International Journal of Farm Sciences **6(4):** 273-278, 2016

Management of plant parasitic nematodes in tomato through chemicals and organic amendments

GC SHARMA, MINAKSHI GUPTA, PALLAVI SINGH and SANGEETA KUMARI

Department of Entomology, Dr YS Parmar University of Horticulture and Forestry Nauni, Solan 173230 Himachal Pradesh, India

Email for correspondence: gian_sharma2003@yahoo.co.in

ABSTRACT

The investigations were undertaken to work out cumulative effect of seven insecticides (cartaf-hydrochloride, fipronil, methyl parathion, chlorpyrifos, imidacloprid, carbofuran and dazomet) against nematodes (*Meloidogyne incognita, Helicotylenchus dihystera* and *Tylenchorhynchus mashhoodi*) in tomato through nursery soil treatment (granular/dust formulations) + bare-root dip treatment of transplanting seedlings (EC/WSP/SP formulations) + field soil treatment (granular/dust formulations). Besides three oilseed cakes (neem, mustard and cottonseed) and three systemic insecticides (thiomethoxam, dimethoate and oxy-methyl demeton) were also evaluated for their efficacy through organic amendments of field soil and bare-root dip treatment of transplanting seedlings respectively. All the seven insecticides with their successive treatments (in nursery soil + root dip treatments + field soil treatment) were found highly effective in reducing the nematode populations, root-galling and increasing the crop yield with superiority of dazomet. Chemical bare-root dip treatment (with thiomethoxam, dimethoate and oxy-methyl dematon) proved second best treatment in restricting the nematode multiplication while soil amendment practice with three oilcakes (neem, mustard and cotton seed) was rated third in efficacy. In comparison to control all the treatments tested were considerably effective against the nematodes.

Keywords: Tomato; nematodes; management; chemical control; oil-cakes; bare-root dip

INTRODUCTION

Although the state of Himachal Pradesh experiences highly diversified agro-climatic conditions its mid-hill region is blessed with the conditions which are highly congenial for tomato cultivation. In this region district Solan is its major producer where though the farmers are small to marginal landholders yet 100 per cent families grow this as a cash crop with 60-80 per cent of the total cultivable area under this crop (Sharma and Kashyap 2005). Due to prevailing mono-cropping system in the state nematode problem is getting predominant over other biotic problems. Every year these tiny organisms are causing tremendous losses (25-50%) to the produce (Sharma and Khan 1993). In the state a number of phytoparsitic nematodes viz *Meloidogyne incognita, Pratylenchus* spp, *Helicotylenchus dihystera, Tylenchorhynchus mashoodi* etc have been found harbouring the crop rhizosphere and the foremost nematode is of major importance (Sharma and Kashyap 2005). In lieu of widespread problem of nematodes with their serious threat to tomato industry in the state present studies were undertaken.

MATERIAL and METHODS

The experiment was laid out in nematode infested farm area of Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP. Before sowing the seed, the water-saturated nursery soil was given seven different chemical treatments @ 0.4 g ai/m^2 (excluding dazomat) for which 8 beds of ½ m^2 were prepared (including one control). However dazomat was applied as per company's recommended dose of 30 g/m^2. Before transplanting the seedlings in the main field the uprooted seedlings from different nursery treatments were given bare-root dip treatment with the respective chemicals @ 1000 ppm (0.1%) for 45 minutes in evening hours (in shade).

After preparing the experimental field 56 beds of size 4 m^2 were prepared for accommodating 14 treatments @ 4 beds/treatment. Before treating/ transplanting the seedlings a composite soil sample was extracted from each bed to work out initial nematode population. Soil samples were analyzed by Cobb's sieving and decanting technique (Cobb 1918). The nematode populations were assessed in 200 cc soil sample. Treatments maintained in the field are given in Table 1.

Observations were recorded on initial nematode populations of an individual bed in the experimental field (before treatment) and final nematode populations (at harvesting), complete yield record (kg) of each bed, root-gall index of 5 randomly selected plants/bed (at harvesting). For root-gall indexing 1-5 scale was used (Taylor and Sasser 1978). Data were analyzed through factorial RBD (for nematode populations) and simple RBD (for multiplication rate, root-gall index and yield of the crop).

RESULTS and DISCUSSION

At harvesting only three nematode species viz *M incognita*, *H dihystera* and *T mashhoodi* were found prevalent in the rhizosphere while the incidence of *P coffeae* and *M xenoplax* was observed in only very few samples with their populations at a very low ebb.

***M incognita*:** The nematode multiplied at a highest rate of 8.75 times in control treatment where initial and final J2 (2^{nd} stage juveniles) nematode populations of 40 and

Table 1. Treatments applied in the field

Treatment	Sequence	Dose/concentration
T_1- Cartaf hydrochloride (Killdan 4 G)	Nursery soil treatment+ root dip treatment + field soil treatment	0.4 g ai /m^2 + 0.1% + 0.4 ai /m^2, respectively
T_2- Fipronil (Agent 0.3 GR)	-do-	-do-
T_3- Methyl parathion (Macedust 2 DP)	-do-	-do-
T_4- Chlorpyrifos (Sacban 10 GR))	-do-	-do-
T_5- Imidacloprid (Matador 70 WG)	-do-	-do-
T_6- Carbofuran (Furasac 3G)	-do-	-do-
T_7- Dazomet (Sumid 98GR)	-do-	30 g/m^2 + 0.1% + 30 g/m^2, respectively
T_8- Neem cake	Only soil application before transplanting	0.3 kg/m^2
T_9- Mustard cake	-do-	-do-
T_{10}- Cotton seed cake	-do-	-do-
T_{11}- Thiomethoxam (Maxima 25 WG)	Only root dip treatment	0.1 %
T_{12}- Dimethoate (Roger 30 EC)	-do-	-do-
T_{13}- Oxymethyl dematon (Metasystox 25 EC)	-do-	-do-
T_{15}- Control		

350 respectively were extracted from the rhizosphere (Table 2). The cumulative chemical treatments from T_1 to T_7 did not allow the nematode to multiply in the rhizosphere and rather reduced its population in all the treatments below their respective initial counts. In these treatments multiplication rate of the nematode ranged between 0.23-0.65 times with dazomet as most effective. Slusarski et al (2012) have also reported high efficacy of dazomet against nematodes due to its methyl isothiocynate releasing capability. Similarly Giannakon et al (2004) studied the efficacy of dazomet in combination with other chemicals against root-knot nematode problem and found its superiority over bio-nematicide treatments. Although there was recorded an increase in final population of the nematode in all the three sole bare-root dip treatments (T_{11}-T_{13}) multiplication rate remained too low (1.2-1.5 times) in comparison to control. Similarly in oilcakes amended beds (T_8-T_{10}) final J2 populations of the nematode were found increased (140-270) over their respective initial counts (50-75); multiplication rates were considerably low (2.8-4.5 times) as compared to control.

H dihystera**:** At harvesting in the cumulative treatments T_1-T_7 although there was reduction in population of *H dihystera* below their initial counts (multiplication rate 0.13- 0.68 times) highest reduction was induced by dazomet (T_7) (multiplication rate 0.13 times). The nematode multiplied to maximum of 4. 22 times in control treatment

Table 2. Effect of different treatments on the nematode populations, their multiplication rate and yield of the crop

Treatment	Nematode population/200 cc soil												Root gall index	Yield (kg/plot)
	M incognita			*H dihystera*			*T mashhoodi*			Total				
	I	F	MR (x)	I	F	MR (x)	I	F	MR (x)	I	F	MR (x)		
T_1	100	65	0.65	65	100	1.53	165	85	0.51	330	250	0.75	1.5	6.4
T_2	250	140	0.56	55	20	0.36	190	70	0.36	495	230	0.46	1.3	6.3
T_3	180	100	0.55	110	75	0.68	240	65	0.27	530	240	0.45	1.4	5.6
T_4	110	70	0.63	135	50	0.37	235	65	0.27	480	185	0.38	1.6	6.2
T_5	80	30	0.37	130	65	0.50	70	35	0.50	280	130	0.46	1.5	6.0
T_6	270	120	0.44	205	60	0.29	185	90	0.48	660	270	0.41	1.6	5.8
T_7	190	45	0.23	145	20	0.13	240	20	0.08	575	85	0.15	1.2	6.6
T_8	50	140	2.80	125	420	3.36	90	180	2.00	265	740	2.79	3.0	3.8
T_9	75	265	3.53	80	275	3.43	100	225	2.25	255	765	3.00	3.0	4.0
T_{10}	60	270	4.50	65	240	3.69	50	180	3.60	175	690	3.94	3.5	3.3
T_{11}	220	265	1.20	120	110	0.91	140	230	1.64	480	605	1.26	2.0	4.1
T_{12}	85	125	1.47	280	250	0.89	210	350	1.66	575	725	1.26	2.0	4.5
T_{13}	100	120	1.20	225	230	1.02	150	190	1.26	475	540	1.13	2.5	4.0
T_{14}	40	350	8.75	90	380	4.22	65	350	5.38	195	1080	5.53	4.6	2.6
$CD_{0.05}$	-	-	2.50	-	-	1.50	-	-	3.12	-	-	1.45	0.48	0.95

I= Initial, F= Final, MR= Multiplication rate

(T_{14}). Field soil amendment with oilcakes (T_8-T_{10}) could not restrict the nematode multiplication considerably enough (multiplication rate 3.36-3.69 times) in comparison to control (Table 2). However chemical bare-root dip treatments (T_{11}-T_{13}) did not allow the nematode to multiply in the rhizosphere (multiplication rate 0.89-1.02).

T mashhoodi**:** Multiplication pattern of the nematode was similar to the former two nematodes. All the cumulative chemical treatments (T_1-T_7) were highly effective in suppressing the nematode population (multiplied 0.08-0.51 times) followed by bare-root dip treatments (T_{11}-T_{13}) where the nematode could multiply only to the tune of 1.26-1.66 times their initial population densities. The nematode multiplied maximum to 5.38 times in control treatment (T_{14}). Although application of neem and mustard oilcakes (T_8 and T_9) considerably restricted the nematode to multiply (multiplication rate 2.00 and 2.25 respectively) in comparison to control in cotton seed oilcake (T_{10}) the nematode multiplication rate (3.60 times) was statistically on par with control (5.38 times)

Root-gall index and yield: Minimum root-galling was observed in cumulative chemical treatments T_1-T_7 (gall index 1.2-1.6) followed by in bare-root dip treatments T_{11}-T_{13} (gall index 2.0-2.5) and in oilcake treatments T_8-T_{10} (gall index 3.0-3.5). Sharma and Kashyap (2005) have also found that bare-root dip treatment of tomato seedlings with carbosulfan (500 ppm) for 30 minutes gave promising results in suppressing root-gall index and juvenile population of root-knot nematode (*M incognita).* Rao et al (1987) have also recorded significant reduction in root-galling and nematode population of *M incognita* along with considerable yield increase in brinjal when before transplanting the seedlings were given bare-root dip treatments with carbosulfan, chlorpyrifos and dimethoate @ 500-1000 ppm for 30 minutes. Minimum yield (2.6 kg) was harvested from control plots (T_{14}) followed by in oilcake applied beds T_8-T_{10} (3.3-4.0 kg) and bare-root dip treatments (4.0-4.5 kg). Yield range was highest (5.6-6.6 kg) in cumulative chemical treatments.

Total nematode population: With multiplication pattern similar to that of individual nematodes maximum nematode population (1080) with highest multiplication rate of 5.53 times was recorded in control (T_{14}) treatment followed by oilcake amended soil (T_8-T_{10}) and in bare-root dip treatments (T_{11}-T_{13}) where nematode populations multiplied between 2.79-3.94 and 1.13-1.26 times respectively. Cumulative chemical treatments (T_1-T_7) showed their superiority in declining the nematode population significantly (multiplication rate 0.15-0.75 times). McSorley (2011) has also reported that organic amendments were not effective against nematodes equivalent to chemical application.

REFERENCES

Giannakou IO, Karpouzas DG and Athanasiadou DP 2004. A novel non-chemical nematicide for the control of root-knot nematodes. Applied Soil Ecology **26:** 69-79.

McSorley R 2011. Overview of organic amendments for management of plant-parasitic nematodes, with case studies from Florida. Journal of Nematology **43(2):** 69-81.

Rao CV, Mani A and Rao PK 1987. Use of insecticides as bare-root dip treatments for the control of the root-knot nematode, *Meloidogyne incognita* on brinjal (*Solanum melongena* L). Tropical Pest Management **33(2):** 137-138.

Sharma GC and Kashyap AS 2005. Management of root-knot nematode (*Meloidogyne incognita*) problem in tomato on farmers' field. Proceedings, National Symposium on Challenging Problems in Horticulture and Forest Pathology, 14-15 Nov 2003, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India, pp 151-157.

Sharma GC and Khan ML 1993. Assessment of yield losses in two solanaceous crops due to *Meloidogyne incognita*. Orissa Journal of Agricultural Research **7:** 92-93.

Slusarski C, Ciesielska J, Malusa E, Meszka B and Sobiczewski P 2012. Metam sodium, metam potsssium and dazomet, sustainable use of chemical fumigants for the control of soil borne pathogens in the horticultural sector. Brochure, Research Institute of Horticulture, Poland.

Received: 25.7.2015 ***Accepted: 22.10.2015***