



RESEARCH NOTE

Management of northern root knot nematode, *Meloidogyne hapla* in carrot (*Daucus carota* L.) with fungal bioagents along with organic amendment

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ABSTRACT: Continuous cultivation of carrot in the same piece of land leads to severe infestation of northern root knot nematode, *Meloidogyne hapla*. Two field experiments were conducted at the Nilgiris and Kodaikkanal to study the influence of fungal bioagents along with farm yard manure against northern root knot nematode, *Meloidogyne hapla* infesting carrot. Application of nematode egg parasitic fungi, *Purpureocillium lilacinum* as seed treatment @ 20g/kg of seed + soil application @ 2.5kg/ha along with soil application of Farm Yard Manure @12.5t/ha suppressed northern root knot nematode, *Meloidogyne hapla* by 23.1% and enhanced the carrot root yield by 33.6% compared to control.

Keywords: Farm Yard Manure, *Meloidogyne hapla*, *Purpureocillium lilacinum*, *Trichoderma harzianum*

Northern root knot nematode, *Meloidogyne hapla* severely affects carrot cultivation and causes 36% avoidable yield losses in the Nilgiris of Tamil Nadu (Anita and Selvaraj, 2011) due to its continuous cultivation in the same piece of land without fallowing or crop rotation with other crops and non availability of effective nematicides as well as absence of resistant cultivars. Though, bioagents are effective against root knot nematode in laboratory and micro plot experiments, the effectiveness under field conditions depend on availability of organic amendments which serve as carbon sources for their multiplication and survival. Hence field experiments were conducted in two different locations to study the effect of nematode egg parasitic fungi along with farm yard manure against northern root knot nematode, *Meloidogyne hapla* in carrot.

Two field experiments were conducted under farmers field during *Kharif* 2014-15 and 2015-16 at Ooty and Kodaikkanal of The Nilgiris and Dindigul districts of Tamil Nadu, respectively with heavy incidences of *Meloidogyne hapla* (one-two J₂/g of soil). The influence nematode egg parasitic fungal bioagents viz., *Purpureocillium lilacinum* and *Trichoderma harzianum* along with farm yard manure were assessed as per the following treatments: T1 - *P. lilacinum* @ 20g/kg seed + Soil application @2.5kg/ha + Soil application of farm yard Manure @ 12.5t/ha. T2- *T. harzianum* @ 20g/kg

seed + Soil application @2.5kg/ha +Soil application of farm yard Manure @ 12.5t/ha and T3-Untreated control. The treatments were applied as per the schedule with plot sizes of 2x3 m² and replicated seven times in a randomized block design. Regular agronomic practices were followed for the experiments.

Observations on soil nematode population, root knot index and carrot tuber yield were recorded. During conclusion of the experiment the final fungal population load (colony forming units) were ascertained by using standard serial dilution technique followed by plating in potato dextrose agar (PDA) media.

Among the two nematode egg parasitic fungal bioagents tested under field conditions against northern root knot nematode, *Meloidogyne hapla*, application of *P. lilacinum* as seed treatment @ 20g/kg seed and soil application @ 2.5kg/ha along with soil application of farm yard manure @12.5 t/ha reduced the soil nematode population by 23.1 % and 52 % , root knot index by 38% and 25% and increased the tuber yield by 47.1% and 21.5% in the field conducted at the Nilgiris and Kodaikkanal respectively followed by application of *T. harzianum* as seed treatment @ 20g/kg seed and soil application @ 2.5kg/ha along with soil application of farm yard manure @12.5 t/ha (Table 1 and Table 2).

Table 1. Evaluation of biopesticides for the management of northern root knot nematode, *Meloidogyne hapla* and yield of carrot cv. New Kuroda at location 1 (Ooty, the Nilgiris)

Treatment	Nematode population per 200 cc soil		Root Knot Index	Yield (t/ha)	Colony Forming Unit (cfu) at harvest
	Initial	Final			
T ₁ <i>Purpureocillium lilacinum</i> @ seed treatment @ 20g/kg seed + <i>P. lilacinum</i> @ 2.5 kg along with 2.5 tons of FYM/ha prior to sowing	253	226 (-23.1)	3.3 (-38)	30.6 (+47.1)	5 x 10 ⁸ cfu/g
T ₂ <i>Trichoderma harzianum</i> @ seed treatment @ 20g/kg seed + <i>T. harzianum</i> @ 2.5 kg along with 2.5 tons of FYM/ha prior to sowing	248	235 (-20.1)	3.6 (-34)	27.2 (+30.8)	4 x 10 ⁸ cfu/g
T ₃ Untreated control	257	383	5.0	20.8	-
CD (p=0.05)	-	5.5	-	2.09	-

Figures in parentheses are per cent (-) decrease / (+) increase over control

Table 2. Evaluation of biopesticides for the management of northern root knot nematode, *Meloidogyne hapla* and yield of carrot cv. New Kuroda at location 2 (Kodaikkanal, Dindigul)

Treatment	Nematode population per 200 cc soil		Root Knot Index	Yield (t/ha)	Colony Forming Unit (cfu) at harvest
	Initial	Final			
T ₁ <i>Purpureocillium lilacinum</i> @ seed treatment @ 20g/kg seed + <i>P. lilacinum</i> @ 2.5kg along with 2.5 tons of FYM/ha prior to sowing	236	260 (-52.02)	3.0 (-25.0)	23.7 (+21.5)	4 x 10 ⁸ cfu/g
T ₂ <i>Trichoderma harzianum</i> @ seed treatment @ 20g/kg seed + <i>T. harzianum</i> @ 2.5 kg along with 2.5 tons of FYM/ha prior to sowing	247	443 (-18.26)	3.6 (-10.0)	21.2 (+8.7)	5 x 10 ⁸ cfu/g
T ₃ Untreated control	242	542	4.0	19.5	-
CD (p=0.05)	-	42.6	-	2.1	-

Figures in parentheses are per cent (-) decrease / (+) increase over control

The pooled data analysis of two field trials revealed that application of *P. lilacinum* as seed treatment @ 20g/kg seed and soil application @ 2.5kg/ha along with soil application of farm yard manure @12.5 t/ha not only reduced the soil nematode population (41.8%) and root knot index (28%) but also enhanced the tuber yield by 33.6% compared to untreated control (Table 3). The current results were in accordance with the results obtained by Devrajan *et al.* (2003) and Anita and Selvaraj.

(2011). The reduction of nematode population, root knot index and enhanced carrot root tuber yield may be due to the action of *P. lilacinum* which is supported by the farm yard manure in addition to supply of nutrients to the plants. While, decomposing organic amendments release many nematicidal factors or compounds or gasses like ammonia, phenols, aldehydes, amino acids and heat which is lethal to nematodes (Reddy *et al.*, 1999).

Table 3. Evaluation of biopesticides for the management of root knot nematode, *Meloidogyne hapla* infestation and yield of carrot cv. New Kuroda. (Pooled Analysis)

Treatment	Nematode population per 200 cc soil		Root Knot Index	Yield (t/ha)	Colony Forming Unit (cfu) at harvest
	Initial	Final			
T ₁ <i>Purpureocillium lilacinum</i> @ seed treatment @20g/ kg seed + <i>P. lilacinum</i> @ 2.5 kg along with 2.5 tons of FYM/ha prior to sowing	244	269 (-41.8)	3.2 (-28.9)	27.08 (+33.6)	4.5 x 10 ⁸ cfu/g
T ₂ <i>Trichoderma harzianum</i> @ seed treatment @ 20g/kg seed + <i>T. harzianum</i> @ 2.5 kg along with 2.5 tons of FYM/ha prior to sowing	247	371 (-19.7)	3.6 (-20.0)	24.20 (+19.6)	4.5 x 10 ⁸ cfu/g
T ₃ Untreated control	250	462	4.5	20.24	-
CD (p=0.05)	-	4.74	-	1.72	-

Figures in parentheses are per cent (-) decrease / (+) increase over control

Application of organic amendments may increase the predatory activities of fungi and predatory nematodes (Azmi, 1999) since it supply carbon sources for natural enemies particularly nematode egg parasitic fungi like *P. lilacinum*. In general organic amendments increases the crop yield, improve the soil health and biodiversity in addition to suppression of nematodes directly or indirectly. The results of current experiments indicated that the addition of organic matter enhances the activity of *P. lilacinum*.

ACKNOWLEDGMENT

The authors acknowledge the financial support rendered by All India Co-ordinated Research Project on Nematodes (AICRP-N), ICAR, New Delhi to carry out the research.

REFERENCES

- Anita, B. and Selvaraj, N. 2011. Biology, yield loss and Integrated Management of root knot nematode, *Meloidogyne hapla* infecting carrot in Nilgiris. *Indian Journal of Nematology*, **41**(2): 144-149.
- Azmi, N. I. 1999. Acceleration activity of predatory nematode in the presence of organic matter, *Indian Journal of Nematology*, **27**: 89-90.
- Devrajan, K., N. Srinivasan and N. Selvaraj, 2003. Biomangement of root knot nematode, *Meloidogyne hapla* in carrot (*Daucus carota* L) *Indian Journal of Nematology*, **33**: 6-8.
- Reddy, P., Rao, M. S. and Nagesh, M. 1999. Nematode Management in Horticulture Crops. In: *Neem in Sustainable Agriculture*, Eds. S. S. Narwal, *et al.*, Scientific Publisher, Jodhpur, India. Pp. 229-246.

MS Received : 21 March 2017

MS Accepted : 25 May 2017