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Influence of neem and Jatropha oil cakes on multiplication of beneficial fungus, Saprozoic and root knot nematode, *Meloidogyne incognita* in tomato

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ABSTRACT: The influence of neem and jatropha oilcakes @1:100 (w/w) as soil amendment on stimulation of saprozoic nematodes and beneficial soil fungi was studied in relation to the plant growth and yield of tomato infested with *Meloidogyne incognita*. The population density of bacteriovorus nematodes (*Cephalobus* sp. and *Acrobeloides* sp.) and predatory nematodes (*Mononchus* sp. and *Mesodoryllaimus* sp.) reached peak at 5 and 7w in jatropha and neem oilcakes amended soil, respectively. The total population density of soil fungi also increased upto 8 w followed by a steep decline in oilcakes amended soil. The fungi *Aspergillus* spp. dominated among the beneficial soil mycoflora *viz*., *Trichoderma viride*, *Cladosporium oxysporum*, *Penicillium* sp, *Aspergillus niger*, *A. flavus*, and *Rhizopus* sp. developed in oilcakes amended soil. The role of stimulated activities of saprozoic and predatory nematodes and beneficial soil fungal antagonsist thereby significantly reducing the *M. incognita* infestation and increased the yield by 69 and 63 per cent in soil amended with neem and jatropha oilcake, respectively.

Keywords: Beneficial fungi, Jatropha oilcake, *Meloidogyne incognita,* Neem oilcake, Predatory nematodes and Soil amendment

INTRODUCTION

Root knot nematode, *Meloidoyne* spp. is an important nematode pest having wide host range with 5500 hosts including several weeds (Trudgill and Blok, 2001). Tomato is one of the most important commercial vegetable crop grown throughout world. Root knot nematodes can cause yield loss range from 35- 85 %.The chemical control of nematode is efficient, but it poses environmental pollution and health hazardous. Nematode management by organic amendments has been attributed to the accumulated toxicity of the decomposing products or to increased host resistance (Alam *et al.,* 1991). In recent year's use oilcakes *viz*., neem, castor and pongamia etc, is gaining much importance in nematode control. *Jaropha curcas* L. leaves, residues and seed cakes can be used as bio fertilizer after suitable processing in bio gas plant.

Jatropha oilcake is toxic to mammals due to the presence of curcin, a lectin (Cano-Asselein, 1986), flavonoids, vitexine, isovitexine and phorbolesters. The seed oil is also reported to possess insecticidal, mollucicidal, fungicidal and nematicidal properties (Chitra and Dhyani, 2006). Therefore, an attempt was made in the present study to understand the influence of neem (*Azadirachta indica* A. Juss) and jaropha (*Jaropha curcas* L.) oilcakes on saprozoic nematodes and beneficial soil mycoflora and to relate their status with growth and yield of tomato.

MATERIALS AND METHODS

The soil was collected from nematode infested field and filled in 10kg earthern pots. Neem and jatropha oilcakes was ground to powder and then incorporated separately in the soil at a ratio of 1:100 (w/w) one week prior to planting of tomato seedlings. Three week old tomato seedlings were transplanted at 3/pot and without oilcakes served as untreated control. Pots were kept moist by regular watering and cultural practices in vogue were adopted throughout the period of experimentation of 17 weeks. Three sets of experiments (i) influence of oilcakes on saprozoic nemtodes, (ii) soil mycoflora and (iii) their effects on growth and yield of tomato grown under similar conditions with seven replications arranged in a completely randomized block design under glass house conditions.

The soil samples (100cc) were collected from first set of experiment at weekly interval and processed by using standard methods for assessment of saprozoic nematodes population. Serial dilution method was employed for determining soil fungal population using potato dextrose agar medium. One gram of soil was drawn from each pot in the second set of experiment at weekly intervals and transferred into 9 ml of sterile water. Serial dilution upto 10^4 were made and one ml of 10^4 dilution of each sample was plated on PDA medium and incubated in BOD at 25 ± 2°C for one week and counted number of colonies. Plant growth parameters *viz*., shoot and root length and weight

Table 1. Influence of oilcakes on soil fungal population at different fortnight interval

Oilcakes	Interval of sampling (in fortnight)								
	1	2	3	4	5	6	7	8	9
1. *Trichoderma viride*									
Neem	7.15	23.80	41.86	58.00	47.93	27.03	17.30	5.36	2.86
Jetropha	4.15	15.47	26.08	35.84	29.81	19.05	12.62	4.57	2.14
Control	1.86	4.50	8.92	13.00	10.90	9.05	7.29	3.07	1.86
CD (P=0.05)	2.68	6.92	9.05	8.25	3.91	3.92	4.12	NS	NS
2. *Cladosporium oxysporum*									
Neem	3.29	12.86	21.14	28.22	23.55	21.00	14.37	5.57	2.43
Jetropha	1.79	8.19	12.65	19.90	16.78	14.98	8.86	4.29	2.14
Control	1.15	3.29	8.57	12.22	10.93	9.43	7.29	3.43	1.57
CD (P=0.05)	1.43	3.43	4.33	5.57	2.86	3.15	4.71	NS	NS
3. *Penicillium* spp.									
Neem	5.69	14.50	22.57	35.00	33.53	23.59	16.86	3.56	1.57
Jetropha	3.15	9.15	17.15	22.64	28.53	22.34	11.98	2.57	1.24
Control	2.51	3.93	7.79	13.50	11.63	8.45	5.55	2.14	1.14
CD (P=0.05)	1.61	3.34	6.73	7.65	3.81	3.59	2.62	NS	NS
4. *Aspergillus niger*									
Neem	24.15	45.93	106.72	139.22	128.83	105.00	72.93	32.14	5.29
Jetropha	12.86	32.00	79.72	80.36	99.45	80.01	67.24	20.79	5.00
Control	6.57	18.08	48.57	55.71	75.30	48.36	29.13	10.79	4.71
CD (P=0.05)	7.65	9.54	8.90	6.46	9.34	8.56	5.12	7.80	NS
5. *A. flavus*									
Neem	9.57	20.14	41.35	56.73	53.52	48.46	39.49	16.22	6.14
Jetropha	4.57	13.50	21.00	34.14	34.25	24.85	17.04	10.22	5.36
Control	4.05	8.07	17.98	24.15	23.37	17.51	12.15	6.57	5.57
CD (P=0.05)	3.36	5.79	7.82	8.34	4.38	4.16	7.05	4.29	NS
6. *Rhizopus* spp.									
Neem	7.93	16.86	61.65	87.81	44.99	57.83	40.43	14.99	5.43
Jetropha	4.86	12.65	43.09	58.93	57.19	44.36	29.22	11.15	4.27
Control	5.79	9.93	22.46	28.22	25.43	28.85	19.72	6.50	3.71
CD (P=0.05)	2.80	1.96	6.29	8.92	4.03	4.15	5.15	1.50	NS
7. Others									
Neem	6.93	12.58	24.29	34.43	35.77	34.85	33.50	10.43	1.86
Jetropha	3.71	7.86	15.79	22.74	19.88	24.45	18.71	6.00	1.57
Control	1.07	4.50	7.79	11.50	13.57	16.09	10.43	3.72	1.43
CD (P=0.05)	2.19	3.79	7.14	6.71	4.25	4.03	5.61	2.75	NS

were recorded at 120 days after transplanting in third set of experiment. The final soil nematode population, number of galls, number of egg masses and gall index were also recorded besides, the yield of fruits picked at three days interval commencing from 70 days after transplanting was recorded. All the data were statically analyzed and critical difference determined (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of oilcakes on saprozoic nematodes

The total population of saprozoic nematodes reached its peak at different periods of 5w (1233) and 7w (1293) in jatropha and neem oilcake amended soil, respectively (Fig 1). The higher population of saprozoic nematodes found initially (upto 5w) in soil amended with jatropha oilcake declined gradually thereafter. Whereas neem cake amended soil contained significantly higher number of saprozoic nematodes after 7w of amendment maintained the same trend thereafter. The bacteriovorous nematodes *viz*., *Cephalodous* and *Acrobeloides* spp; predatory nematodes *viz*., *Mononchus* and *Mesodorylaimus* spp, showed increasing trend with slight fluctuation during initial period of upto 8 w and thereafter decline. The report of increase in bacterial population as well as bacteriovorous due to addition of plant material (Opperman *et al*., 1993) and increase in predatory nematode population in earlier weeks after amending the soil due to increased contacts between predators and prey (Khan *et al*., 1991) support the present findings.

Influence of oilcakes on soil fungal antagonist

The total fungal population was increased upto 8 w followed by a steep decline. The highest population of fungi recorded in neem cake (464) differed significantly from the population found in jatropha oilcake amended (336) and unamended soil (235) (Fig. 2). There was a marked predominance of *Aspergillus* spp in neem followed by jatropha oilcake amended soil with regard to the density of individual fungus *viz*., *A. flavus, A. niger, C. oxysporium, Penicillium* sp*, Rhizopus* sp. and *T. viride* recorded in the present study (Table 1). However difference in their population was maintained constantly and significantly only in respect to *T. viride* at almost all the intervals of sampling. Several rhizosphere mycoflora are stimulated on addition of oilcakes. Fungal population as a part of microbes increased markedly during decomposition of oilcakes as reported by Meshram and Goswami (1989).

Influence of oilcakes on *M. incognita* host infestation

Oilcakes of neem and jatropha as soil amendment had significant effect on enhancing the biomass of tomato compared to untreated control. The increased in yield components of shoot length (30%) and weight (35%); root length (38%) and weight (64%) was highest in neem cake amended soil (Table 2). The highest reduction in *M. incognita* host infestation in terms of number of galls / root (43%); number of egg masses/g root (49%) and root knot index (43%) and its soil population (243/200cc) recorded in plants grown in neem cake amended soil resulted in highest fruit yield of 510.9 g/plant as against 486 and 307.9 g/plant in jatropha oil cake and untreated control, respectively (Table 3).

Jatropha seed contains nematicidal properties which leads to decreased the nematode population in soil and decreases the galls and egg masses in tomato roots. Jatropha oilcake also contains high content of lectin which may be toxic to nematodes. Amino acids released during the decomposition of organic amendments were also toxic to nematodes. Kalaiarasan *et al*. (2007) concluded that application of jatropha and neem oilcake @ 20g/pot and 10g/pot, respectively was most effective in reducing *M. incognita* and producing better plant growth of tomato. The organic amendments in the form of oilcakes have already been proved to be effective in reducing the soil and root population of *M. incognita* and to increase yield of many crops including tomato (Ramakrishnan *et al*., 1999); cucumber (Konsam *et al*., 2013); rice (Manju and Sankari Meena, 2015).

Interrelationship between soil biota and *M. incognita* host infection

In the present study, there was a distinct difference between oilcakes amended and unamended soil with regard to the population of bacterial feeders and predatory nematodes encountered frequently and predominantly in the total population of saprozoic nematodes. The competition by the bacterial feeders i.e., *Cephalobus* sp and *Acrobeloides* sp with *M. incognita* for space and the predatory potential of nematodes *viz*., Mononchids and Dorylaimids preying on other nematodes includes the *M. incognita* (Bilgrami, 1990) might have resulted in the population reduction of *M. incognita.* The fungi increased abundantly in amended soil might plays a role in the suppression of *M. incognita.* This was in line with Samadhanam and Sethi (1994).

The significantly larger biomass of plants and fruit yield of tomato in soil amended with oilcakes compared to plants grown in unamended soil can be attributed to marked reduction in *M. incognita* host infestation

Table 2. Influence of neem and jatropha oilcakes on *M. incognita* plant growth characters and yield of tomato

Treatment	Plant growth and yield characters				
	Shoot length (cm)	Shoot weight (g)	Root length (cm)	Root weight (g)	Yield/ plant (g)
T_1-Neem cake	89.45 (54)	29.75 (52)	23.94 (83)	12.58 (40)	518.90 (69)
T_2- Jatropha cake	79.32 (29)	24.85 (27)	19.03 (46)	10.64 (18)	486.00 (63)
T_3- Untreated control	61.41	19.62	13.07	8.99	307.90
CD (P=0.05)	62.12	19.65	13.64	6.12	32.80

Figure in parentheses are per cent increase over control

Table 3. Influence of neem and jatropha oilcakes on *M. incognita* host infestation

Treatment	Host infection			
	No. of galls/g of root	No. of egg mass	Root knot index	Soil nematode population
T_1 - Neem cake	32.63 (43)	11.14 (49)	1.76 (61)	242 .57 (44)
T_2- Jatropha cake	34.36 (40)	12.14 (46)	2.56 (43)	256.31 (30)
T_3- Untreated control	56.97	21.69	4.51	365.31
CD (P=0.05)	2.73	1.79	0.85	7.03

Figure in parentheses are per cent decrease over control

Fig. 1. Effect of oil cakes on total saprophytic nematode population at weekly intervals of sampling in tomato

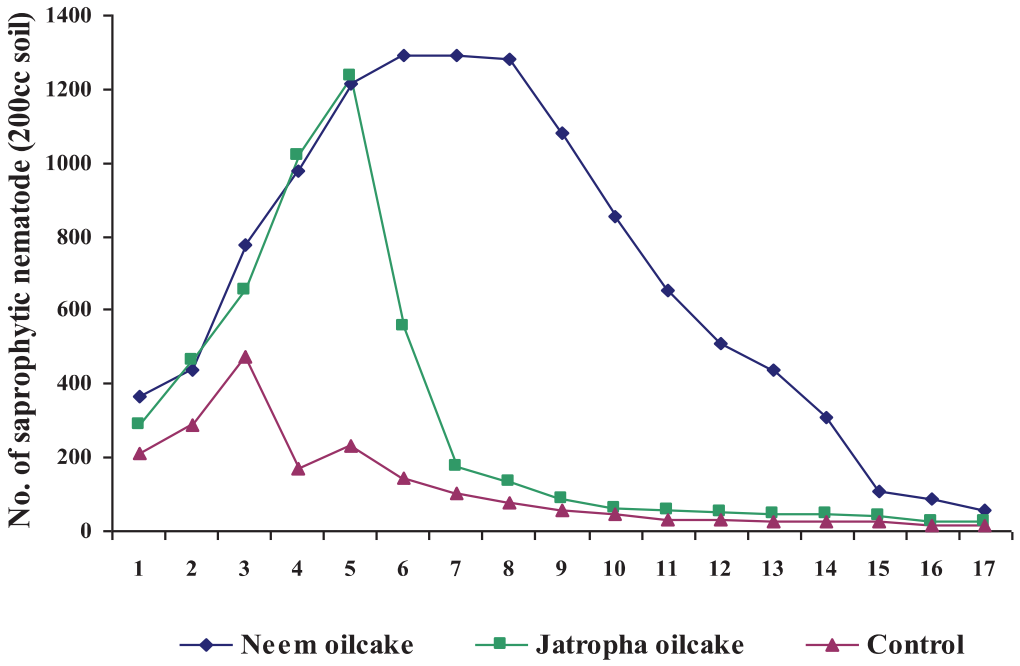
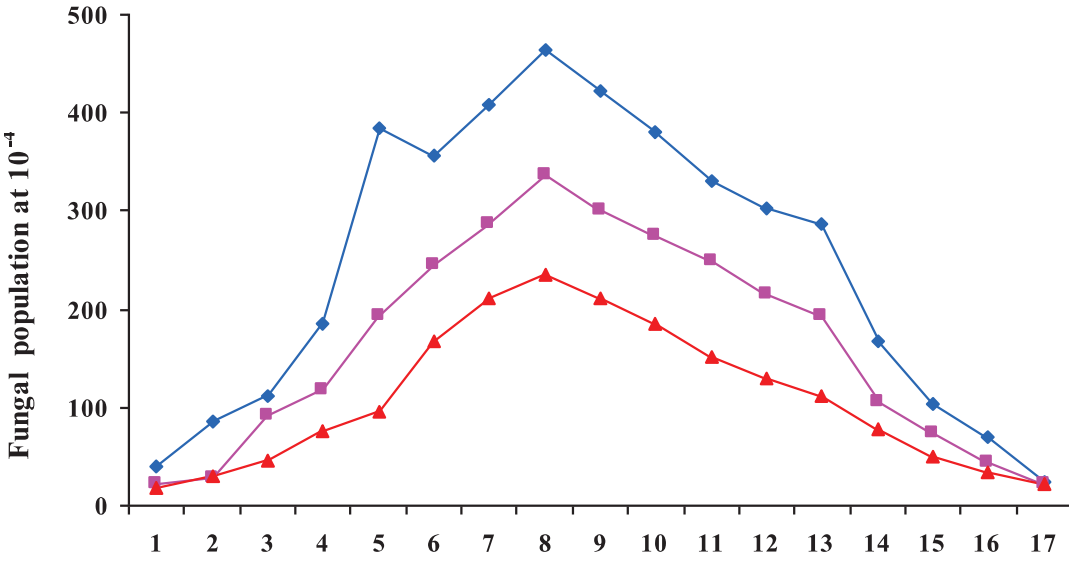


Fig. 2. Influence of oil cakes on total fungal population at weekly interval of sampling in tomato

omato



subsequently to the apparent stimulatory effect of oilcakes in increasing bacteriovorus, predatory nematodes and fungal antagonists. Soil amended with jatropha residues showed that microbial biomass (bacterial and fungal) concentration were significantly higher (Chaudhary *et al*., 2011). The possible mechanism of nematode control has been suggested that increase in microbial activity; increase in saprophytic fungi population (Tyagi and Alam, 1995); increase in saprozoic nematode population (Vemana *et al*., 1999) in the phase of decomposition of oilcakes release of many compounds such as ammonia, phenol, aldehydes and fatty acids were reasons for the reductions of plant parasitic nematodes. It may be attributed from the result presented and discussed above that apart from the abiotic factors, biotic factors such as saprozoic nematodes and nematode fungal antagonists stimulated enormously by the addition of neem and jatropha oilcake as soil amendment had effect in the suppression of *M. incognita* thereby improving the growth and yield of tomato.

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