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EFFICACY OF TWO ORGANIC AMENDMENTS AND A NEMATICIDE TO MANAGE ROOT-KNOT NEMATODE *(Meloidogyne incognita)* OF TOMATO *(Lycopersicon esculentum* L.)

M. I. FARUK[1], M. L. RAHMAN[2], M. R. ALI[3], M. M. RAHMAN[4]
AND M. M. H. MUSTAFA[5]

Abstract

A field experiment was conducted in two consecutive years to find out the efficacy of poultry refuse (PR), mustard oilcake (MOC), and Furadan 5G for the management of root-knot disease *(Meloidogyne incognita)* of tomato. Soil was treated with PR @ 3 and 5 t/ha, MOC @ 0.3 and 0.6 t/ha 3 weeks before transplanting and Furadan 5G @ 40 kg/ha on the day of transplanting of tomato seedlings. PR @ 3 t/ha and MOC @0.3 t/ha were applied alone and also mixed with Furadan 5G @ 20 kg/ha. The soils of the experimental plots were inoculated with chopped severely galled *(M incognita)* roots of tomato at the time of treatment application. In both the years, considerable reduction in root-knot disease and increase in plant growth and fruit yield were achieved with different treatments with two organic materials applied alone or mixed with Furadan 5G. The most effective treatment was PR @ 3 t/ha + Furadan 5G @ 20 kg/ha followed by PR alone @ 5 t/ha. Efficacy of PR @ 3 t/ha and MOC @ 0.6 1/ha were also appreciable. In first year and second year, gall index values were 6.50 and 6.27 under control, respectively. The severity was reduced to 2.27-4.00 in first year and 1.73-4.07 in second year due to application of the four treatments. On the other hand, fruit yield under control was 50.9 t/ha at first year and 47.6 t/ha in second year. The highly effective four treatments increased fruit yield to 71.1-82.5 t/ha in first year and 60.8-82.0 t/ha in second year. The fruit yield of tomato was directly and linearly correlated with gall indices in tomato gall. Based on findings of the study PR @ 3 t/ha + Furadan @20 kg/ha and PR alone @ 5 t/ha were noted as effective treatment to manage root-knot disease of tomato.

Keywords: Poultry refuse, mustard oilcake, Furadan, *Meloidogjyne incognita*, tomato.

Introduction

Tomato *(Lycopersicon esculentum* L.) is one of the most popular vegetables in Bangladesh (Chowdhury, 1979). It ranks second after potato in production and consumption. In this country, the average yield of tomato is too low as compared to that of other tomato growing countries. Several yield limiting factors of tomato

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[1]Senior Scientific Officer, Plant Pathology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, [2]Principal Scientific Officer, Training & Communication Wing, BARI, Gazipur, [3]Principal Scientific Officer, Plant Pathology Division, BARI, Gazipur, [4]Senior Scientific Officer, Plant Pathology Division, BARI, Gazipur, [5]Deputy Director, Bangladesh Rural Development Board, Dhaka, Bangladesh.

are enumerated. Among them, diseases caused by fungi, bacteria, nematodes, and viruses play major role. The root-knot disease caused by *Meloidogyne incognita* is highly damaging and yield reducing factor of tomato throughout the country (Mian, 1986). In some cases, especially in the intensive tomato growing areas, root-knot nematode is one of the major limiting factors affecting tomato production. The average losses due to root-knot nematode infestation are 20.6% in tomato (Sasser, 1989). It causes about 40% yield loss of tomato in Bangladesh and about 46.2% yield reduction in India (Mohsin, 1987; Anon., 1986). A number of approaches aimed for controlling root-knot nematodes through application of nematicides (Hossain *et al*., 1989), organic soil amendments (Trivedi *et al*., 1978; Mian and Rodrigued-Kabana, 1982; Faruk *et al*., 2001; Ban *et al*., 2004), cultural management, physical methods like soil solarization and biological measures like *Trichoderma* spp, *Pacecilornyces lilacinus*, *Pasturia penetrans* and *Pseudomonas aeruginosa* (Rao *et al*., 1997; Reddy *et al*., 1998 and Siddiqui *et al*., 1999). Tomato cultivar resistant to root-knot nematode is not available in Bangladesh. Chemical control of this nematode is very expensive and also not desirable because chemical nematicides may affect the agro-eco system and also has detrimental effect on numerous beneficial parasites, predators and other microbes prevailing in the soil. Therefore, alternate management options against the disease are to be sought. Presently, researchers have diverted their attention to manage plant nematode through use of organic amendments (Mian and Rodrigued-Kabana, 1982; Faruk *et al*., 2001; Ban *et al*., 2004) and to develop integrated approaches against the pest because often any single approach may not be effective to manage the plant parasitic nematode efficiently.

Under the above circumstances, the present piece of research was undertaken to find out efficacy of poultry refuses, mustard oilcake, and Furadan 5G to manage root-knot nematode of tomato and to increase plant growth and yield of tomato.

Materials and Method

A field experiment was conducted to test efficacy of two commonly available organic amendments, namely mustard oil cake (MOC) and poultry refuses (PR) and a nematicide Furadan 5G (Carbofuran) to control root-knot nematode of tomato. The experiment was conducted in two consecutive years. A total of 8 treatments including a control viz. (I) control, (ii) Furadan 5G @ 40 kg/ha, (iii) poultry refuse @ 5 t/ha, (iv) poultry refuse @ 3 t/ha, (v) poultry refuse @ 3 t/ha+ Furadan 5G @ 20 kg/ha, (vi) mustard oilcake @ 0.6 t/ha, (vii) mustard oil cake @ 0.3 t/ha, (viii) mustard oilcake @ 0.3 t/ha+ Furadan 5G @ 20 kg/ha were maintained in this experiment.

The experiment was conducted in the experimental field of Plant Pathology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 3 m × 2 m.

Standard cultivation procedures recommended by BARI were followed to grow tomato with little modification. The experimental land was prepared with proper tillage and fertilizers were added during final land preparation. Requisite quantity of fresh poultry refuse and mustard oil cake were incorporated with the soil 3 weeks before transplanting of tomato seedlings and allowed to decompose properly. Furadan 5G was applied to the experimental field just before transplanting of seedlings. To ensure inocula of the nematode, chopped severely galled tomato roots infected with *M. incognita* were mixed with soil around the tomato seedlings @ 2 g/plant. Twenty five days old and apparently healthy tomato seedlings of variety BARI Tomato-2 (Ratan) were transplanted in the experimental plots maintaining row to row and plant to plant distance of 60 cm and 40 cm, respectively. Ten additional seedlings per plot were also transplanted in between two rows. During crop season, necessary weeding, irrigation and other intercultural operations were done as per recommendation of the crop (Anon., 2007).

The root-knot disease severity was recorded at 60 days after transplanting. The additional ten plants per plot were carefully uprooted after 60 days of transplanting and the root systems were cleaned with running tap water. Data on length and weight of shoot and root were recorded. The severity of root gall was recorded in terms of gall index based on a 0-10 scale (Zeck, 1971). Data on fruit yield were recorded from five randomly selected plants per plot. The fruit yield was expressed in t/ha.

Results and Discussion

Severity of root gall: In both the years, the severity of root gall of tomato was drastically reduced over control due to treatment of soil with mustard oilcake (MOC) as well as poultry refuse (PR) and application of Furadan 5G. In the first year, the maximum average gall index value of 6.5 was recorded in the control plot. It was reduced to 2.33 to 4.33 due to treatments with two organic amendments at different doses and the Furadan 5G. Higher reduction of root-knot severity was corroborated with higher dose of the materials. The lowest severity of root-knot disease of tomato was recorded from the treatment with PR @ 3t/ha+Furadan 5G @ 20 kg/ha, which was followed by PR @ 5 t/ha and MOC @ 0.3 t/ha+ Furadan 5G @ 20 kg/ha. The second highest gall index value was found in plots treated with MOC @ 0.3 t/ha, which was followed by Furadan 5G @ 40kg/ha (Table 1).

Table 1. Effect of soil treatment with two organic amendments and one nematicide on the severity of root-knot disease *(Meloidogyne incognita)* and shoot growth of tomato in two consecutive years.

Organic amendments and Furadan with dose	Gall index (0-10 scale)		Shoot length (cm/plant)		Shoot weight (g/plant)	
	1st year	2nd year	1st year	2nd year	1st year	2nd year
Control	6.50 a	6.27 a	63.5 c	59.3 c	233.3 c	190.0 c
Furadan 5G @ 40 kg/ha	4.00 ab	4.07 a	64.0 c	67.3 b	320.0 bc	253.3 b
Poultry refuse @ 5 t/ha	2.67 bc	1.73 d	82.7 a	85.0 a	433.3 a	380.0 a
Poultry refuse @ 3 t/ha	3.33 abc	2.60 c	69.0 abc	85.0 a	320.0 bc	380.0 a
Poultry refuse@ 3t/ha + Furadan @ 20kg/ha	2.33 c	1.53 d	80.2 ab	85.3 a	426.7 a	360.0 a
Mustard oilcake @0.6 t/ha	3.33 abc	2.67 c	75.3 abc	73.0 b	353.3 b	296.7 b
Mustard oilcake @0.3 t/ha	4.33 ab	2.73 c	66.3 bc	10.0 b	306.7 bc	276.1 b
Mustard oilcake @3t/ha + Furadan @ 20kg/ha	3.00 abc	2.27 cd	68.3 abc	69.7 b	360.0 b	293.3 b
LSD	0.4	0.78	14.53	7.188	24.37	45.20
CV(%)	1.2	10.76	11.63	3.94	10.68	6.12

Values within the same column with a common letter do not differ significantly (P = 0.05)

In the second year, the highest gall index value of 6.27 was found in control plot and the values were reduced to 1 .53 to 4.07 due to application of different treatments. The reduction in disease severity was significant compared to control. The maximum reduction was obtained with PR @ 3 t/ha + Furadan 5G @ 20 kg/ha followed by PR @ 5 t/ha and MOC 0.3 t/ha + Furadan 5G @ 20 kg/ha. The least effective treatment to reduce root galling was Furadan 5G @ 40 kg/ha followed by MOC @ 0.3 t/ha, MOC @ 0.6 t/ha and PR @3 t/ha (Table I).

Shoot growth: Average shoot length of tomato under control was 63.5 cm/plant in first year and 59.3 cm/plant in second year. Treatment of soil with PR, MOC, and Furadan 5G at different doses increased the parameter to 64.0-82.7 cm/plant in first year and 67.3-85.3 cm/plant in second year. In the first year, the highest shoot length was obtained with PR @ 5 t/ha followed by PR @ 3 t/ha + Furadan 5G @ 20 kg/ha and MOC @ 0.6 t/ha. The lowest increase in shoot length was recorded under the treatment with Furadan 5G @ 40 kg/ha followed by MOC @ 0.3 t/ha and MOC @ 0.3 t/ha + Furadan 5G @ 20 kg/ha. In second year, the maximum shoot length was recorded from plots treated with PR @ 3 t/ha+Furadan 5G @ 20 kg/ha. It was almost identical to the shoot length recorded from plots treated with PR @ 5 and 3 t/ha. The least effective treatments to increase shoot length was Furadan 5G @ 40 kg/ha followed by MOC @ 0.3 t/ha + Furadan 5G @ 20 kg/ha. MOC @ 0.3 t/ha and MOC @ 0.6 t/ha (Table I).

In first year, the shoot weight of tomato was only 233.3 g/plant under control. It increased to 306.0-433.3 g/plant due to treatments with PR, MOC, and Furadan 5G at different doses. The highest shoot weight was achieved with PR @ 5 t/ha followed by PR @ 3 t/ha, PR @ 3 t/ha + Furadan 5G @ 20 kg/ha and MOC @ 3 t/ha + Furadan 5G @ 20 kg/ha. The least effective treatment to increase shoot weight was MOC @ 0.31/ha, which was followed by PR @ 5 t/ha and PR @ 3 t/ha. In second year, the shoot weight of tomato was 190.0 g/plant when both the organic amendments and the nematicide were not applied (control). Application of PR, MOC, and Furadan 5G at different doses gave higher shoot weight over control within the range of 306.0-433.3 g/plant. Two treatments with PR alone (5 t/ha and 3 t/ha) yielded the highest shoot weight. The second highest shoot weight was found in plots treated with PR @ 3 t/ha +Furadan 5G @20 kg/ha followed by MOC @ 0.6 t/ha and MOC @ 0.3 t/ha + Furadan 5G (a) 20 kg/ha. The least effective treatment to increase shoot weight was Furadan *5G* alone @ 40 kg/ha followed by MOC @ 0.3 t/ha (Table I).

Table 2. Effect of soil treatment with two organic amendments and one nematicide on root growth of tomato in soil inoculated with *Meloidogyne incognita.*

Organic amendments and Furadan with dose	Root growth (cm/plant)		Root weight (g/plant)	
	1st year	2nd year	1st year	2nd year
Control	20.80 f	19.07 b	35.20 ab	12.99
Furadan 5G @ 40kg/ha	27.87e	20.47b	38.74a	13.53
Poultry refuse @ 5 t/ha	42.33 ab	24.28 a	27.30 c	16.97
Poultry refuse @ 3 t/ha	38.67 abc	26.33 a	28.63 bc	17.53
Poultry refuse @ 3 t/ha+ Furadan 5G @20 kg/ha	44.00 a	24.87 a	31.33 bc	15.70
Mustard oilcake @0.6 t/ha	38.33 abc	24.53 a	28.83 bc	14.09
Mustard oil cake @0.3 t/ha	36.33 bcd	24.67 a	28.57c	13.70
Mustard oilcake @0.3 t/ha+ Furadan5G @20 kg/ha	31.33 de	25.27 a	27.48 e	16.55
LSD	6.27	3.81	6.60	NS
CV(%)	10.39	6.60	12.57	

Values within the same column with a common letter do not differ significantly (P = 0.05)

Root growth: Amendment of soil with PR and MOC and application of Furadan 5G showed positive effects on root growth of tomato as compared to control. In first year, the minimum root length of 20.8 cm/plant was recorded under control. The highest root length of 44 cm was achieved with PR @ 3t/ha + Furadan5G @ 20 kg/ha followed by the treatment with PR alone @ 5 t/ha giving 42.33 cm root length. Other five treatments also increased root length over control within the range of 27.7-31.3 cm/plant. In second year, root length under control was only 19.07 cm/plant. It was increased to 24.28-26.33 cm/plant due to application of PR and MOC. In first year, root weight was 35.20 g/plant under control. It was increased to 38.7 g/plant due to application of Furadan 5G @ 40 kg/ha. Other treatments caused reduction in root weight giving 27.30-31 .33 g/plant. However, in second year, root weight increased to some extent over control showing 12.99 g/plant under control and 13.5-17.5 in plots treated with PR, MOC, and Furadan 5G in different doses (Table 2).

Crop yield: Organic soil amendments with PR and MOC and Furadan *5G* at different doses gave appreciable increase in fruit number per plant and fruit yield per hectare in both the years. However, yield increase was not significant under all treatments compared to control (Table 3).

Table 3. Effect of soil treatment with two organic amendments and one nematicide on fruit yield of tomato in soil inoculated with *Meloidogyne incognita.*

Organic amendments and Furadan with dose	Fruit number/plant		Fruit yield (t/ha)	
	1st year	2nd year	1st year	2nd year
Control	27.67 b	23.47 d	50.90 c	47.63 f
Furadan 5G @ 40kg/ha	43.l3ab	34.53c	64.50bc	54.65e
Poultry refuse @ 5 t/ha	51 .67 a	46.40 a	82.00 a	72.72 a
Poultry refuse @ 3 t/ha	44.73 ab	37.07abc	73.00 ab	63.83 bc
Poultry refuse @ 3 t/ha+ Furadan 5G @20 kg/ha	50.93 a	44.87 ab	82.50 a	69.72 ab
Mustard oilcake @0.6 t/ha	39.20 ab	42.13 abc	69.35 b	66.50 bc
Mustard oilcake @ 0.3 t/ha	36.67 ab	35.60 bc	63.45 bc	57.78 dc
Mustard oilcakc @ 0.3 t/ha+ Furadan 5G @ 20 kg/ha	38.80 ab	39.20 abc	71.15 ab	60.78 cd
LSD	13.98	8.98	16.75	5.72
CV (%)	14.38	9.75	11.85	3.82

Values within the same column with a common letter do not differ significantly (P =0.05)

Under control, fruit number per plant was 27.7 in 1st year and 23.5 in 2nd year. Per plant fruit number increased to 36.7-51.7 in 1st and 34.5-46.4 in 2nd year due to different treatments. In 1st year, only the treatments with PR @ 5 t/ha and PR @ 3 t/ha + Furadan 5G @20 kg/ha increased fruit number significantly over control. In 2nd year, all seven treatments with PR, MOC, and Furadan 5G caused significant increase in fruit number over control. The lowest increase was achieved with Furadan 5G at 40 kg/ha followed by MOC @ 0.3 t/ha. The highest fruit number was obtained with PR @ 5 t/ha, which was statistically similar to PR @ 3 t/ha, PR @ 3 t/ha+Furadan5G @ 20 kg/ha, MOC @ 0.6 t/ha and MOC @ 0.3 t/ha+Furadan5G @ 20 kg/ha (Table 3).

In first year, the lowest fruit yield of 50.9 t/ha was found under control. The yield was increased from 64.5 to 82.5 t/ha due to application of different treatments with MOC, PR 5, and Furadan 5G. The maximum yield was obtained with PR @ 3 t/ha + Furadan 5G @ 20 kg/ha followed by PR @ 5 t/ha, PR @ 3 t/ha and MOC @ 0.3 t/ha + Furadan 5G @ 20 kg/ha. Efficacy of four treatments to increase yield was statistically similar. Differences in fruit yield harvested from control plots and plots treated with Furadan 5G @ 40 kg/ha and MOC @ 0.3 t/ha were not significant.

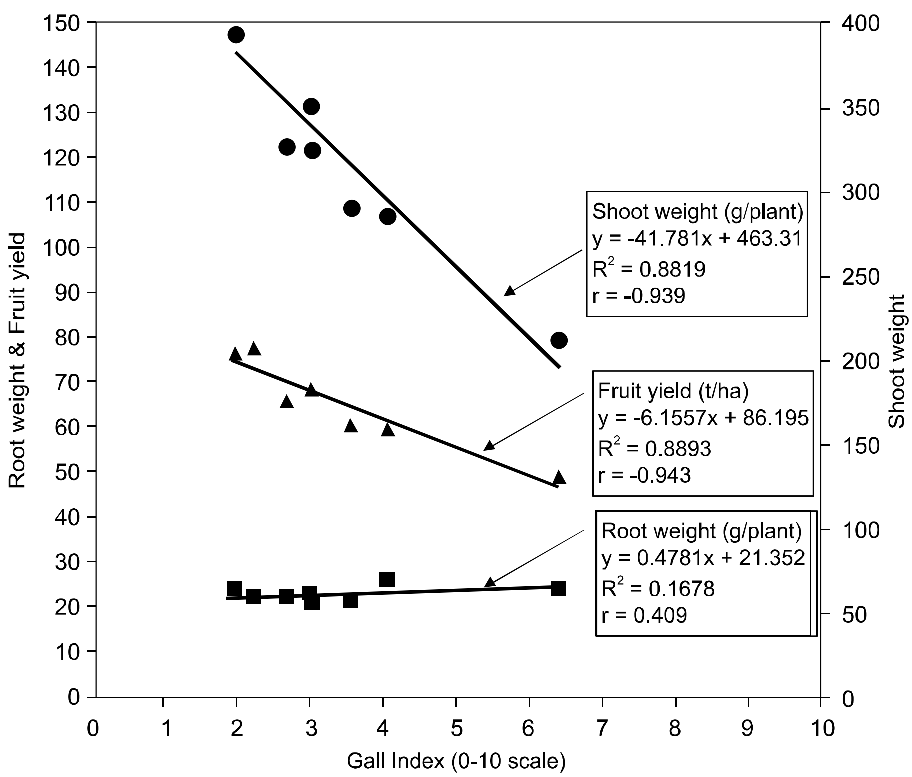

Fig. 1. Relationship of shoot weight, root weight and fruit yield with gall index of tomato grown, in soil inoculated with *Meloidogyne incognita* and treated with poultry refuse, mustard oilcake and Furadan 5G.

In 2nd year, average fruit yield was 47.6 t/ha under control and 54.6 to 72.7 t/ha under treated plots. The yield increase over control was significant under all treatments with PR, MOC, and Furadan 5G. The highest yield was obtained with PR @ 5 t/ha, which was statistically similar to PR @ 3 t/ha + Furadan 5G @ 20 kg/ha. The lowest yield increase was found under Furadan 5G @ 40 kg/ha followed by MOC @ 0.3 t/ha.

Correlation and regression analysis was performed to find out the relationship of fruit yield, shoot weight and root weight with gall index values of tomato grown in soil inoculated with *M. incognita* and treated with PR, MOC, and Furadan 5G. Pooled data on those parameters recorded in two consecutive years were used for this analysis and found that the relationship was linear and negative for fruit yield and shoot weight with coefficient of correlations (r) 0.943 and 0.939, respectively, while in case of root weight the relationship was not significant (r = 0.409). The relationship was significant in case of fruit yield and shoot weight and influence of gall index on those two parameters may be attributed to 88.93% (R^2=0.8893) and 88.19% R^2=0.8819), respectively. Relationship between root weight and gall index was not significant and may be attributed to only 16.78% (R^2=0.l678). The results indicated that organic amendments improved plant growth. It may be due to addition of plant nutrients to the soil. Their higher doses caused phytotoxicity resulting lower root weight compared to lower dose. A Lower R^2 value indicates that other factors are also involved in plant growth and yield increase.

Results of the present study reveal that soil amendment with poultry refuse @ 5 and 3 t/ha, and mustard oilcake @ 0.6 and 0.3 t/ha are effective to reduce root-knot severity and to increase plant growth and fruit yield of tomato grown in *M. incognita* inoculated soil. Efficacy of both the amendments was corroborated with higher dose of application. However, effectiveness was improved when PR and MOC were applied at lower dose mixed with Furadan 5G @ 20 kg/ha. Furadan 5G alone @ 40 kg/ha also reduced gall index values and improved plant growth to some extent, but its efficacy was not as good as PR and MOC. Similar findings have been reported by many other researchers. Some of them reported that poultry refuse and mustard oilcake are effective in controlling root-knot nematode and enhancing plant growth and yield of tomato (Wahundcniya, 1991; Nahar *et al.* 1996: Faruk *et al.*, 2001; 2002) and many other crops (Ahamad *et al.*, 1987; Mishra *et al.*, 1987; Hossain *et al.*, 1989; Ban *et al.*, 1999; 2004; 2004a). Accelerated yield of tomato under field conditions has been reported by other investigators using higher dose of organic soil amendments alone or their application at lower dose mixed with Furadan 5G (Wahundeniya, 1991; Nahar *et al.*, 1996; Faruk *et al.*, 2001; 2002). Soil amendment with poultry refuse has also been reported to be effective against root-knot nematode of okra (Ban *et al.*, 1999), brinjal (Ban *et al*., 2004; Ahamad *et al*., 1987), potato (Hossain *et al*., 1989), bottle gourd (Khan, 1996) and jute (Mishra *et al*., 1987).

Among the treatments tested in the present study, the most effective one was poultry refuse @ 5 t/ha followed by poultry refuse 3 t/ha mixed with Furadan 5G @ 20 kg/ha. Based on findings of the present investigation these two treatments may be recommended for controlling root-knot of tomato.

References

Ahamad, M. U., A. K. Biswas and J. Hossain. 1987. Effect of organic soil amendments on the development of root knot disease at the early growth stage of brinjal. B*angladesh J. Plant Pathol.* **3**(1&2): 3l-36.

Anonymous.1986. Annual report (1985-86). Plant Pathology Division, BARI, Joydebpur, Gazipur, 68p.

Anonymous.2007. Research Report on Horticultural Crops (2006-07). Horticulture Research Centre, BARI, Joydebpur, Gazipur, 9lp.

Bari, M. A., M. I. Faruk, M. L. Rahman and M. R. Ali. 2004. Management options for root-knot nematode in lady's finger. B*angladesh J. Plant Pathol.* **20** (l&2): 49-30.

Bari, M. A., M. I. Faruk, M. L. Rahman and M. R. Ali. 2004a. Effect of organic soil amendments and nematicide on root-knot nematode of brinjal. *Bangladesh J. Plant Pathol.* **20** (1&2): 27-30.

Bari, M. A., M. S. Nahar, M. F. Alam and I. H. Hossain. 1999. Efficacy of pre-plant soil treatment with four organic amendments and two nematicides to control root knot of Okra. *Bangladesh J. Plant Pathol*. **15**(l&2): 27-30.

Chowdhury, B. 1979. Vegetables. 6th Revised Edition, The Director National Book Trust, New Delhi, India. 45p.

Faruk, M. I., M. L. Rahman and M. A. Ban. 2002. Management of root knot nematode of tomato using *Trichoderma harzianum* and organic soil amendment. *Bangladesh J. Plant Pathol.* **18**(1&2):33-37.

Faruk, M.l., M. A. Ban, M. S. Nahar, M. A. Rahman and M. M. Hossain. 2001. Management of root knot nematode *(Meloidogyne)* of tomato with two organic amendments and a nematicide. *Bangladesh J. Plant Pathol.* **17**(l&2):27-30.

Hossain, S., I. H. Mian and K. Tsuno. 1989. Efficacy of three nematicides and two oilcakes for control of root knot nematode *(Meloidogyne incognita)* in potato seedlings. *J. Fac. Agric. Kyushu University* **34**(1&2):1 15-121.

Khan, A. G. 1996. Efficacy of chemical and soil amendments with mustard oil cake on the root-knot *(Meloidogyne javanica)* of bottle gourd. An M. S. Thesis submitted to the Faculty of Agriculture, BAU, Mymensingh. 40p.

Mian, I. H. and R. Rodrigued-Kabana. 1982. A survey of the nematicidal properties of some organic matenials available in Albana as amendments to soil for control of *Meloidogyne arenaria,* Nematropica **12**(2):23 5-246.

Mian, M. I. 1986. Plant parasitic nematode associated with some crop species in Bangladesh. *Bangladesh J. Plant Pathol.* **2**(1): 7-13.

Mishara C. B., B. Singh and S. K. Laha. 1987. Integnrated approach for root-knot management in Jute. *Indian J. Nematol.* **17**(2): 282-287.

Mohsin, M. 1987. Influence of inoculum level on pathogenicity and population development of noot-knot nematode on potato and susceptibility of its clones to the nematode. M. Sc. (Ag) thesis submitted to the Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh.59p.

Nahar, M. S., M. 1. Haq, M. S. Islam and M. H. Hossain. 1996. Efficacy of organic soil amendment for the management of root knot disease *(Meloidogyne incognita)* of tomato. *Bangladesh J. Plant Pathol.* **12**(1&2):l7-20.

Rao, M. S., P. P. Reddy and M. Nagesh. 1997. Management of root-knot nematode. *Meloidogyne incognita* on tomato by integration of *Trichoderma harzianum* with neem cake. *Zeitschrift-fur-Pflanzenkrankheten-und Pflanzenschutz,* **104**(4):423-425.

Reddy, P. P., M. Nagesh and V. Devappa.1998. Management of *Meloidogyne incognita* on potato by integration of *Trichoderma harzianurn, Glomus Jasciculuturn* and neem cake Advances in 1PM for horticultural crops. Proceedings of the First National Symposium on Pest Management in Horticultural Crops: environmental implications and thrust, India. 349-3 52.

Sasser, J. N. 1989. Plant Parasitic Nematodes: The Farmer's Hidden Enemy. North Carolona State University, Raleigh, North Carolona: 7-14.

Siddiqui, I. A., S. E. Haque and A. Gaffar.1999. Root dip treatment with *Pseudomonas aeruginosa* and *Trichoderma* spp. in controlling root-knot complex in chilli. *Pakistan J. Nematol.***17:** 65-75.

Trivedi, P. C., A. Bhannagar and B. Tiagi. 1978. Control of nematode on *Capsicum annum* by application of oilcakes. *Indian Phytopathol.* **32**(1): 75-76.

Wahundeniya, 1. 1991. Effect of poultry manure on root knot nematode *(Meloidogyne* spp.) in tomato *(Lycopersicon esculentum* Mill). *Trop. Agric.* l43-153.

Zeck, M. W. 1971. A rating scheme for field evaluation of root knot nematode infestation. *Planzenschuta-Nacht* **24:** 14 1-144.