International Journal of Farm Sciences **8(1):** 31-33, 2018; doi: 10.5958/2250-0499.2018.00009.5

Effect of different management practices on nematode populations and yield of ginger

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ABSTRACT

Some pre-sowing and sowing time/post-sowing treatments were evaluated against the nematode infestation in ginger under in vivo. The experiment was laid out in the field infested with nematodes viz *Pratylenchus coffeae*, *Meloidogyne incognita*, *Helicotylenchus dihystera*, *Tylenchorhynchus mashhoodi* and *Mesocriconema xenoplax*. Pre-plant treatments used were T_1 (Hot water treatment of seed rhizomes at 45°C for 3 h), T_2 (Summer ploughing twice at an interval of 15 days), T_3 (Summer solarisation of field soil with polythene tarp for 15 days), T_4 ($T_1 + T_2$), T_5 ($T_1 + T_3$) and T_6 (Control); sowing/post–sowing treatments were T_1 (Application of neem cake @ 2.5 tons/ha at sowing), T_2 (Application of carbofuran @ 0.3 g ai/m^2 at sowing), T_3 [Neem cake at sowing + carbofuran at 45 days after sowing (DAS)], T_4 (Carbofuran at sowing + neem cake at 45 DAS), T_5 (Neem cake at 45 DAS), T_6 (Carbofuran at 45 DAS) and T_7 (Control). All the treatments considerably reduced the nematode infestation and enhanced the crop yield in comparison to control; among pre-sowing treatments combination of summer soil solarization and hot water treatment of ginger rhizomes was found the best while among sowing/post-sowing treatments application of neem cake at the time of sowing followed by the application of carbofuran after 45 days of sowing showed most promising results.

Keywords: Ginger; nematodes; management; hot water; neem cake; carbofuran

INTRODUCTION

Ginger (*Zingiber officianle* Roscoe) is one of the important cash crops of northeast and northwestern Himalayan states of India as well as southeast Asian countries and is highly prone to nematode infestation (Charles 1978, Mohapatra et al 1986). Globally avoidable yield losses ranging between 11-80 per cent have been known to be induced by the nematode infestation on ginger (Charles 1978, Parihar and Yadav 1986, Anon 1993). In India the state of Himachal Pradesh is among the pioneer producers of ginger. Plant parasitic nematodes are among the major limiting factors in production of the crop and yield losses up to 40 per cent have been recorded due to their infestation (Anon 1993). Although ginger fields of the state have been found harbouring the populations of root-knot nematode (*Meloidogyne* spp), root lesion nematode (*Pratylenchus* spp), spiral nematode (*Helicotylenchus* spp), stunt nematode (*Tylenchorhynchus* spp), lance nematode (*Hoplolaimus* spp) etc the former two are of major economic importance (Khan 2003). The nematodes also exaggerate the ginger rot problem by facilitating the entry of fungal pathogens (*Fusarium* and *Pythium* spp) through their feeding sites (Dohroo 1990, Kaur and Sharma 1988). Keeping in view the economic importance of nematodes in ginger production the present studies were undertaken to workout effective management practices through integrated approach.

MATERIAL and METHODS

The experiment was laid out in nematode infested field located at the farm of the Department of Entomology of Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. Sixty five beds of 6 m^2 size were prepared for 6 pre-sowing and 7 sowing/post-sowing treatments @ five for each. Pre-plant treatments used were T_1

(Hot water treatment of seed rhizomes at 45°C for 3 h), T_2 (Summer ploughing twice at an interval of 15 days), T_3 (Summer solarisation of field soil with polythene tarp for 15 days), T_4 ($T_1 + T_2$), T_5 ($T_1 + T_3$) and T_6 (Control); sowing/post-sowing treatments used were T_1 (Application of neem cake @ 2.5 tons/ha at sowing), T_2 (Application of carbofuran @ 0.3 g ai/m^2 at sowing), T_3 [Neem cake at sowing + carbofuran at 45 days after sowing (DAS)], T_4 (Carbofuran at sowing + neem cake at 45 DAS), T_5 (Neem cake at 45 DAS), T_6 (Carbofuran at 45 DAS) and T_7 (Control). Agronomic practices followed were as per package of practices. At harvesting observations were recorded on population densities of different nematode species (per 200 cc soil samples) prevalent in the field, root gall-index (induced by root-knot nematode), yield of the crop (kg/bed) and per cent increase in yield over control. To estimate nematode populations composite soil samples (each made of 3 sub-samples) were collected from each bed. From each thoroughly mixed composite soil sample only 200 cc soil was processed for nematode extraction through Cobb's sieving and decanting technique (Cobb 1918).

RESULTS and DISCUSSION

Effect of pre-sowing treatments on nematodes and yield of ginger (Table 1)

All the treatments (T_1 - T_5) considerably reduced the nematode populations over control (T_6). Minimum populations of all the nematodes (*P coffeae*, *H dihystera*, *T mashhoodi* and *M xenoplax*) were recorded in T_5 (combination of rhizome treatment with hot water + solarization) followed by in T_4 (combination of rhizome treatment with hot water + summer ploughing) while least impact was recorded in T_1 (hot water treatment). The treatments T_4 and T_5 did not allow root-knot nematode to multiply in the rhizosphere (root gall-index 1). Although root galling was recorded in all other treatments it was minimum in T_3 (solarization) followed by T_2 (summer ploughing). In comparison to control (T_6) root gall-index was found significantly reduced in Treatments T_3 - T_5 while it was at par in T_1 and T_2. Highest yield increase of ginger over control was recorded in T_4 and T_5 (36.3%) followed by T_2 and T_3 (25%) while it remained minimum (13.6%) in hot water treatment of ginger rhizomes (T_1).

Effect of sowing time/post-sowing treatments on nematodes and yield of ginger (Table 2)

Overall nematode population was found minimum (300/200 cc soil) in T_3 (Neem cake at sowing + carbofuran at 45 DAS) followed by population density of 340 in T_4 (carbofuran at sowing + neem cake at 45 DAS) while it was maximum (1780) in control. Statistically there was considerable reduction in nematode population in all the treatments (T_1 - T_6) over control (T_7). Variations among the former six treatments were non-considerable. Root gall index being induced by the infestation of root-knot nematode was also found reduced to the highest (1.6 and 2.0) in the two treatments (T_3 and T_4 respectively) while among other treatments (excluding control) it was maximum in T_5 (Neem cake at 45 DAS). Except T_5 all other treatments (T_1 - T_4 and T_6) significantly reduced the gall index over control. Statistically T_3 was found most promising in comparison to all other treatments. Highest crop yield was recorded in the treatment

Table 1. Effect of pre-sowing treatments on nematode populations and yield of ginger

T	Nematode population/200 cc soil					Root gall index	Yield (kg/6 m^2 bed)	% increase in yield over control
	P coffeae	*H dihystera*	*T mashhoodi*	*M xenoplax*	Total			
T_1	420	120	220	120	880	3.6	2.5	13.6
T_2	320	80	180	80	660	3.4	2.75	25.0
T_3	200	100	100	60	460	2.8	2.75	25.0
T_4	120	60	100	60	340	1.0	3.0	36.3
T_5	40	40	20	20	120	1.0	3.0	36.3
T_6	620	240	440	180	1480	4.0	2.2	-
CD	86.22	41.12	60.70	52.97	239.24	0.61	NA	-

T_1 (Hot water treatment of seed rhizomes at 45°C for 3 h), T_2 (Summer ploughing twice at an interval of 15 days), T_3 (Summer solarization of field soil with polythene tarp for 15 days), T_4 ($T_1 + T_2$), T_5 ($T_1 + T_3$), T_6 (Control)
Root gal index scale (1-5): 1 (no galls), 2 (1-10 galls), 3 (11-30 galls), 4 (31-100 galls), 5 (>100 galls)

Table 2. Effect of neem cake and carbofuran (in different combinations) against plant parasitic nematodes and yield of ginger

T	Nematode population/200 cc soil					Root gall index	Yield (kg/6 m^2 bed)	% increase in yield over control
	P coffeae	*H dihystera*	*T mashhoodi*	*M xenoplax*	Total			
T_1	320	120	240	160	840	2.4	3.25	30
T_2	180	200	140	120	640	2.6	3.0	20
T_3	80	80	100	40	300	1.6	3.75	50
T_4	160	20	120	40 3	40	2.0	3.5	40
T_5	420	320	140	120	1000	3.2	3.0	20
T_6	200	120	120	100	540	2.4	3.0	20
T_7	820	380	360	220	1780	4	2.5	-
CD	86.41	106.71	76.54	81.67	708.42	0.70	NA	-

T_1 (Application of neem cake @ 2.5 tons/ha at sowing), T_2 (Application of carbofuran @ 0.3 g ai/m^2) at sowing), T_3 [Neem cake at sowing + carbofuran at 45 days after sowing (DAS)], T_4 (Carbofuran at sowing + neem cake at 45 DAS), T_5 (Neem cake at 45 DAS), T_6 (Carbofuran at 45 DAS), T_7 (Control)

T_3 (3.75 kg/bed) followed by T_4 (3.5 kg/bed) ie where both neem cake and carbofuran were applied in combination. The treatments where neem cake or carbofuran were applied alone (T_1, T_3 and T_2, T_4 respectively) the yield enhancement was more in the former treatments. Similar results have also been reported by Mohanty et al (1992). From the overall results it can be inferred that among pre-sowing treatments combination of summer soil solarization (with polythene sheet for 15 days) and hot water treatment of ginger rhizomes (45°C for 3 h) proved the best in reducing the nematode infestation and improving the crop yield while among sowing/post-sowing treatments application of neem cake @ 2.5 tons/ha at the time of sowing followed by the application of carbofuran @ 3 kg ai/ha after 45 days of sowing showed most promising results. Sharma (2006) has also reported superiority of this treatment (neem cake and carbofuran) over others while working on the nematode management in ginger.

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