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Cover cropping in guava orchards to reduce population of root knot nematode, *Meloidogyne enterolobii*

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ABSTRACT: Guava orchards across the countryhave been facing sudden decline in the recent years due to incidence of root knot nematode, *Meloidogyne enterolobii* and *Fusarium* sp. Five crops *viz.*, marigold (*Tagetus erecta*), cowpea (*Vignaunguiculata*), sunnhemp (*Crotalaria juncea),*onion (*Allium cepa),* garlic (*Allium sativum*) grown around the basin of guava plants were evaluated for their effect on population reduction of *M.enterolobii*, at two locations in Tamil Nadu, India. It was observed that onion and garlic were more effective in reducing the nematode population in guava, owing to the higher phenol, peroxidase and phenyl alanine lyase activity in these plants leading to repellent effect on the rootknot nematode, *M.enterolobii* in guava rhizosphere. Cowpea was also effective in reducing the nematode population as it attracted maximum juveniles into its roots, itself acting as a trap crop. Hence, it is concluded from the study to considerably reduce the population of root knot nematode, *M.enterolobii*.

Keywords: Guava, root knot nematode,covercrops, management

INTRODUCTION

Guava (*Psidium guajava* L), called as 'poor mans apple' is one of the important tropical fruit crops in India. Guava orchards across the country have been facing sudden decline in the recent years due to severe incidence of root knot nematode, *Meloidogyne enterolobii* and *Fusarium* sp. The incidence of *Meloidogyne enterolobii* was first reported in Ayakudi village of Dindigul district (Poornima*et al*., 2016). *M. enterolobii* is regarded was the most aggressive nematode species with when compared to other tropical species of root knot nematode (Brito*et al*., 2004) in view of its high reproduction rate, induction of large galls and a very wide host range. Lack of chemicals to knock out the juveniles which hatch inside the compound galls, lack of resistant rootstocks for grafting and poor functioning of the nursery act to stop dissemination of infested plants has led to the urgency of finding alternate sources to reduce the menace. An attempt was made to check population reduction of *M. enterolobii* in guava when grown as cover crops.

MATERIALS AND METHODS

Identification of root knot nematode species associated with Guava using posterior cuticular pattern (PCP)

Root samples were stained by acid fuchsin lactophenol method (Eisenback*et al*., 1980). After clearing with plain lactophenol, the adult females were excised randomly from the stained roots. Ten adult females were selected randomly and used for species identification by posterior cuticular pattern (PCP) variations (Hartman and Sasser, 1985).

Collection of soil and root samples

Soil and root sampleswere collected from 2-3 year old guava trees at a depth of 20-30 cm and at a distance of 120 cm from the trunk. From each locality, five trees were selected randomly and from each tree, three samples were collected. The soil samples were mixed thoroughly and a composite sample of 200cc and 5g rootsware taken in polythene bags and sealed tightly with label for processing.

Extraction of nematodes from soil and root samples

Extraction of second stage juveniles from guava rhizosphere was done by sieving and decantation method (Cobb, 1918), followed by modified Baermann's funnel technique (Schindler, 1961). Root population was assessed using method by staining the roots with acid fuchsin lactophenol and cleared by plain lactophenol. The stained adult females of *M.enterolobii* on roots were observed and counted under stereoscopic binocular microscope (Mc Beth *et al.,* 1941).

Effect of trap and inter crops on root knot nematode *M.enterolobii* in guava

a. **Laying down of the field trials**

With a view to find out the effect of covercrops on reducing population of root knot nematodes infestation on guava, two field trials were taken at Karamadai and Thondamuthur during 2017-2018. One year old guava orchards with the variety Lucknow-49 planted at a spacing of 1.7m x 1.7m was selected for this study. The soil type was red loamy in nature. Drip method of irrigation was followed. Eight treatments were imposed in RBD and replicated thrice. For each treatments nine plants were randomly selected. The treatments consist of cover crops with local varieties of marigold (*Tagetus erecta*), cowpea (*Vignaunguiculata*), sunnhemp (*Crotalariajuncea),* onion (*Allium cepa)* and garlic (*Allium sativum*) grown around the basin of respective guava plants. Sixth treatment was biofumigation, performed by incorporating the harvested remains of plants of Cruciferaceae family *viz.,* cabbage, radish and cauliflower around the guava plant within the basin @250g/ plant. These plant parts on decomposition emanate chemical substances, known as isothiocyanates (ITC's), able to suppress nematode pests, in addition to enhance the soil biological activities. Seventh treatment was incorporation of FYM, @1 kg/plant. Eighth treatment was untreated control.Observations on nematode population in soil (250 cc) and root (5g) were made at 45 days after planting and at harvest.

b. **Collection and extraction of soil and root samples**

Nematode population was collected after 45 days of sowing of cover crops, application of biofumigation and FYM and again at harvest from 200cc of rhizosphere soil at a depth of 20 cm and at a distance of 1.5 feet from the trunk and 5g of tertiary roots of guava.Samples were taken from all the nine plants of each replication, pooled into one sample and a composite sample of 200 cc was taken for processing.**N**ematodes were extracted from the soil by sieving and decantation method (Cobb, 1918), followed by modified Baermann's funnel technique (Schindler, 1961).Compound and simple galls were cut from the root samples, macerated for 10-15 seconds using a waring blender, suspension poured through 6-8 layers of tissue paper until the suspension becomes clear. Nematodes were collected from 7days to ten days and the pooled collections were stored in a refrigerator. The population of adult nematode in roots was counted after staining the roots with acid fuchsin (kept overnight) and clearing by plain lactophenol (Mc Beth *et al.,* 1941). The same methodology was used to collect soil and root samples to assess the initial population.

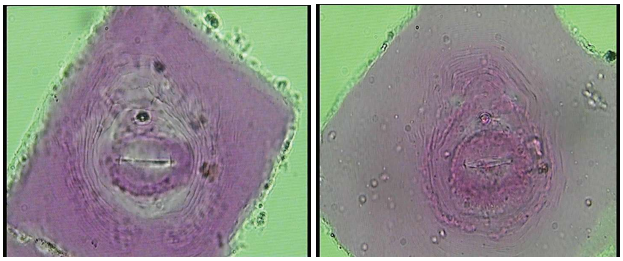
c. **Biochemicalanalysis of the roots of cover crops to assess their antinemic activity**

Phenol content was estimated as per the procedure given by Zieslinand Ben-Zaken (1993). Assay of Peroxidase activity was carried out as per the procedure described by Hammer Schmidt *et al.,* (1982). Poly Phenol Oxidase (PPO) activity was determined as per the procedure given by Mayer *et al.,* (1965). The Phenyl Alanine Ammonia Lyase (PAL) assay was carried out as per the method described by Ross and Sederoff (1992).

RESULTS AND DISCUSSION

Morphological characterization of root knot nematode *Meloidogyne enterolobii* Yang and Eisenback, 1983

The posterior cuticular patter (PCP) was oval shaped with fine striae, dorsal arch rounded to square, weak



Posterior Cuticular Pattern (PCP) of *M. enterolobii*in guava (var. L 49)

lateral lines with out prominent forkings were present sometimes. Slit like vulva and tail tip was devoid of striae. The pattern was similar to the original description of Rammah and Hirschmann (1988) which is a synonym of *M.enterolobii*.

Effect of treatments on population of*M. enterolobii*in guava

The results obtained from the various agronomic practices*viz.,* inter cropping, trap cropping, biofumigation and FYM in guava for the management of *M.enterolobii* are given in table. Among the treatments, inter cropping with onion was found to be more effective in reducing the nematode population in soil by 50.79 and 74.30 percent in root population at location 1 (Karamadai) and 55.5 in soil and 74.13percent in rootsin karamadai and Thondamuthur, respectively. The next best treatment was inter cropping with garlic wherein the soil population wasreduced by 47.28and by 67.89 percent in root in Karamadai and by 47.62 in soiland 59.20 percent in root at Thondamuthur. Third best treatment was intercropping cowpea which rather acts as trap crop, itself attracts more

number much of nematodes towards their roots and reducing soil population of *M. enterolobii* in guava rhizosphere by42.27% and by 54.00% in root in Karamadai and 39.29% in soil and 50.27% in root in Thondamuthur compared to untreated control (Table 1 and Plate 1)..

Table 1. Effect of treatments on Root knot nematode, *Melodigyne enterolobii* population in guava (soil and root) with cover crops, biofumigation and FYM

Treatment	Nematode population			
	Location 1 (Karamadai)		Location 2 (Thondamuthur)	
	Soil(200cc)	Root(500g)	Soil(200cc)	Root(500g)
Marigold (Local)	168.66 (30.77)[d]	44.76 (74.30)[d]	151.00 (34.63)[d]	50.21 (38.10)[d]
Cowpea	140.64 (42.27)[c]	35.98 (54.00)[c]	140.23 (39.29)[c]	40.34 (50.27)[c]
Sunnhemp	174.75 (28.27)[e]	58.55 (25.14)[e]	160.12 (30.68)[e]	61.76 (23.86)[e]
Onion (Local)	119.90 (50.79)[a]	20.10 (74.30)[a]	102.76 (55.51)[a]	20.98 (74.13)[a]
Garlic (Local)	128.43 (47.28)[b]	25.11 (67.89)[b]	120.99 (47.62)[b]	33.09 (59.20)[b]
Biofumigation	178.00 (26.94)[f]	50.00 (25.85)[f]	170.00 (26.40)[f]	68.00 (16.17)[f]
FYM	181.43 (25.53)[g]	65.32 (16.49)[g]	185.31 (19.77)[g]	70.01 (13.69)[g]
Untreated control	243.65	78.22	231.00	81.12
SED	0.0014	0.008	0.001	0.008
CD (0.05)	0.003	0.017	0.002	0.018

Plate 1. Effect of cover crops grown in the basin of guava plants on population of root knot nematode, *Meloidogyn enterolobii*

				
Marigold grown in guava basin	Cowpea grown in guava basin	Sunnhemp grown in guava basin	Onion grown in guava basin	Garlic grown in guava basin
				
Root of marigold devoid of galls proving to be a non host of *M.enterolobii*	Root of cowpea showing nodules and root knot galls proving to be a good host of *M.enterolobii*	Root of sunnhemp showing nodules but absence of root knot galls proving to be a non host of *M.enterolobii*	Onion roots devoid of galls and found to be repellant to *M.enterolobii*	Garlic roots devoid of galls and found to be repellant to *M.enterolobii*

Biochemical assay of cover crops grown in guava

The results of the analysis revealed that there was an increased rate of induction of phenols peroxidase, poly phenoloxidase and Phenyl alanine ammonia lyasein the plants treated with onionand garlic, followed by cowpea and marigold.Onionand garlic was found to be more effective in reducing the nematode population in soil**.** Application of onionrecorded highest total phenol, peroxidase, poly phenol oxidase, and Phenyl alanine ammonia content of 21.24, 3.42,3.24 and 4.72 mg respectively.There was a significant induction of total phenol, peroxidase, poly phenol oxidase and Phenyl alanine ammonia content in the plants treated with garlic and cowpea which showed 58.29, 97.94, 93.26, 78.22 and 53.84, 96.92, 90.30, 78.28 per cent increase over control (Fig.1.).

Sangwan *et al*. (1990) reported that few essential oils extracted from the onion showed their nematicidal effects and Allicin a repellent property found in onion thus killed the nematodes.According to Gupta and Sharma (1993) garlic has larvicidal properties, and that was more in essential oil from the dried and crushed

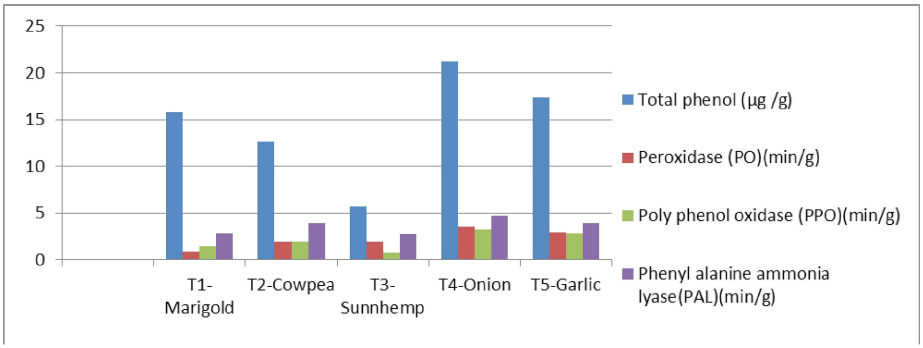


Figure 1.Biochemical assay of cover crops grown in guava

bulbs. Vijayalakshmi *et al.* (1999) reported that high concentrations of garlic showed phytotoxicity symptoms in crop plants and resulted in wilting of the crop. There was a significant induction of total phenol, peroxidase, poly phenol oxidase and Phenyl alanine ammonia lyase content in the plants treated with onionand garlic. Benkeblia (2005) found that the methanolic extract of garlic showed higher total phenol content than the methanolic extract of onion.

Marigold has been used extensively as a biological nematicide the world over for many years. Marigold was the least effective treatment thus reduced galling by 58.3 percent when compared to the untreated control (Pluke *et al*., 1999).Kreuger *et al.* (2007) affirm the results found from marigold and explain that the alpha-terthienyls in *T.erecta* inhibited root knot nematode from juvenile stage to maturity. Using cow pea as a cover crop it is ability to associate with nitrogen fixing bacteria and thus provide nitrogen and the effect of cow pea in nematode management and with nematode resistance vegetable cultivar may provide the organic vegetable grower with a viable means for root knot nematode management. (McSorley and Galllaher, 1991).

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