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Studies on the bio-efficacy of *Dactylaria brochopaga* against root-knot nematode *Meloidogyne incognita* on brinjal

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Abstract

The *In vivo* efficacy of *Dactylaria brochopaga* against root-knot nematode, *Meloidogyne incognita* on brinjal was studied. The observations on predacity test of *D. brochopaga* against J₂ of *Meloidogyne incognita* showed that J₂ trapping increased with the increase in J₂ population and the exposure time allowed for trapping in culture being maximum at 96 hours of exposure period. While studying the effect of *D. brochopaga* in combination with various organic manures, the observations on plant height and root length showed increase in length significantly in all the treatments in comparison to the inoculated, uninoculated and treated check with minimum in inoculated check, 16.00 and 3.62 followed by treated check 18.50 and 7.50, 18.00 and 6.00 in T₃, 17.75 and 7.00 in T₁, 17.62 and 6.87 in T₂, 17.25 and 6.50 in T₄, 17.00 and 6.87 in T₅ respectively in descending order. The reproduction parameters of *Meloidogyne incognita* on brinjal i.e. Nematode population in root and soil, eggs/ plant, total nematode population and multiplication factor significant decreased in all the treatments over the inoculated check where as significant increase was observed over the treated check. The nematode population in root and soil, egg / plant, total nematode population and nematode multiplication factor was highest (121.75, 1198.00, 8642.50, 9962.25, and 6.64) in inoculated check followed by 52.25, 188.25, 3182.00, 3422.50 and 2.28 in T₅, 41.25, 182.75, 1639.50, 2163.00 and 1.44 in T₂ 46.75, 162.00, 1879.00, 2087.75 and 1.39 in T₄, 48.50, 156.75, 1836.75, 2042.00 and 1.36 in T₃, 42.50, 183.25, 1774.25, 2000.00 and 1.33 in T₁ with the minimum 26.50, 122.00, 1345.50, 1494.00 and 0.99 in treated check (T_s) respectively in descending order.

Keywords: Root-knot nematode, Nematode trapping fungi, Bio-efficacy, Bio-control of nematode, Nematode management

1. Introduction

Among plant parasitic nematodes, root-knot nematode, *Meloidogyne spp.* have been identified as one of the noxious nematode problem in India as well as in world over, causing enormous yield loss in brinjal crop along with more than 2000 plant species of vegetable, fruit, spices and causing average yield loss of 5% globally. (Hussy and Janssen, 2002) [7]. The avoidable yield loss in vegetable crops due to *Meloidogyne spp.* ranges between 28.3 to 47.5 in tomato, 26.5 to 50.0 in brinjal, 19.7 to 33.3 in chilli and 60.0 to 90.0 per cent in bitter gourd under Indian condition (AICRP, 1992). Among various approaches known so far for the management of root-knot nematode, culture practices are not generally preferred because of several inherent difficulties (Jatala 1985) [9]. Although nematicidal applications manage root-knot nematode population effectively but due to high cost, non-availability, mammalian toxicity, environmental pollution and resurgence of new nematode pests, biological control of root-knot nematode through nematode trapping and antagonistic fungi is observed to be the one of the potential approaches having ability to be the environmentally safe and effective as alone and in combination as an integral part of the integrated nematode management strategy. *Arthrobotrys oligospora* having proven its nematode controlling potential (Mankar, 1962; Kerry, 1987; Cooke, 1962) [15, 5, 10]. The sophisticated larval capturing mechanism and higher nematode predacity indicate the bio-control potential of *D. brochopaga*. (Singh *et al.*, 2007) [20]. Accordingly studies on the bio-efficacy of *D. brochopaga* against root-knot nematode, *Meloidogyne incognita* on brinjal was studied.

Materials and Methods

In vitro Studies on nematode capturing ability of *Dactylaria brochopaga* was tested against J₂ of root-knot nematode, *M. incognita* using the method as described by Belder and Jansen (1994) [4]. 2.00 mm fungal disc of *D. brochopaga* was taken from the periphery of 10-12 day old culture and inoculated into the 50 mm diameter petri dishes containing 1:10 maize meal agar

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medium (0.2% agar). The Inoculated maize meal agar plates were incubated at 28 ± 1 °C. For a period of 8 days and fungal discs were removed for the use in experimentation. The population of second stage of *M. incognita* was obtained from Brinjal infected plants. Egg masses were collected from roots in cavity blocks and incubated at 25 °C for 48 hours to obtain freshly hatched juveniles. The Juveniles were washed with sterile water before transferring into Petri dishes containing Fungus culture. A drop of sterile water containing J2 was poured with the help of micropipette into 8 day old Fungus cultures. All Petri dishes were incubated at 28 ± 1 °C for trapping. Four replications were maintained for each treatment and observations on number of captured J2 were recorded daily up to 4 days and percentage of captured J2 was calculated.

In vivo studies on bio-control efficacy of *D. brochopaga* against *M. incognita* on brinjal was conducted in pots at departmental field. For experimentation *M. incognita* infested sick soil having inoculum level of three larvae per gram of soil was used. Sick soil was hand mixed to make the nematode population uniform before adding amendments @ 15 gms/kg (Vermicompost, cow dung manure, goat dung and poultry manure) and mass culture of *D. Brochopaga* @ 10gms/kg soil with (3.20×10^5) cfu on weight bases. Sick soil without fungus and without amendments served as control. Fungus and amendments were uniformly mixed in sick soil before filling the pots. Three days old seedlings of brinjal Var. Pusa Purple Round free from nematode infection

were transplanted in pots, @ one seedling per pot. Each treatment were replicates 4 times. The pots were watered regularly and observations were recorded on plant height, root length, number of galls nematode population in root and soil population per plant after 45 days of planting.

Results and Discussion

The observations presented in table-1 on predacity test of *Dactylaria brochopaga* against J₂ of *Meloidogyne incognita* showed that J₂ trapping increased with the increase J₂ population and exposure time allowed for trapping in culture. The minimum J₂ trapping (4.50%) was observed in 100 J₂ level at 24 hours exposure period. It further increased to 5.62, 6.65, 8.44 and 10.85% after 24 hours, 37.50, 56.87, 63.92, 73.87 and 80.40% after 48 hours, 63.50, 72.87, 80.57, 89.56 and 95.65 after 72 hours and 82.50, 96.50, 99.50, 99.69 and 99.90 percent after 96 hours exposure period in 100, 200, 300, 400 and 500 nematode population level respectively in ascending order. The increase in percent predacity with the increase in time and population may be attributed to the time required for fungus to initiate trap formation on the mycelium. Various scientists have reported that in *D. brochopaga* nematode trapping device are initiated within 24 hours of exposure period in presence of nematode (Cooke, 1962, Jaffee, *et al.*, 1992; Persmark and Nordbring-Hertz 1997; Mankau, 1962, Kerry, 1987, Bandyopadhyay *et al.*, 2001; Kumar and Singh 2006; and Simon and Anamika 2011) [5, 8, 17, 15, 10, 3, 11-12, 18].

Table 1: Predacity effect of *D. brochopaga* against root-knot nematode, *Meloidogyne incognita* *in vitro* condition.

J ₂ Inoculum levels	% J ₂ captured/Exposure period(in hours)			
	24	48	72	96
100	4.50	37.50	63.50	82.50
200	5.62	56.87	72.87	96.50
300	6.65	63.92	80.57	99.50
400	8.44	73.87	89.56	99.69
500	10.85	80.40	95.65	99.90
CD. at 5%	0.88	1.26	1.32	1.62

The observations presented in table-2 on plant growth (i.e. plant height, root length) , root galls and nematode reproduction parameters (i.e. Nematode population in root and soil, Eggs/ Plant, Total Nematode Population and Multiplication factor) indicate that the use of *Dactylaria brochopaga* @ 10 gm/kg soil in combination with the goat dung, poultry manure, vermi-compost and cow dung @ 15 gms/kg soil significantly increased the plant root length and reduced the galls/plant, nematode population in root and soil, eggs/plant, total nematode population and nematode multiplication factor whereas no significant difference on plant height was observed. The minimum plant height and the root length i.e.16.00 and 3.62 was observed in inoculated check followed by treated check i.e.18.50.7.50, 18.00 and 6.00 in T₃, 17.75 and 7.00 in T₁, 17.62 and 6.87 in T₂, 17.25 and 6.50 in T₄, 17.00 and 6.87 in T₅ respectively in descending order. The decrease in plant height and root length in treatments may be due to nematode feeding feeder roots (T₆) and the use of carbofuran 3G @ 2kg ai/ha (T₈).The observation (Table-2) on reproduction parameters of *Meloidogyne incognita* on brinjal i.e. Nematode population in root and soil, eggs/ plant, total nematode population and multiplication factor significant decrease in all the treatments over the inoculated check where as significant increase was observed over the treated check. The nematode population in root and soil, egg/plant, total nematode population and

nematode multiplication factor was highest (121.75, 1198.00, 8642.50, 9962.25, and 6.64) in inoculated check followed by 52.25, 188.25, 3182.00, 3422.50 and 2.28 in T₅, 41.25, 182.75, 1639.50, 2163.00 and 1.44 in T₂ 46.75, 162.00, 1879.00, 2087.75 and 1.39 in T₄, 48.50, 156.75, 1836.75, 2042.00 and 1.36 in T₃, 42.50, 183.25, 1774.25, 2000.00 and 1.33 in T₁ with the minimum 26.50, 122.00, 1345.50, 1494.00 and 0.99 in treated check (T₈) respectively in descending order.

The plant height and root length and nematode reproduction parameters where *D. brochopaga* was applied in combination with organic manures may be attributed to the fact that on decomposition the organic manures releases various organic acids which might have acted as the limiting factor for nematode activity and increase in nutrient supply to the plant and enhanced the tolerance level of plant against nematode feeding resulted in to increase over (T₇) and decrease in comparison to other checks (T₆ & T₈). The results observed are fully supported by Singh *et al.*, (2007) [20] He reported that the effect of *D. brochopaga* reduce 90% root-knot disease in rice and Linford and Yap (1938, 1939) [13-14] observed that out of five species of nematode trapping fungi incorporated in the soil, only a few gave a little control of nematodes. However, when nematode trapping fungi were incorporated with organic matter, they showed better effect. Bandyopadhyay 2001 [3]; El-Nagdi *et al.* 2003 [6]; Mohamed *et al.* 2011 [16]; Simon and

Anamika 2011 [18]; and Arndt 1994 [2] also observed that inoculation of the organic substrate with the *A. oligospora* and

D. brochopaga reduced the population of *M. incognita* in tomato plant.

Table 2: Effect of *Dactylaria brochopaga* in combination with organic manures on root- knot nematode, *Meloidogyne incognita* multiplication on brinjal.

Treatments	Plant Height (In cm)	Root Length (In cm)	Galls/ Plant	Nematode Population		Eggs/ Plant	Total Nematode Population	M/F
				In Root	In soil			
T ₁	17.75	7.00	21.75	42.50	183.25	1774.25 (42.12)	2000.00 (44.72)	1.33
T ₂	17.62	6.87	21.50	41.25	182.75	1639.50 (40.49)	2163.00 (46.51)	1.44
T ₃	18.00	6.00	23.25	48.50	156.75	1836.75 (42.86)	2042.00 (45.19)	1.36
T ₄	17.25	6.50	22.75	46.75	162.00	1879.00 (42.30)	2087.75 (45.69)	1.39
T ₅	17.00	5.87	28.00	52.25	188.25	3182.00 (56.41)	3422.50 (58.50)	2.28
T ₆	16.00	3.62	52.25	121.75	1198.00	8642.50 (92.96)	9662.25 (98.30)	6.64
T ₇	19.75	8.12						
T ₈	18.50	7.50	1200	26.50	122.00	1345.50 (36.68)	1494.00 (38.65)	0.99
C.D at 5%	2.13	1.66	3.16	2.72	2.96	4.63		

Observations are the mean of four replicates

*The figures perianthesis are square root transformation values

T₁ = *D. brochopaga*@10g/kg soil + Goat dung@15g/kg soil

T₂ = *D. brochopaga*@10g/kg soil + Poultry manure@15g/kg soil

T₃ = *D. brochopaga*@10g/kg soil +Vermicompost@15g/kg soil

T₄ = *D. brochopaga*@10g/kg soil + Cow dung@15g/kg soil

T₅ = *D. brochopaga* alone @10g/kg soil

T₆ = Inoculated check

T₇ = Uninoculated check

T₈ =Treated check

M/F=Multiplication factor

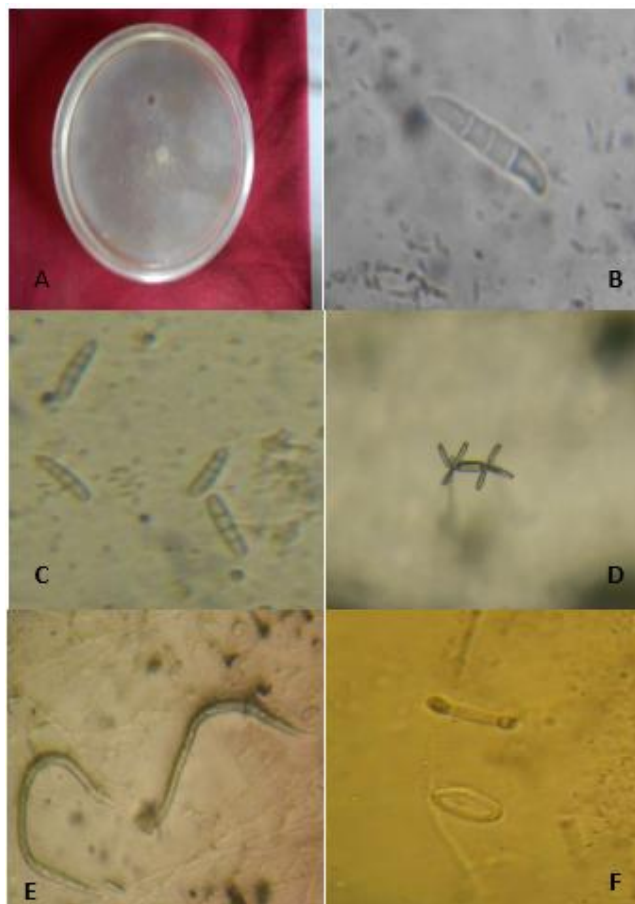


Fig 4: Nematode trapping fungus, *Dactylaria brochopaga* Drechsler, 1937

(a) Plating for pure culture (b) Single conidia sowing three septa (c) Three Conidia showing three septa (d) Loose capitulate conidia on conidiophore (e) Nematode Trapping constricting ring (f) Constricting ring formation on mycelium

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