International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 2757-2761

Received: 22-03-2018
Accepted: 29-04-2018

Saroj Yadav
Department of Nematology, College of Agriculture, CCS HAU Hisar, Haryana, India

Jaydeep Patil
Department of Nematology, College of Agriculture, CCS HAU Hisar, Haryana, India

Anil kumar
Department of Nematology, College of Agriculture, CCS HAU Hisar, Haryana, India

Correspondence
Saroj Yadav
Department of Nematology, College of Agriculture, CCS HAU Hisar, Haryana, India

Bio-nematicidal effect of *Azadirachta indica*, against *Meloidogyne incognita* in tomato

Saroj Yadav, Jaydeep Patil and Anil Kumar

Abstract
A pot experiment under screen house conditions was carried out to manage the root-knot nematode, *Meloidogyne incognita* in tomato by using different neem leaves @ 5, 10, 20 and 30 g/kg soil along with chemical as well as untreated checks. Soil was autoclaved and inoculated with root-knot nematode (1000 J_2/kg soil). Neem leaves were incorporated to the soil in pot as treatment wise and a waiting period of ten days was given for decomposition of neem leaves before transplanting of tomato seedling. The results revealed that all plant growth parameters of tomato improved while the nematode reproduction factors were suppressed significantly in case of neem leaves and chemical checks as compare to untreated inoculated check. Among the doses neem leaves 30 g/ kg soil were found to be effective in suppressing galling (38) and final population in soil (170) followed by 20 g/ kg soil in improving plant growth of tomato and reducing reproduction of root knot nematode.

Keywords: *Meloidogyne incognita, Azadirachta indica,* tomato

Introduction

Tomato, *Lycopersicon esculentum* Mill. is an important vegetable crop grown worldwide for its edible fruits, responsible for correcting malnutrition in third-world countries like India. Tomatoes are consumed in the form of juice, paste, ketchup, puree, soup, etc. Fruits, besides containing the essential amino acid like tryptophan, also have citric and malic acids in appreciable amounts. Tomato contains a glucoalkaloid ‘tomatine’ which is used as precipitating agent for cholesterol. The estimated world production of tomato is about 125.02 million tons and the total area under its cultivation is about 45.5 lakh ha. Indian contribution to the annual world production was 10.26 million tons, with an area of 5.72 lakh ha in 2006 (Mane *et al.*, 2010) [20]; however, a slightly increased 17.50 million tons in the recent years FAO, STAT (2012) [10]. Andhra Pradesh ranked first for tomato production. Despite great production rate globally, productivity of this vegetable is far below expectation particularly in India as compared to other countries, which could mainly be due to improper and inadequate supply of nutrients, disease incidence, and lack of adoption of new improved production technologies.

There are several constraints on the successful cultivation of tomato. Nematode alone causes about 20.6% loss in yield worldwide (Sasser, 1989) [26]. Subramaniyan, Rajendran, and Vedivelu (1990) [33] reported yield loss of 42.05–54.42% due to *Meloidogyne incognita* from India. Jain *et al.*, (1994) [17] reported 47.3 and 71.9% yield loss in vegetable crops due to *M. javanica* and *M. incognita*, respectively. The crop is greatly affected with root-knot nematodes in all parts of India and elsewhere (Siddiqui & Shaukat, 2003; Sikora & Fernández, 2005) [30, 32] and difficult crop pests to control (Chitwood, 2002) [8] because they have high reproduction rates (Ananhirunsalee, *et al.*, 1995) [3]. Nematode-infected plants generally show foliar symptoms like nutrient deficiency, particularly nitrogen (Birat, 1963; Good, 1968) [6, 13], yield losses in tomato due to root-knot nematode *Meloidogyne* spp. ranges from 35 to 50% in India (Jain, 1991; Jonathan *et al.*, 2001) [16, 18] and as high as 85% globally (Sasser, 1979; Taylor & Sasser, 1978) [25, 34]. Several plants, belonging to different botanical families, contain principles possessing nematicidal or nematostatic properties (Gommers, 1981; Grainge and Ahmed, 1988) [12, 14]. Investigations on extracts from various indigenous plants and neem (*Azadirachta indica* A. Juss.) products have revealed that some of them are effective against insects and nematodes (Holyoke and Reese, 1987; Byomakesh *et al.*, 1998; Nanjegowda *et al.*, 1998; Khanna and Sharma, 1998; Sharma, 2000) [15, 7, 23, 19, 28] and commercial formulations of them are already available. Neem-based formulations are known to have nematicidal potential, particularly against plant parasitic nematodes (Alam, 1990; Mojumder, 1995) [2, 22].

The fresh extracts of fruits, leaf bark, root and gum of neem inhibited hatching of *Meloidogyne incognita* (Siddiqui and Alam, 1985) [19]. Therefore, investigations were undertaken to evaluate the efficacy of the fresh neem leaves applied as soil application, on plant status, root gall index and final nematode density of the root-knot nematode *Meloidogyne incognita* (Kofoid *et* White) Chitwood in tomato.

Materials and Methods

Raising of tomato seedlings

Tomato seeds (cv. Selection-7) were given pre-sowing treatment with Bavistin (0.1%) + Indofil M-45 (0.25%) to control damping off. Seedlings were raised from these treated seeds in a nursery on the departmental farm.

Rearing of *Meloidogyne incognita*

Egg masses of *M. incognita* were isolated from infected tomato roots and placed singly in Petri dishes containing distilled water. The second stage juveniles emerging from each single egg mass were inoculated on seedlings of brinjal (*Solanum melongena* L.) cv. Pusa Purple Long, grown in earthen pots containing 4,000 g steam sterilized soil (soil : sand : FYM in the ratio of 1 : 1 : 1). The plants were maintained in a screen-house for six month to allow the reproduction of the nematode. This nematode culture was used for the experiments.

Assay Procedure

A soil mixture (soil: sand in the ratio of 1:1) was sterilized by autoclaving. According to treatment neem leaves @ 5, 10, 20 and 30 gm/pot were mixed in soil. This mixture was used to fill 1000 cm3 plastic pots sterilized by dipping in 5% formalin for 5 minutes. After filling pot soil were watered and waiting period 15 days for decomposition of leaves. Carbofuran 0.1 g a.i. /kg soil, untreated inoculated and untreated uninoculated check also maintained. One four week- old healthy tomato seedling was transplanted into each pot. Seedlings were grown under screen-house conditions. Fifteen days after transplanting, each pot was inoculated with 1000 freshly hatched second stage juveniles of *M. incognita*. The egg masses were isolated from infected brinjal roots and placed singly in Petri dishes containing distilled water. The second stage juveniles emerging from egg masses were collected after three days and combined for use. Observations on plant status, *viz.*, shoot length; dry shoot weight and dry root weight were recorded at the end of the experiment. The final nematode populations of second stage juveniles per 200 cc of soil were counted after extraction by the Cobb decanting and sieving technique.

Results and Discussion

Effect on plant status

Plant height increased with the increase in concentration of all tested dosage of neem leaves and the increase was significant at all concentrations (Table I). Nematode inoculated plants treated with neem leaves @ 30gm/pot concentration attained the maximum shoot lengths of 34.5 cm, followed by plants treated with neem leaves @ 20gm/pot with a shoot lengths of 28.5 cm. Mean dry shoot weight increased with the increase in concentration of the neem leaves and the increase was significant for all treatments. Neem leaves @ 30gm/pot treated plants had the highest mean dry shoot weight of 19.5 g as compared to 5.6 g in the control, followed by mean dry shoot weights of 17.3 g in neem leaves @ 20gm/pot. Data indicated (Table 1) that significant increase in dry root weight was observed with the increase in concentration of the neem leaves. Mean dry root weight was 8.2 g in plants treated with the neem leaves 30gm/ pot concentration, as compared to the average dry root weight of 2.2 g of plants untreated uninoculated.

Effect on population of *M. incognita*

All neem leaves dosage greatly suppressed the soil population density of *M. incognita* and the suppression was greater the higher the concentration of the nematicide. The differences in the number of nematodes/200 cc soil were significantly decrease nematode populations in increasing dose of neem leaves. The lowest nematode population was observed when treating with neem leaves 30gm/pot and carbofuran check. Plants treated with carbofuran (35) and neem leaves 30gm/pot (38) had the lowest mean of galls, followed by neem leaves 20gm/ pot (41) treated plants. Neem leaves @ 5 gm/pot treated plants showed least degrees of root gall suppression. This indicates that, although all neem concentration reduced the infestation by *M. incognita* significantly, the degree of their efficacy varied significantly. At 30gm/pot neem leaves (38) was the most effective. The maximum root galls of the untreated inoculated plants (84) as compared to other treatment.

Azadirachtin is the main active content of neem and is reported very effective and target specific to controlling insects and nematodes pests of the various crops. The findings of the present study can be correlated with of Egumnjobi & Afolami (1976) [9] where they have reported the successful use of neem leaves extracts in nematode control. Mishra (1999) [21] states that the neem formulations are most effective control of root knot nematode *Meloidogyne* sp. as compared to other botanicals. Akhtar and Malik (2000) [1], Siddiqui & Alam (2001) [31], they have reported that phenols, amino acids, aldehydes and fatty acids are release from neem which is antagonistic to root-knot nematodes. Our results are supported by the study of Siddiqui & Alam, (2001) [31]; Ravishankar & sharma (2005) [24]; Ganai, *et al* (2014) [11]; Satyandra *et al* (2011) [27]; Babu & Rana (2012) [5] Archana & Prasad (2014) [4] states that organic amendments of soil using dried poultry litter, municipal refuse, oil cakes of ground nut, neem mustard & neem products (which are commercial available in market) have been found effective in the control of *Meloidogyne incognita*.

In present study thus it may be concluded that changes in protein after infection are related to defence action, because abnormal metabolites are produced in adjacent non-infected tissues. Such metabolites accumulated in infected tissues and are toxic to parasites and inhibit their growth and penetration. The metabolites released from the chemical constituents of neem (Azadirachtin, salannin, limonoids, triterpenoids, phenolic compounds, carotenoids, steroids and ketones) stimulated the plant cells to release abnormal metabolites which repel the nematodes from the uninfected cells of plant. However, the green leaves are rich in azadirachtin, salannin, meliantrol and nimbin (Jacobson, 1990; National Research Council, 1992). So the use of neem products stimulated and changes the physiology of plant cells and tissue to repel the nematode parasites.

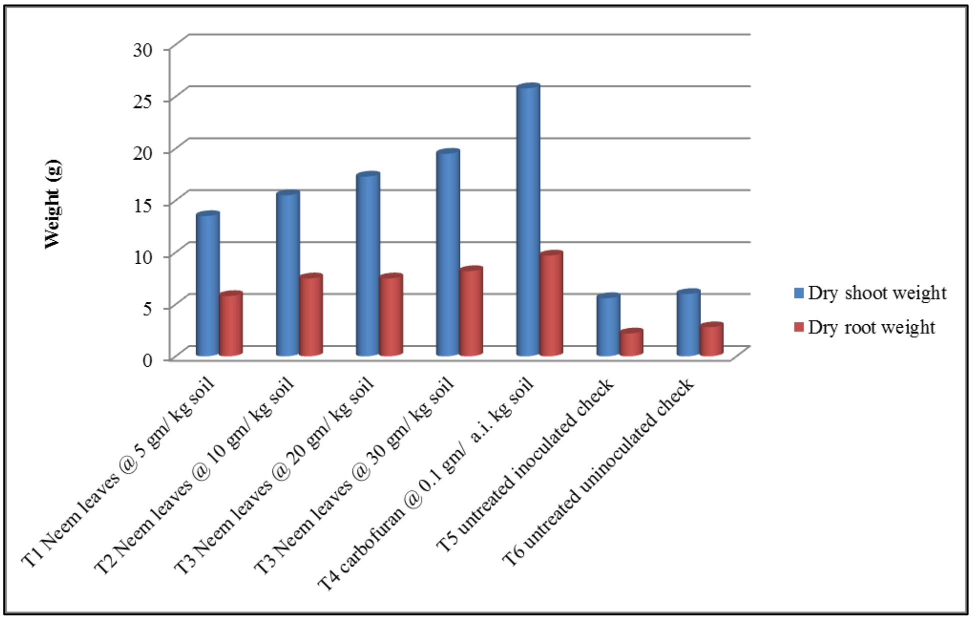

Fig 1: Effect of neem leaves on plant growth parameters (dry shoot and root weight in g)

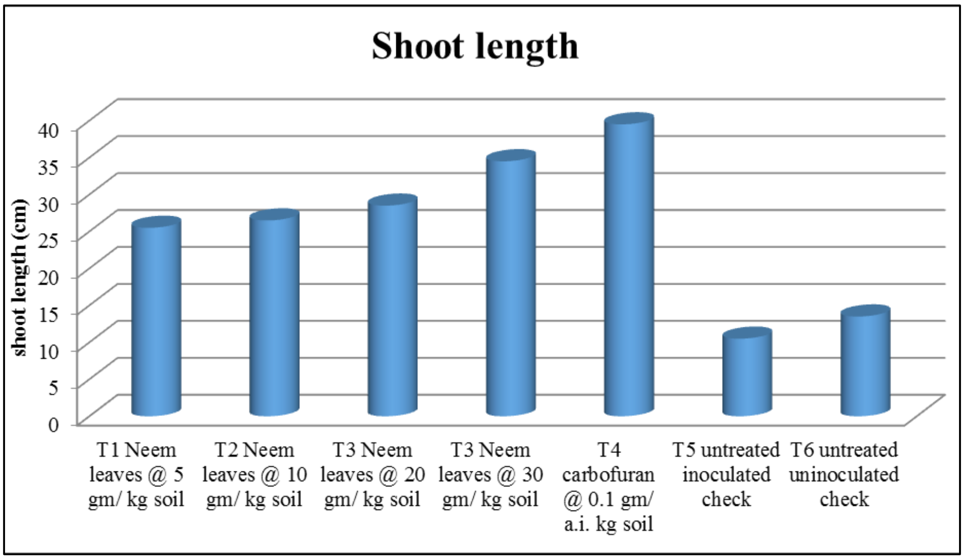

Fig 2: Effect of neem leaves on plant growth parameters (shoot length in cm)

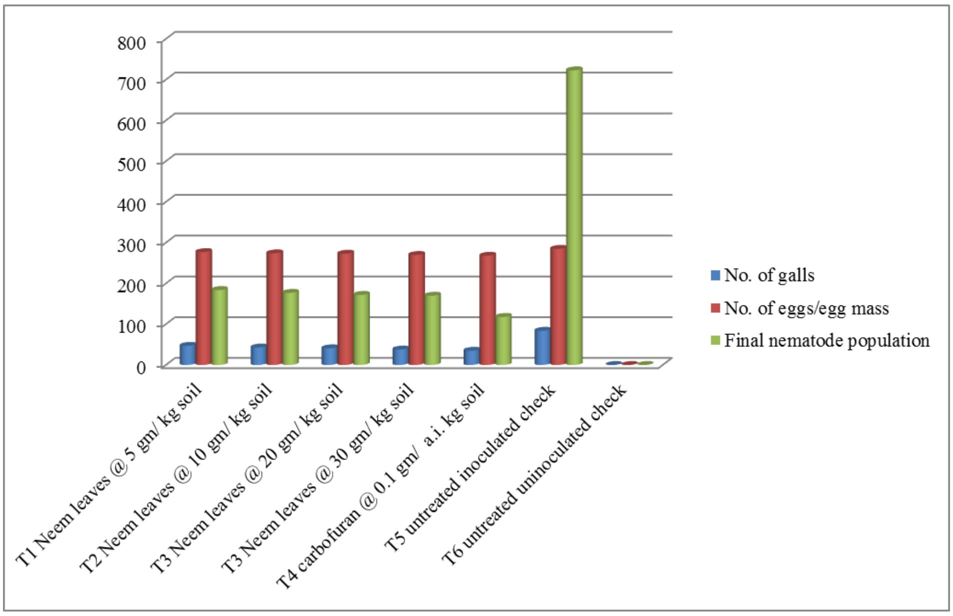

Fig 3: Effect of neem leaves on nematode reproduction in tomato

Table 1: Effect of neem leaves on plant growth parameters and *Meloidogyne incognita* in tomato

Treatments	Shoot Length	Dry shoot weight	Dry root weight	Number of galls per root	Number of eggs per egg masses	Final Nematode Population
T1 Neem leaves @ 5 gm/ kg soil	25.5	13.5	5.8	47 (6.9)	277 (16.5)	184 (13.5)
T2 Neem leaves @ 10 gm/ kg soil	26.5	15.5	7.5	43 (6.5)	274 (16.5)	177 (13.3)
T3 Neem leaves @ 20 gm/ kg soil	28.5	17.3	7.5	41 (6.4)	273 (16.5)	172 (13.1)
T3 Neem leaves @ 30 gm/ kg soil	34.5	19.5	8.2	38 (6.2)	270 (16.4)	170 (13.0)
T4 carbofuran @ 0.1 gm/ a.i. kg soil	39.5	25.8	9.7	35 (5.9)	268 (16.3)	118 (10.9)
T5 untreated inoculated check	10.5	5.6	2.2	84 (9.2)	285 (16.8)	723 (26.9)
T6 untreated uninoculated check	13.5	6.0	2.8	0 (1.0)	0 (1.0)	0 (1.0)
CD	1.911	2.038	1.157	0.156	0.055	0.101
SEm	0.913	0.973	0.552	0.053	0.019	0.034

References

1. Akhtar M, Malik A. Roles of organic amendments and soil organisms in the biological control of plant parasitic nematode: A review. Bioresource Technology. 2000; 74:35-47.
2. Alam MM. Neem in nematode control. *In*: Nematode Biocontrol: Aspects and Prospects (Jairajpuri M.S., Alam M.M. and Ahmed J., eds). CBS Publishers and Distributors, Delhi, India. 1990, 51-55.
3. Ananhirunsalee K, Barker KR, Beute MK. Infection, reproduction and root galling by root-knot nematode species and concomitant populations on peanut and tobacco. Journal of Nematology. 1995; 27:172-177.
4. Archana US, Prasad D. Management of Plant-parasitic Nematodes by the Use of Botanicals. J Plant Physiol Pathol. 2014; 2:1.
5. Babu L, Rana. Efficacy of neem products as seed treatment against *Meloidogyne incognita* in Okra. Annals of Plant Protection Sciences. 2012; 20(1):268-269.
6. Birat RBS. Effect of major plant nutrient in gall formation. Science & Culture. 1963; 29:311-312.
7. Byomakesh D, Padhi NN, Dash R. Relative efficacy of neem products against root knot nematode on tomato. Indian Journal of Nematology. 1998; 28:163-167.
8. Chitwood DJ. Phytochemical based strategies for nematode control. Annual Review of Phytopathology. 2002; 40;221-249.
9. Egumnjobi OH, Afolami LM. Nematodes and maize growth in Nigeria 11. Effects of some amendments on the yield of maize (zea mays) in Nigeria. *Nematologica Mediternean*, 1976; 3:65-73.
10. Faostat. Production of tomato by countries. Food and Agriculture Organization. Retrieved. 2012; 21:2014.
11. Ganai AM, Rehman B, Kavita P, Asi M, Siddiqui MA. Phytotherapeutic approach for the management of *Meloidogyne incognita* affecting *Abelmoschus esculentus* (L.) Moench. Archives of Phytopathology and Plant Protection. 2014; 47:1797-1805.
12. Gommers FJ. Biochemical interactions between nematodes and plants and their relevance to control. Helminthological Abstracts, Series B, Plant Nematology. 1981; 50:9-24.
13. Good JM. Relation of plant parasitic nematodes of management practices. In G.C. Smart & V.G. Perry (Eds.), Tropical nematology. Gainesville, FL: University of Florida Press, 1968, 113-138.
14. Grainge M, Ahmed S. Handbook of Plants with Pest-Control Properties. J Wiley and Sons, New York. USA., 1988, 260.
15. Holyoke CW, Reese JC. Acute insect toxicants from plants. *In*: Handbook of Natural Pesticides. Vol. III Insect Growth Regulators, Part B (Morgan E.D. and Mandava N.B., eds.). CRC Press, Boca Raton, Florida, USA. 1987, 67-118.
16. Jain RK. Nematode pests of vegetable crops. In D. S. Bhatti & R. K. Walia (Eds.), Nematode pests of crops. Delhi: Cosmo Publishers, 1991, 77-79.
17. Jain RK, Dabur K, Gupta DC. Assessment of avoidable losses in yield due to root-knot nematode (*Meloidogyne* spp.) in few vegetable crops. Indian Journal of Nematology. 1994; 24:131-134.
18. Jonathan EI, Kumar S, Devarajan K, Rajendran G. Nematode pests of commercial flower crops. In E. I. Jonathan (Ed.), Fundamentals of plant nematology. Trichy: Devi Publication, 2001, 20-48.
19. Khanna AS, Sharma NK Phytotherapeutic effect of some indigenous plants/nematicides on *Meloidogyne incognita* infesting tomato. *In:* Proceedings of National Symposium on Rational Approaches in Nematode Management for Sustainable Agriculture, 23-25 November 1996, GAU, Anand Gujarat, India. 1998, 4-6.
20. Mane R, Sridevi R, Salimath MN, Deshpande SK, Khot AB. Performance and stability of different tomato (*Solanum lycopersicon*) genotypes. Indian Journal of Agricultural Sciences. 2010; 80:898-90.
21. Mishra SD. Effects of an aqueous extracts of green leaves of neem, madar and tulsi on the hatching of eggs of root-knot nematode, *Meloidogyne incognita*. Current Nematology. 1999; 7:133-135.
22. Mojumder V. Nematoda, nematodes. *In:* Neem Tree and Other Meliacious Plants: Source of Unique Natural Products for Integrated Pest Management (Schmutterer H., ed.). *VCH Publications, Weinheim, Germany.* 1995, 129-150.
23. Nanjegowda D, Naik BG, Ravi K, Reddy PP, Kumar NKK., Verghese A. Efficacy of neem products and a nematicide for the management of root-knot nematode *Meloidogyne incognita* in tomato nursery. *In*: Advances in IPM for horticultural crops. Proceedings of the First

National Symposium on Pest Management in Horticultural Crops: environmental implications and thrusts. 15-17 October 1997, Bangalore, India. 1998, 318-320.

24. Ravi Shankar M, Sharma RV. Effect of carbosulfan (25 STD) and Neem seed kernel powder as corm dressing for the management of root-knot nematode. Indian Journal of Nematology. 2005; 35:53-55.
25. Sasser JN. Economic importance of *Meloidogyne* in tropical countries. In F. Lamberti & C. E. Taylor (Eds.), Root-knot nematodes (*Meloidogyne* spp.): Systematics, biology and control (pp. 359–374). London: Academic Press, 1979.
26. Sasser JN. Plant-parasitic nematodes: The farmer's hidden enemy. Raleigh, NC: A co-operative publication of the Department of Plant Pathology and the Consortium for International Crop Production. 1989, 115.
27. Satyandra S, Rai AB, Sing RK. Bio-management of root-knot disease of Chili (*Capsicum annum*) caused by *Meloidogyne incognita*. Vegetable Science. 2011; 38:63-67.
28. Sharma GC. Efficacy of neem based formulations against the root knot nematode *Meloidogyne incognita*. Pesticide Research Journal. 2000; 12:183-187.
29. Siddiqui MA, Alam MM. *IARI Neem Newsletter*, 1985; 2:43-47.
30. Siddiqui IA, Shaukat S. Suppression of root-knot disease by *Pseudomonas fluorescens* CHA0 in tomato: Importance of bacterial secondary metabolite, 2,4-diacetylpholoroglucinol. Soil Biology and Biochemistry. 2003; 35:615-1623.
31. Siddiqui MA, Alam MM. IPM of Ecofriendly Agriculture. 2001; 23:9-11.
32. Sikora RA, Fernández E. Nematode parasites of vegetables. In M. Luc, R. A. Sikora, & J. Bridge (Eds.), Plant parasitic nematodes in subtropical and tropical agriculture Wallingford: CAB Publications, 2005, 319-392.
33. Subramaniyan S, Rajendran G, Vedivelu S. Estimation of loss in tomato due to *Meloidogyne incognita* and *Rotylenchulus reniformis*. Indian Journal of Nematology. 1990; 20:239-240.
34. Taylor AL, Sasser JN. Biology, identification and control of root-knot nematode (*Meloidogyne* spp.) Raleigh, NC: North Carolina State University, 1978, 111.