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INFLUENCE OF ORGANIC AMENDMENTS ON POPULATION AND REPRODUCTION OF ROOT KNOT NEMATODE, *MELOIDOGYNE INCOGNITA* IN EGGPLANTS

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ABSTRACT

The influence of organic amendments on population and reproduction of root knot nematode, *Meloidogyne incognita* in eggplants were evaluated by amending buffalo, cow, goat, poultry, sheep and mixture of tested manures through pot experiment at 5, 10 and 15% of 1.5 Kg soil pot^{-1}. The results revealed that the population of larvae (1435.8), females (27.25) and males (3.75), in roots were significantly decreased in poultry manure followed by goat and cow manures. The reduction in reproduction factor was also related with the rate of organic amendments in the soil used per pot. The maximum reduction of root knot nematode was recorded in poultry manure (52.58), followed by goat (49.02) and cow manures (46.60).

Keywords: Eggplant, *Meloidogyne incognita*, organic amendment, population, reproduction, root knot nematode

INTRODUCTION

Eggplant suffers from a number of plant pathogens. Amongst these, six species of nematodes (*Meloidogyne* sp., *Pratylenchus* sp., *Rotylenchulus* sp., *Tylenchorhynchus annulatus* and *Tylenchorhynchus* sp. and *Xiphinema radicicola*) and 8 species of fungi are known to damage eggplant in Pakistan (Ghafoor and Khan, 1976). Eggplant is susceptible to nematode invasion due to multiple cropping pattern, good moisture level prevailing and continued presence of host. The above ground symptoms are similar to many other root diseases or environmental factors, limiting water and nutrient uptake. These symptoms consist of wilting, stunted plants, chlorotic or pale green leaves, and reduced yields during periods of moisture stress. Most characteristic symptoms; however, are those occurring on underground plant parts. Infected roots swell at the point of infection and form knots or galls. Several infections may occur along the same area resulting in large fleshy galls. The appearance of galls depends in part upon the host and the nematode species involved. Infected roots are retarded in

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growth and lack fine feeder roots. Rotting of roots may develop late in the season (TAES, 2004; Stephen *et al*., 2004).

The root knot nematodes, *Meloidogyne* spp. are responsible to cause yield losses up to 16.8–85.0% (Sasser, 1989). Though the use of nematicides is found to be very effective in nematode control, but their utility is limited due to higher cost, non – availability at sometimes, environmental pollution, residual problem, etc. Therefore, the chemical control is discouraged now-a-days all over the world. Stephen *et al*. (2004) reported that increasing the organic matter in soil encourages the growth of numerous fungi, bacteria and beneficial nematodes that may provide some level of biological control for root knot nematodes; hence, various organic amendments have been tested and reported to have nematicidal properties (Devi and Hassan, 2002; Stephan *et al*., 2002; Sharma *et al*., 2004).

In Pakistan, research regarding soil amendments with organic matter (manures viz., buffalo, cow, goat, poultry and sheep) against plant parasitic nematodes is limited, except Lodhi *et al*. (2002). Therefore, this study is carried out to determine the effect of various organic manures for improving eggplant growth and suppressing root knot nematode populations in roots and soil.

MATERIALS AND METHODS

The composite samples of infested eggplants, showing symptoms of root knot disease were uprooted very gently from fields. The infested root samples were kept in polythene /plastic bags tightened with rubber band and stored at 15^{O}C in the laboratory for isolation of root knot nematodes.

Isolation of root knot nematodes from each sample was done by direct observation of root knots under stereoscopic microscope, by following techniques, using Baerrman funnel method as described by Barker (1985).

The knots of infected eggplant roots were gently cut into small pieces and powdered in a blender for 30 seconds, containing 150 ml distilled sterile water. The material was then passed in 60-mesh sieve kept over 200-mesh sieve. After washing, nematodes were collected in 150-ml beaker. The cavity blocks/ Syracuse dishes were filled with the contents of nematodes, collected in beaker. The females were picked up with very fine needle and placed in a drop of water on the glass slide. A cover slip was placed over the slide and was sealed by coating the cover slip with nail polish and observed under stereoscopic microscope.

The isolated root knot nematodes, *Meloidogyne incognita* were fixed in TAF solution (Triethenolamine 2.0 ml, Formalin 7.0 ml, Distilled water 91.0 ml) by placing a drop of lactophenol over clean slide. The root knot nematode was identified by studying the typical female perenial pattern of isolated mature females, as defined by Taylor and Netscher (1974) and its typical taxonomical characteristics mentioned by Mai and Lyon (1975).

To evaluate the influence of organic amendments, pot experiment was conducted at the Department of Plant Pathology, Faculty of Crop Protection, Sindh Agriculture University Tandojam.

Nurseries of eggplant were raised by seeding variety BSS 330 long. Buffalo, cattle, goat, poultry, sheep and mixture of all these five manures (at equal ratio) were used as amendment by mixing at 75, 150 and 225 g/earthen pot (5, 10 and 15% of soil). After a month of amendment, one and half month old eggplant seedlings were transplanted at 5 seedlings/ pot, containing 1.5 kg steam sterilized soil amended with manure. Freshly hatched *Meloidogyne incognita* (2500 larvae) were artificially inoculated one week after transplanting through drenching. The experiment was laid out as completely randomized design with four replications. The pots were lightly irrigated whenever needed.

Observations

The plants were up-rooted after 60 days and the data were recorded for number of larvae, females and males / plant. The nematode reproduction factor per plant root system was also calculated accordingly.

Analysis of data

The data were analyzed for analysis of variance and means were compared at $P<0.05$ and 0.01, by using computer software "Student edition of statistix, Version 1.0".

RESULTS AND DISCUSSION

The influence of organic amendments on population and reproduction of root knot nematode, *Meloidogyne incognita* in eggplants vary from one amendment to another and significantly different in comparison to control. The results so far achieved are described as under.

Effect of organic amendments on nematode population

The nematode population per plant root system was significantly decreased as the soil amendment dose was increased (Table 1), even lowest dose of all amendments showed significantly reduced nematode population as compared to control (inoculated un-amended soil). The lowest nematode population (1466.80), was recorded in case of the soil amended with poultry manure at 15%, followed by goat and cow manures at 15% (1578.25 and 1650.30) as compared to poultry and goat manures at 10% (1671.50 and 1836.55), mixture of manures at 15%, cow manure at 10%, sheep manures at 15%, mixture of manure at 10% and poultry manure at 5% (1842.05, 1962.30, 1996.00, 2022.05 and 2067.25). It is also clear from the same table that the highest nematode population (3094.25) was recorded from control (inoculated un-amended) followed by buffalo and sheep manures at 5% (2689.25 and 2588.55) as compared to buffalo manure at 10% (2483.00), mixture of manures, goat manure and cow manure at 5%

(2427.05, 2205.75 and 2362.05) and sheep manure at 10% and buffalo manure at 15% (2176.00 and 2116.30). There were no nematode population in case of control (no manure no inoculum) (Table 1).

Table 1. Effect of organic amendments on total nematodes population in eggplant inoculated with *Meloidogyne incognita*.

Manure	Dose (%) of 1.5 Kg soil / pot	Number of Larvae/plant	Number of Males/plant	Number of Females/plant	Total nematode population
Buffalo	5	2620.0	19.500	49.75	2689.25
	10	2419.0	16.500	47.50	2483.00
	15	2064.8	12.000	39.50	2116.30
Cow	5	2304.8	14.250	43.00	2362.05
	10	1918.8	07.500	36.00	1962.30
	15	1615.8	05.000	29.50	1650.30
Goat	5	2149.5	14.000	42.25	2205.75
	10	1797.3	06.250	33.00	1836.55
	15	1544.5	04.750	29.00	1578.25
Poultry	5	2017.0	10.750	39.50	2067.25
	10	1633.0	05.750	32.75	1671.50
	15	1435.8	03.750	27.25	1466.80
Sheep	5	2524.3	16.500	47.75	2588.55
	10	2123.0	12.250	40.75	2176.00
	15	1951.0	08.250	36.75	1996.00
Mixture of all	5	2369.3	14.500	43.25	2427.05
	10	1975.3	09.500	37.25	2022.05
	15	1802.8	06.250	33.00	1842.05
Control	Inoculated un-amend	3020.0	20.500	53.75	3094.25
Control	Un-inoculated un-amend	-	-	-	-
LSD	P < 0.01	133.99	2.1957	4.9023	-
	P < 0.05	100.75	1.6510	3.6861	-

The maximum reduction (%) in total nematode population/root system over control (Fig. 1) was recorded in case of poultry manures (52.59) when amended at 15% followed by goat and cow manures at 15% (48.99 and 46.66) as compare to poultry and goat manures at 10% (45.98 and 40.64) as compare to mixture of manures at 15%, cow at 10%, sheep at 15%, mixture of manure at 10% and poultry manures at 5% (40.46, 36.58, 35.49, 34.65 and 33.19). Also from the same fig. 1, the minimum reduction (%) over control in nematode population/root system was recorded (13.08) when amended with buffalo manures at 5% followed by the sheep manures at 5% and buffalo manures at 10% (16.34 and

19.75) as compare to mixture of manures, cow and goat manures at 5% (21.56, 23.66 and 28.71), and sheep manure 10% and buffalo manure at 15% (29.67 and 31.60).

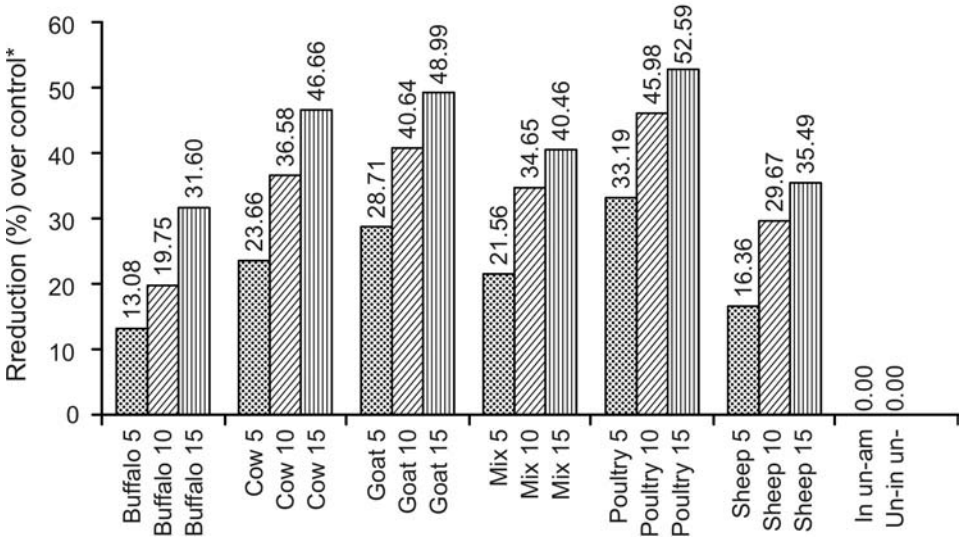

Figure 1. Reduction (%) over control, of total nematodes population in eggplant roots inoculated with *Meloidogyne incognita.*

* Reduction over control (%) = Meloidogyne without manure (3094.25) - Meloidogyne with manure / Meloidogyne without manure X 100

Effect of organic amendments on nematode reproduction factor

The nematode reproduction factor per plant root system was significantly decreased as the soil amendment dose was increased; even lowest dose of all amendments showed significantly reduced nematode population as compared to control (inoculated un-amended soil) (Table 2). The minimum reproduction factor (2.93) per root system was recorded in case of the soil amended with poultry manures at 15% followed by goat and cow manures at 15% (3.15 and 3.30) as compare to poultry and goat manures at 10% (3.34 and 3.67), and mixture of manures at 15%, cow manure at 10%, sheep manures at 15%, mixture of manures at 10% and poultry manure at 5% (3.68, 3.92, 3.99, 4.04 and 4.13), respectively. It is also clear from the same table that the highest nematode reproduction factor (6.18) was recorded from control (inoculated un-amended) followed by buffalo manure at 5% (5.37), followed by sheep manure at 5% and buffalo manure 10% (5.17 and 4.96) as compare to mixture, cow, goat manure at 5% (4.85, 4.72 and 4.41), and sheep manure at 10% and buffalo manure at 15% (4.35 and 4.23). There were no nematode reproduction in case of control (no manure no inoculum).

Table 2. Effect of organic amendments on nematode reproduction factor in eggplant inoculated with *Meloidogyne incognita*.

Manure	Dose (%) of 1.5 Kg soil / pot	Final nematode population/plant (Pf)	Nematode reproduction factor (Rf)*
Buffalo	5	2689.25	5.37
	10	2483.00	4.96
	15	2116.30	4.23
Cow	5	2362.05	4.72
	10	1962.30	3.92
	15	1650.30	3.30
Goat	5	2205.75	4.41
	10	1836.55	3.67
	15	1578.25	3.15
Poultry	5	2067.25	4.13
	10	1671.50	3.34
	15	1466.80	2.93
Sheep	5	2588.55	5.17
	10	2176.00	4.35
	15	1996.00	3.99
Mixture of all	5	2427.05	4.85
	10	2022.05	4.04
	15	1842.05	3.68
Control	Inoculated un-amended	3094.25	6.18
Control	Un-inoculate un-amended	-	-
LSD	P < 0.01	-	-
	P < 0.05	-	-

* Rf = Pf/Pi (Rf = Preproduction factor, Pf = final population, Pi = initial population)

The maximum reduction (%) over control in nematode reproduction factor/root system (Fig. 2) was recorded (52.58) when amended at 15% followed by goat and cow manures at 15% (49.02 and 46.60), as compare to poultry and goat manures at 10% (45.95 and 40.60) and mixture of manures at 15%, cow manure at 10%, sheep manure at 15%, mixture of manures at 10% and poultry manure at 5% (40.45, 36.56, 35.45, 34.62 and 33.17) (Fig. 2). Also from the same figure, the minimum nematodes reproduction factor/root system was recorded (13.10) when amended with buffalo manure at 5% followed by the sheep manures at 5% and buffalo manure at 10% (16.34 and 19.74) as compare to mixture of manures, cow and goat manure at 5% (21.52, 23.62 and 28.64), and sheep manure 10% and buffalo manure at 15% (29.61 and 31.55).

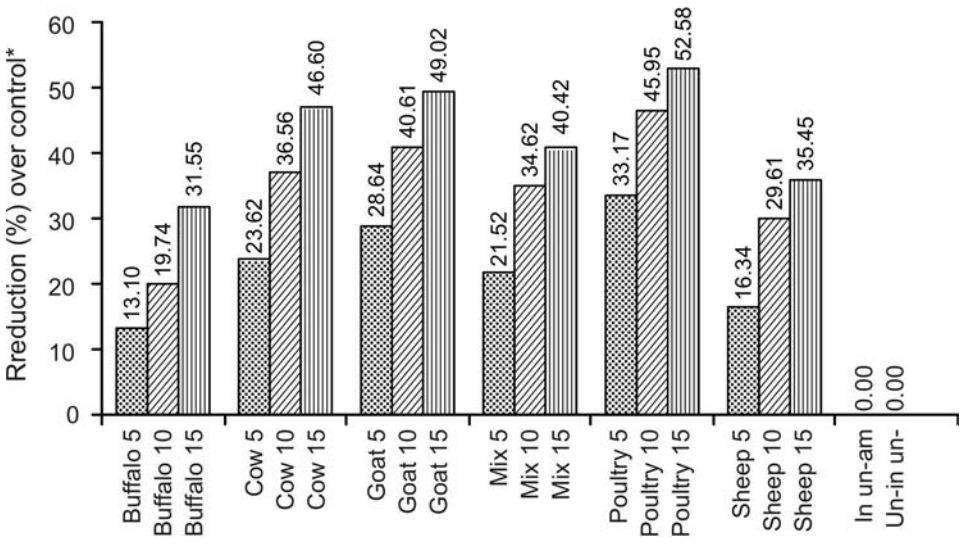

Figure. 2. Reduction (%) over control, of nematodes reproduction factor in eggplant roots inoculated with *Meloidogyne incognita.*

* Reduction over control (%) = Meloidogyne without manure (6.16) - Meloidogyne with manure / Meloidogyne without manure X 100

Meanwhile, the nematode population (larvae, females and males per root system) was significantly decreased as dose of soil amendment was increased. The minimum nematodes population (1466.80) per plant was recorded when soil was amended with poultry manure, followed by goat manure (1578.25), as compared to cow manure (1650.30), mixture of all tested manures (1842.05), sheep manure (1996.00), and buffalo manure (2116.30). Where as the maximum nematodes population was recorded (3094.25) in case of control (inoculated un-amended) while no nematodes population was found in control (un-inoculated un-amended). Whereas, the nematodes reproduction factor per root system was significantly decreased as dose of soil amendment was increased. The minimum nematode reproduction factor (2.93) per plant was recorded when soil was amended with poultry manure, followed by goat manures (3.15), as compared to cow manure (3.30), mixture of manures (3.68), sheep manure (3.99), and buffalo manure (4.23). Whereas, the maximum nematodes reproduction factor was recorded (6.18) in case of control (inoculated un-amended) while no nematodes reproduction factor was found in control (un-inoculated un-amended). The reduction was related with the rate of amendments in the soil used per pot. The results so far obtained are in conformity with other researchers. Dias *et al*. (2000) also reported that eggs were significantly lower in regard to control. El-Zawahry (2000) reported that organic manure treatments with farmyard, goat, rabbits, poultry and pigeon showed reduced nematode population in soil and roots. Ibrahim and Ibrahim (2000) observed that the soil amended with manures greatly

suppressed the nematode reproduction (egg mass production). Umar and Jada (2000) also used goat manure that inhibited the growth and development of *Meloidogyne incognita* in pot tests. Siddiqui *et al*. (2001); Verma *et al*. (1998) also reported that application of organic manuring resulted in less galling and nematode multiplication. Bulluck *et al*. (2002) reported that soil amendments had a large impact on nematode community structure and diversity. Costa *et al*. (2002) observed reduced nematode egg production when poultry manure extracts were applied to *M. incognita*-inoculated tomato plants. Devi and Hassan (2002) reported that all treatments of *T. viride*, farmyard and poultry manures reduced nematode gall formation. Sundararaju *et al*. (2002) reported that the population of root knot nematode (*Meloidogyne incognita*) was significantly lower in plants that received poultry manure.

In regard to mode of action of organic manure against soil nematode, Lazarovits *et al*. (2001) reported that high-nitrogen-containing organic amendments such as poultry or cattle manure had an immediate suppressive effect on soil nematodes as a result of ammonia release immediately after initiation of microbial decomposition. Also, Oka and Pivonia (2002) stated that organic fertilizers contain ammonia and formulations releasing this form of nitrogen in the soil that can suppress nematode populations. Mbah and Onweremadu (2009) reported that farming practices such as organic fertilizing can be geared to conserve and promote soil aggregations that impede the nematode larvae movement.

CONCLUSION

It is concluded from the results that organic amendments significantly decreased the population of root knot nematode, *Meloidogyne incognita* in infected eggplant roots. The reduction was related with the rate of organic amendments in the soil used per pot. Increased dosage of amendments decreased nematode population as compared to control (without amendment). Poultry manure found to be the best followed by goat manure as compared to cow manure and mixture of manures, than sheep and buffalo manures.

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