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Efficacy of *Gliocladium virens* and *Talaromyces flavus* with and without Organic Amendments Against *Meloidogyne javanica* Infecting Eggplant

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Abstract: The efficacy of *Gliocladium virens* and *Talaromyces flavus* with and without the amendments of oil cakes of castor, groundnut, linseed, mahua and neem against *Meloidogyne javanica* infecting eggplant was evaluated under glass house conditions. All the treatments significantly improved the plant growth and reduced nematode multiplication and root galling as compared to plants inoculated with *M. javanica* alone. The individual treatment of *Gliocladium virens* was more effective in reducing nematode multiplication and improving plant growth than that of *T. flavus*. The amendment of neem cake with both the fungal biocontrol agents was found to be the best treatment for managing *M. javanica* infecting eggplant.

Key words: *Gliocladium virens*, *Talaromyces flavus*, oil cakes, *Meloidogyne javanica*, biocontrol, eggplant

INTRODUCTION

The root knot nematode *Meloidogyne javanica* is an important pest of eggplant in India and else where in the world. The use of nematicides in the disease management practices has been restricted because they pose a threat to environment, humans and wildlife. Organic amendments are not only safe to the humans and environment but also have the capability to improve the physical properties of soil besides suppressing the nematode populations. Among the organic amendments the oil cakes of several plants have been found to be effective against plant parasitic nematodes as reported by different workers (Khan and Saxena, 1997; Srivastava, 2002; Ahmad and Choudury, 2004; Ashraf *et al*., 2005). Similarly several opportunistic fungi have been reported to be effective in the management of plant parasitic nematodes (Papavizas, 1985; Jatala, 1986; Jimenez and Gallod, 1988; Khan and Saxena, 1997; Sankaranarayanan *et al*., 1998; Manuzca Gomez and Varon de Agudelo, 2001; Ashraf *et al*., 2005). Moreover combining the use of organic amendments with the promising opportunistic fungal biocontrol agents might result in enhanced biocontrol activities against plant parasitic nematodes.

Hence the present study was carried out to explore the efficacy of opportunistic fungal biocontrol agents *Gliocladium virens* and *Talaromyces flavus* with and without the integration of different oil cakes for the management of root knot nematode, *M. javanica* infecting eggplant under glasshouse conditions.

MATERIALS AND METHODS

Powdered oil cakes of castor (*Ricinus communis* L.), linseed (*Linum usitatissimum*), groundnut (*Arachis hypogea* L.), mahua (*Madhuca indica* Gmel) and neem (*Azadirachta indica* A. Juss.) were applied separately at the rate of 10 g per pot containing 1 kg sterilized soil + river sand + farmyard

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manure (3:1:1) mixture. The pots were watered after treatment to ensure proper decomposition of oil cakes. After two weeks of waiting period, three week old seedlings of eggplant var. Pusa Purple Long were transplanted one per pot. One day after planting these seedlings were inoculated either individually with 1000 freshly hatched second-stage juveniles of *M. javanica* or concomitantly with 1 g (mycelium + spores) of the tested fungi (*G. virens* or *T. flavus*). Inoculations were done by carefully removing the top layer of soil and the required quantity of nematode suspension and/or fungul inoculum was poured uniformly all around the exposed roots using sterilized pipette. Exposed roots were immediately covered by levelling the soil properly. Untreated and uninoculated plants served as control. Each treatment was replicated three times and suitably randomized on a glass house bench. Watering was done as and when required.

After 60 days of inoculation, plants were uprooted and roots carefully washed thoroughly in slow running tap water. Observations were recorded on plant growth characters viz. length and dry weight. For interpretation of the results, the reduction in plant growth was calculated in terms of percentage dry weight reduction. The galling caused by root-knot nematodes was estimated by counting the number of galls per root system. The nematode population both in soil and roots was determined by using the method as suggested by Southey (1986). Reproduction factor of nematode was calculated by the formula R = Pf/Pi, where Pf represented the final and Pi initial population of the nematode. Percentage of fungal infection in eggmass and eggs was recorded according to Khan and Husain (1990). The data were analyzed statistically and the averages compared according to Duncan's multiple range test.

RESULTS

The perusal of data presented in Table 1 clearly shows that *Meloidogyne javanica* caused significant reduction in plant growth (48.7%) of eggplant as compared to uninoculated plants grown in unamended soil. The soil amendments either individually with biocontrol agents (*Gliocladium virens* and *Talaromyces flavus*) or concomitantly with bioagent and oil cake, resulted in significant improvement in plant growth and reduction in the nematode multiplication and the root galling caused by *M. javanica* as compared to plants inoculated with *M. javanica* alone. The individual treatment of *G. virens* was found to be more effective against *M. javanica* than that of *T. flavus*. The efficacy of both the biocontrol agents in reducing nematode multiplication and root galling and improving plant

Table 1: Efficacy of *Gliocladium virens* and *Talaromyces flavus* with and without the amendments of oil cakes against *Meloidogyne javanica* infecting eggplant var. Pusa Purple Long.

Treatments	Plant length (cm)	Plant dry weight (g)	Reduction in dry weight over control (%)	Nematode population/ pot	R = Pf/Pi	No. of galls/ root System	Fungal infection (%)	
							Eggs	Egg masses
Control	64.9^{a}	19.9^{a}	-	-	-	-	-	-
M. javanica (Mj)	34.2^{g}	10.2^{f}	48.7	13510	13.5^{a}	158^{a}	-	-
Mj + *G. virens* (Gv)	43.8^{de}	12.7^{d}	36.2	11710	11.7^{c}	129^{c}	18^{e}	23^{j}
Castor cake (Cc) + Mj + Gv	45.8^{cd}	13.7^{b}	31.2	9339	9.3^{f}	88^{g}	27^{c}	37^{h}
Groundnut cake (Gc) + Mj + Gv	47.4^{b}	13.9^{b}	30.2	9243	9.2^{f}	85^{g}	29^{c}	39^{gh}
Linseed cake (Lc) + Mj + Gv	50.4^{b}	14.9^{a}	25.1	7420	7.4^{g}	55^{i}	32^{b}	46^{ef}
Mahua cake (Mc) + Mj + Gv	43.7^{e}	13.0^{cd}	34.7	11251	11.2^{d}	119^{e}	22^{d}	30^{i}
Neem cake (Nc) + Mj + Gv	52.0^{b}	15.2^{a}	23.6	7131	7.1^{g}	52^{i}	35^{a}	50de
Mj + *T. flavus* (Tf)	38.3^{f}	11.1^{e}	44.2	13000	13.0^{b}	149^{b}	-	40^{gh}
Mj + Tf + Cc	47.0^{c}	13.8^{b}	30.6	9509	9.5^{f}	88^{g}	-	67^{b}
Mj + Tf + Gc	43.3^{e}	12.8^{d}	35.7	11506	11.5^{cd}	125^{d}	-	54^{d}
Mj + Tf + Lc	46.1^{cd}	13.3^{c}	33.2	10625	10.6^{e}	102^{f}	-	61^{c}
Mj + Tf + Mc	38.3^{f}	11.2^{e}	43.7	12809	12.8^{b}	147^{b}	-	44^{fg}
Mj + Tf + Nc	52.3^{b}	14.0^{b}	29.6	9211	9.2^{f}	80^{h}	-	76^{a}
CD (P = 0.05)	2.8	0.30			0.4	3.6	2.8	5.0

Values of the same column sharing a common letter are not significantly different (P = 0.05)

growth increased in presence of different oil cakes. The highest improvement in plant growth and best protection of eggplant against *M. javanica* was observed by the application of *G. virens* with neem cake where as the combination of *T.flavus* with mahua cake was least effective in managing *M. javanica* on eggplant. The integration of neem cake with *G. virens* gave best results in managing *M. javanica* which was followed by oil cakes of linseed, groundnut, castor and mahua where as the integration of *T. flavus* with neem cake was most effective followed by castor, linseed, groundnut and mahua. The combination of oil cakes with either of the bioagents increased the fungal parasitism of eggs and eggmasses of *M. javanica* (except *T. flavus* which was unable to infect eggs) as against the individual application of biocontrol agents. Integration of *G. virens* with neem cake resulted in the highest infection of eggs (35%) and that of *T. flavus* with neem cake gave highest infection (76%) of eggmasses of *M. javanica.*

DISCUSSION

The results clearly indicate that these opportunistic fungal biocontrol agents i.e., *G. virens* and *T. flavus* were able to manage *M. javanica* infecting eggplant under Indian agro-climatic conditions by parasitizing eggmasses and eggs except *T. flavus* which parasitized only eggsmasses. The nematicidal effect of *Gliocladium* sp. against root-knot nematode have been reported by several workers (Sankaranarayanan *et al*., 1998; Manuzca Gomez and Varon de Agudelo, 2001). Similarly *Gliocladium* have been reported as a potential fungal bioagent against several plant pathogens and plant parasitic nematodes (Papavizas, 1985). The efficacy of *G. virens* and *T. flavus* in managing root-knot nematode, *M. javanica* was increased in presence of either of the oil cakes of castor, groundnut, linseed, mahua and neem. The incorporation of soil amendments may be effective in controlling nematodes primarily by altering soil microorganisms (Godoy *et al*., 1983; Rodriguez-Kabana *et al*., 1987). The nematicidal effect of organic amendments may be associated with breakdown of nitrogenous materials (Sikora, 1992). Moreover several nematicidal compounds (organic acids, hydrogen sulfide, nitrogenous ammonia, phenols, tannins) are released during the degradation of organic amendments or synthesized by microorganisms involved in such degradation (Rodriguez-Kabana *et al*., 1995). The fungal biocontrol agents utilize oil cakes to grow and multiply, which increases their parasitism on eggs and eggmasses of nematode. These factors seem to be responsible for the effectiveness of oil cakes and biocontrol agents viz. *G. virens* and *T. flavus* in reducing the population buildup of *M. javanica* and improving plant growth of eggplant. The present results suggest that there is a great possibility of integrating oil cakes of different plants with these biocontrol agents in the management of root knot nematodes.

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