	12.6	80.0	3.3	8.0	0.4	2.5	1.2	0.3
(T.r) + (F.s) + (Rr	11.0	74.0	2.6	7.0	3.3	8.0	0.4	2.5
(T.ha) + (F.s) + (Rr)	12.9	82.9	3.2	10.2	0.5	2.4	1.3	0.4
Check (*Fusarium*	6.4	58.0	0.9	7.1	0.1	1.6	0.4	0.2
Check (*Rotylenchulus reniformis*) (R.r)	5.6	55.0	0.8	5.0	0.1	1.0	0.4	0.2
Check (F.s) + *R. reniformis* (Rr)	5.2	51.2	0.7	3.9	0.7	0.1	0.3	0.1
Check (Plant)	7.8	81.3	1.0	7.6	0.3	2.0	0.6	0.3
New L.S.D 0.5	0.52	3.3	0.3	0.52	0.16	0.10	0.21	0.12
New L.S.D 0.01	2.2	5.7	0.78	1.2	0.5	0.39	0.5	0.36

of root-rot was great decreased in soil infested with either *M. javanica* or *R. reniformis. T. hamatum* and *T. harzianum* showed more effective in reducing disease incidence in the soil infested with *M. javanica or R. reniformis.* While, *T. reesei* showed less effective in reducing the pathogen incidence.

Use of *Trichoderma* species alone or in combination with *F. solani* gave a highly significant ($p<0.01$) reduction of female and egg-masses of root-knot and reniform nematode (Table 2). Great reduction in root-knot nematode females (more than 50%) was recorded where *T. hamatum, T. harzianum* and *T. koningii* were used alone followed by T. viride and *T. koningii* when treated in combination with *F. solani.* The same trend was noticed in the number of galls and immature stages in roots.

Highly significant reductions were observed on female reduction of *R. reniformis* (Table 2) where *T. harzianum* and *T. koningii* were used followed by *T. viride* and *T. hamatum* when used alone. Whereas, *Trichoderma* species treated with *F. solani,* a highly significant reduction in reniform nematode, was observed in case of *T. hamatum* and *T. harzianum.* It also noticed that, use of *F. solani* with

Table 6: Effect of *Trichoderma* species in the growth of sunflower in infested soil with *Fusarium solani* and / or *Meloidogyne javanica*

Treatment	Plant length (cm) Root	Plant length (cm) Shoot	Plant fresh weight (g) Root	Plant fresh weight (g) Shoot	Plant dray weight (g) Root	Plant dray weight (g) Shoot	Flower disc weight (g) Fresh	Flower disc weight (g) Dray
Trichoderma harzianum (T.h.)	12.8	86.3	3.9	12.3	0.6	2.5	1.4	0.5
Trichoderma viride (T.v.)	12.9	83.3	2.7	10.1	0.5	1.9	1.2	0.4
Trichoderma koningii (T.k)	12.5	80.5	3.3	10.6	0.6	1.9	1.3	0.4
Trichoderma reesei (T.r)	13.0	86.5	2.6	10.2	0.5	1.7	1.2	0.4
Trichoderma hamatum (T.ha)	11.8	88.0	3.8	11.6	0.7	2.4	1.6	0.4
(T.h.) + *(Fusarium solani* (F.s)	12.8	82.6	3.6	11.6	0.4	2.6	1.3	0.4
(T.v.) + (F.s)	12.3	73.6	2.3	7.8	0.4	2.5	1.1	0.4
(T.k) + (F.s)	11.6	71.6	3.3	8.0	0.4	2.4	1.2	0.4
(T.r) + (F.s)	10.8	70.0	3.0	7.3	0.5	1.9	1.1	0.4
(T.ha) + (F.s)	12.3	86.0	3.5	9.8	0.4	2.8	1.6	0.5
Meloidogyne javanica (M.j)	12.6	85.5	3.2	10.6	0.4	2.7	1.4	0.4
(T.v) + (M.j)	12.0	76.6	2.6	10.2	0.4	2.6	1.1	0.4
(T.k) + (M.j)	12.5	80.0	3.0	10.5	0.4	2.1	1.4	0.4
(T.r) + (M.j)	11.0	74.0	2.3	8.8	0.5	2.0	1.0	0.3
(T.ha) + (M.j)	12.3	84.3	3.3	10.6	0.4	2.1	1.7	0.5
(T.h) + (F.s) + (M.j)	11.9	79.8	3.0	9.1	0.4	2.0	1.2	0.4
(Ty) + (F.s) + (M.j)	11.6	77.3	2.2	7.1	0.4	1.7	0.8	0.3
(T.k) + (F.s) + (MA)	11.3	75.5	2.8	7.4	0.4	2.0	1.1	0.3
(T.r) + (F.s) + (M.j)	10.2	70.1	2.1	7.0	0.3	1.9	0.8	0.2
(T.ha) + (F.s) + (M.j)	12.0	80.7	3.0	9.2	0.4	2.2	1.2	0.3
Check (*F. solani*)	6.2	59.3	0.9	7.0	0.2	1.5	0.7	0.2
Check (*M. javanica* (M.j))	12.3	71.0	3.1	3.3	0.8	0.5	0.1	0.0
Check (F.s.) + Nematode (M.j)	4.6	45.6	3.7	2.8	0.9	0.2	0.0	0.5
Check (plant)	8.0	80.0	1.2	8.0	0.3	2.0	0.7	0.4
New L.S.D 0.5	0.5	4.3	0.4	0.8	0.13	0.2	0.13	0.1
New L.S.D 0.1	1.2	6.6	0.9	2.1	0.43	0.48	0.46	0.30

either *M. javanica* or *R. reniformis* gave 55.1 and 43.5% female reduction respectively.

Due to the effect of *Trichoderma* species on *Fusarium* population treated in *M. javanica* or *R. reniformis* infested soil. Population density of *F. solani* was increased in soil rhizospere until 9 weeks of plant growth by 9.4×10^4 cfu/g soil (Table 3). Also, data showed that population density of *F. solani* was greatly increased in soil infested with either *M. javanica* or *R. reniformis.* Inoculation soil with *M. javanica* increased *F. solani* population counts in soil than did reniform nematode, *R. reniformis.* Treatment of *Trichoderma* species recorded minimum population density of *F. solani. T. hamatum* and *T. harzianum* gave highly reduction in *F. solani* by 0.6×10^4 and 1.3×10^4 cfu/g soil. Moreover, these antagonisms gave greatly effect in reducing *Fusarium* count in infested soil with either *M. javanica* or *R. reniformis.*

Concerning *Trichoderma* population in fungal-nematodes infested soil, data indicated that population density of *Trichoderma* species was increased in soil rhizospere until 9 weeks of plant growth (Table 4). *T. hamatum* and *T. harzianum* counts were higher in soil rhizosphere during 9 weeks compare with other *Trichoderma* species. Moreover, *T. koningii* colonization was multiplied three times from one to 9 weeks in soil rhizosphere. The infested soil with both *Fusarium* and nematodes, the result, indicated that increased in population of *Trichoderma* in soil rhizosphere. The highest population counts was obtained in infested soil with *M. javanica* alone or with *F. solani.* Also, the addition of *T. harzianum* or *T. hamatum* in infested soil with *F. solani* and *M. javanica* or *R. reniformis* yielded the highest population in soil rhizosphere.

Due to the effectiveness of *Trichoderma* species on plant growth in infested soil with fungal-nematodes disease complex, results present in (Table 5, 6) revealed that, soil infested with *F. solani* significantly ($p<0.05$) decrease plant height and weight. Also, soil infested with *F. solani* when mixed with *M. javanica* led to lowest value of plant length, weight and flower disc weight. But the treatment of *Trichoderma* species alone or in combination with root-rot fungus or nematodes was significantly increased plant growth parameters. *T. hamatum, T. harzianum* and *T. koningii* gave the best result in plant growth parameter. While, a slight increase was observed in *T. reesei.*

Discussion

In the present study, data showed that *F. solani* treated with root-knot or reniform nematodes increased root-rot disease incidence to a great extend than plant infested with the pathogen alone (Table 1). Also, plant infection was greatly increased in soil infested with *M. javanica* than *R. reniformis.* This result can be explained that nematodes predispose the plant pathogen invasion, as has been reported (Siddiqui *et al*., 1999). The interaction between the pathogen fungi and the endo-parasitic nematode, *M. javanica* gave a great damage to plant growth than the semi-endo parasite nematode, *R. reniformis* (Mousa, 1994). The addition of *Trichoderma* species in controlling disease complex caused by root-rot and root-knot or reniform nematodes, data indicated that, significant reduction in the pathogen and nematodes population and increased plant growth parameter. Several species of *Trichoderma* have been reported to suppress soil borne disease fungi included *Fusarium* and parasitic nematodes (Siddiqui *et al*., 1999). *Trichoderma* species are known to produce other secondary metabolites such as enzymes (Di Pietro, 1995). These enzymes in biocontrol can often assigned in both mechanism parasitism and antibiosis. In particular cell wall degrading enzymes such as chitinase, B-1,3-glucanases and cellulase, but only important features of micoparasites for colonization of their pathogens, but exhibit considerable antifungal activity on their one. Chitinase enzymes have been consider important in the biocontrol pathogenic fungi at low concentration because of their ability to degrade fungal cell walls of which a major component is chitin (Lorito *et al*., 1993). Also, most plant parasitic nematode eggs have a second layer is a thick chitins layer of eggshell, which is secreted by the egg (Lee, 1965). Recently, has been achieved for various chitinases, B-1, Bglucanase and cellulase from biocontrol fungi, *T. harzianum, T. hamatum* and *T. koningii* (Cotes *et al*., 1996). Whereas cellulase , glucanase and glucosidase are main enzymes produce by *T. viride* and *T. reesei* (Kanotra and Mathur, 1995). Lorito *et al*. (1993) found that two purified chitinase from *T. harzianum* inhibited *F. solani* growth at 30 mg/ml concentration. Besides parasitism of root-knot nematode it also hypothesized that the production of nematicidal compounds by *Trichoderma* species directly affected the nematode or made rootless attractive which might have resulted the reduction in the nematode population. These, results confirm the report of Siddiqui *et al*. (1999). Moreover, many authors recorded that, *Trichoderma* species as nematophagous fungi on eggs, larvae and females of cyst nematodes (Meyer *et al*., 1990).

In this study, treatment of *Trichoderma* species successfully reduced fungal-nematodes disease complex and increased plant growth parameter. In conclusion, the present study demonstrated the important of using biocontrol agents in reducing the damages of fungi-nematodes disease complex in order to manage the disease on economic crops.

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