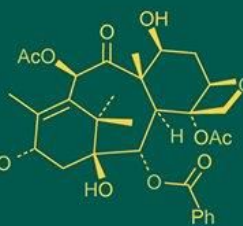
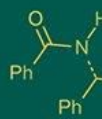


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2025; SP-9(2): 668-673
www.biochemjournal.com
Received: 16-12-2024
Accepted: 21-01-2025

Mansi Machal
Department of Nematology,
Assam Agricultural University,
Jorhat, Assam, India

Aparajita Borah
Department of Nematology,
Assam Agricultural University,
Jorhat, Assam, India

Bornali Mahanta
Department of Nematology,
Assam Agricultural University,
Jorhat, Assam, India

Pathogenicity of root-knot nematode, *Meloidogyne incognita* on bitter gourd, *Momordica charantia* L.

Mansi Machal, Aparajita Borah and Bornali Mahanta

DOI: <https://www.doi.org/10.33545/26174693.2025.v9.i2Si.3874>

Abstract

An experiment was conducted in the net house of Department of Nematology, A. A. U. Jorhat, during the rabi season of 2020 to study the pathogenicity of root-knot nematode, *Meloidogyne incognita* on bitter gourd (*Momordica charantia* L.). Bitter gourd germplasm 'Priya' was selected for this investigation mainly because of its high susceptibility to *M. incognita*. The pot experiment was carried out in a completely randomized design with five replications. Seeds were sown in 1kg capacity pots filled with sterilized soil and 10 days old seedlings were inoculated with second stage juveniles of *M. incognita* in a logarithmic series of check, associated check, 10, 100, 1000, 10,000 juveniles (J₂) per pot. After 45 days of inoculation, it was observed that at highest inoculum level plants had stunted growth, chlorotic leaves with very less number of branches. It was also observed that at the highest inoculum level the root system were very much reduced with larger galls and the galls coalesced within the roots. The treatments with no nematode *i.e.*, check and associated check was found to be free from galls and egg masses. The plant growth parameters like plant height, shoot and root weight (fresh and dry) exhibited a declining trend from initial inoculum level of 100 J₂ to highest inoculum level of 10,000 J₂ per pot but the nematode multiplication factors viz., number of galls per root, number of egg masses per root and final nematode population in soil exhibited an increasing trend from initial inoculum level of 10 J₂ to 1000 J₂ per pot, but it declined at inoculum level of 10,000 J₂ per pot. In treatments with no nematode (check and associated check), no significant difference was found in plant growth parameters viz., plant height, shoot and root weight (fresh and dry) and nematode multiplication factors like number of galls per root, number of egg masses per root and final nematode population in soil. Further, no significant difference was observed in treatments between 10 and 10,000 J₂ per pot for number of galls per root, number of egg masses per root and final nematode population in soil.

Keywords: *Meloidogyne incognita*, bitter gourd, pathogenicity

Introduction

Bitter gourd (*Momordica charantia* L.), commonly referred to as Karela, bitter melon, bitter apple, bitter squash, balsam pear, and African cucumber, is a significant vegetable crop in India. It is a member of the Cucurbitaceae family and is extensively cultivated for its edible fruits across Asia, Africa, and the Caribbean. In India, the primary states for its cultivation include Maharashtra, Gujarat, Uttar Pradesh, Haryana, Rajasthan, Punjab, Tamil Nadu, Andhra Pradesh, West Bengal, Assam, Bihar, and Odisha. The fruits of bitter gourd are recognized for their high nutritional value, providing a rich source of carbohydrates, proteins, and minerals, surpassing other cucurbits in terms of nutritive content (Miniraj *et al.*, 1993; Desai and Musmade 1998) [13, 5]. Varieties of bitter gourd exhibit variations in both shape and the degree of bitterness, which is attributed to the presence of cucurbitacin-like alkaloid momordicine and triterpene glycosides (momordicoside K and L) (Jefferey, 1980; Okabe *et al.* 1982) [7, 14]. This vegetable is particularly noted for its mineral content, including iron, potassium, and magnesium, as well as vitamins A and C. A 100-gram serving of bitter gourd fruit contains 13 mg of sodium, 602 mg of potassium, 7 g of carbohydrates, 0.2 g of fat, 3.6 g of protein, 1.9 g of fiber, 1 g of sugar, and provides 34 KJ of energy. Furthermore, extracts from bitter gourd exhibit various health benefits, including antioxidant, antimicrobial, antiviral, antihepatotoxic, and antiulcerogenic properties, along with the potential to reduce blood sugar levels (Welihinda *et al.*, 1986; Raman and Lau, 1996) [24, 17]. The crop is adversely affected by various pests and diseases attributed to fungi, bacteria, viruses, and nematodes, resulting in a significant decline in both growth and yield.

Corresponding Author:
Mansi Machal
Department of Nematology,
Assam Agricultural University,
Jorhat, Assam, India

Numerous species of phytonematodes have been identified in the rhizosphere of the bitter gourd plant, with the root-knot nematode, *Meloidogyne incognita*, being particularly noteworthy due to its considerable economic impact and a broad host range encompassing approximately 232 genera, as documented by Krishnappa, Sable and Darekar (1985) [18] indicated that an inoculum level of 500 or more *M. incognita* J₂ per plant is adequate to induce a marked decrease in the growth parameters of bitter gourd. Additionally, Pankaj (1990) [15] and Venkatesan (2009) [22] established that a threshold of 1000 J₂ is considered pathogenic for *M. incognita* in bitter gourd. Consequently, this study focuses on the pathogenicity of the root-knot nematode, *Meloidogyne incognita*, on the bitter gourd species, *Momordica charantia*.

Materials and Methods

The pot experiment was conducted in the net house of Department of Nematology, Assam Agricultural University, Jorhat, during rabi season of 2020 to study the pathogenicity of *Meloidogyne incognita* on bitter gourd. Bitter gourd germplasm 'Priya' was selected for this investigation mainly because of its high susceptibility to *M. incognita*. Required quantities of earthen pots were collected and filled with 1 kg of autoclaved soil. The pots were labelled according to the treatments and replications. The pots were arranged in completely randomized design (CRD) with 5 replications for each treatment. Ten days old seedlings were inoculated with second stage juvenile of *M. incognita* in a logarithmic series of check, associated check, 10, 100, 1000, 10,000 juveniles (J₂) per pot. The plants were watered regularly. Observations on different plant growth parameters were taken after 45 days of inoculation. Plant heights were recorded before uprooting the plants. The potted plants were uprooted carefully and the root system was washed carefully with tap water so that there was no loss of roots and egg masses. Number of galls and egg masses per root system were recorded. Similarly, fresh shoot and root weights were taken. For recording dry weight the plants were packed in paper bags and labelled according to the treatments. The bags were kept in an oven at 60 °C till constant weight of dried plant materials was obtained. The nematode population in the pot soil was determined by washing 200cc of homogenously mixed pot soil by Cobb's Modified sieving and decanting technique (Christie and Perry, 1951) [3]. Statistical analysis was performed using OPSTAT

software.

Results

The data on pathogenicity of root-knot nematode, *Meloidogyne incognita* on Bitter gourd were presented in Table 1 and 2; Figures 1, 2 and 3. After 45 days of inoculation, it was observed that there was a progressive decrease in all plant growth parameters of bitter gourd with the increasing inoculum level of *M. incognita* from 10 to 10,000 second stage juveniles per pot containing 1 kg of sterilized soil. At the highest inoculum level, plants had stunted growth, chlorotic leaves with very few branches. Further, it was observed that at the highest inoculum level, root systems were very much reduced with larger galls which were coalescent in the root. The treatments with no nematode (Check and associated check) were free from galls and egg masses. The plant growth parameters viz., plant height, shoot and root weight (fresh and dry) decreased progressively from initial inoculum level of 100 to highest inoculum level of 10,000 J₂ per pot. However, the highest reduction i.e. 13.80 percent of plant growth parameters like plant height, shoot and root weight (fresh and dry) was observed in inoculums level of 10,000 J₂ per pot. Further, no significant difference was observed was in plant height, shoot and root weight (fresh and dry) among the treatments with no nematode i.e. check and associated check and 10 J₂ per pot. However, a significant difference was observed in plant height, shoot and root weight (fresh and dry) in the treatments having 100, 1000 and 10,000 J₂ per pot. Similarly, number of galls per root, number of egg masses per root and final nematode population in soil increased gradually from initial inoculum level of 10 to 1000 J₂ per pot, however, it declined at the highest inoculum level of 10,000 J₂ per pot.

The maximum number of galls per root, number of egg masses per root and final nematode population in soil were recorded in the inoculum level of 1000 J₂ per pot while the minimum number of galls per root, egg masses per root and final nematode population in soil were recorded in the treatment with 10,000 and 10 J₂ per pot. It was also observed that there was no significant difference for number of galls per root, number of egg masses per root and final nematode population in soil in between the treatments with 10 and 10,000 J₂ per pot, however, these treatments differed significantly from the treatments with 100 and 1000 J₂ per pot, respectively.

Table 1: Effect of different inoculum level of *Meloidogyne incognita* on plant growth parameters of bitter gourd (Mean of 5 replications)

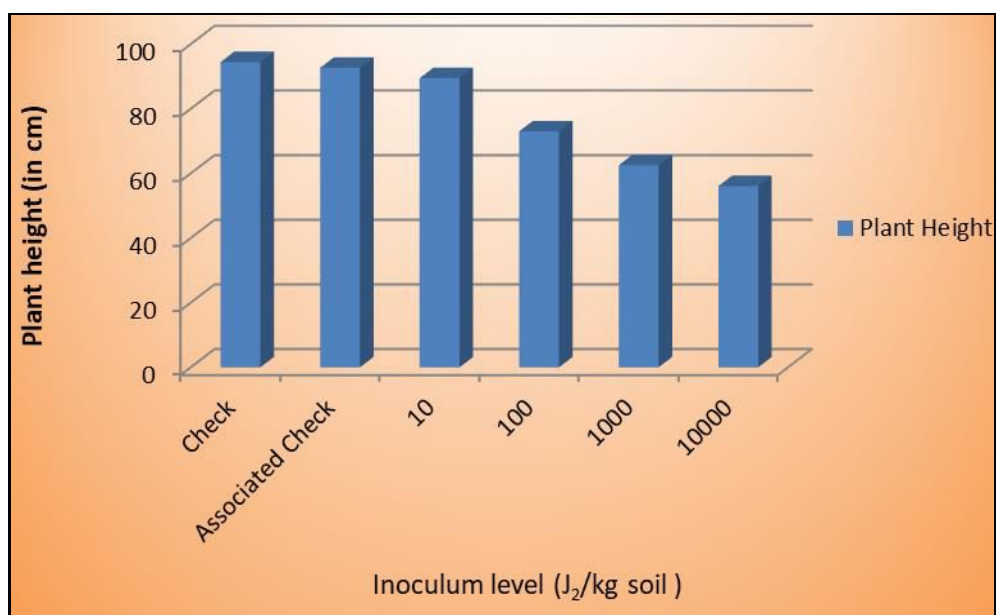
Inoculum level (J ₂ /kg soil)	Plant height (cm)	Fresh weight of shoot (g)	Dry weight of shoot (g)	Fresh weight of root (g)	Dry weight of root (g)
T ₁ :Check	94.44 ^a	28.42 ^a	3.62 ^a	13.54 ^a	2.36 ^a
T ₂ :Associated check	92.68 ^a	28.31 ^a	3.60 ^a	13.47 ^a	2.31 ^a
T ₃ :10	89.46 ^b	26.93 ^b	2.83 ^b	12.81 ^b	1.56 ^b
T ₄ :100	73.03 ^c	24.67 ^c	2.60 ^b	12.01 ^c	1.48 ^c
T ₅ :1000	62.52 ^d	18.46 ^d	1.58 ^c	9.43 ^d	1.09 ^d
T ₆ :10,000	56.06 ^e	14.62 ^e	1.09 ^d	7.46 ^e	0.87 ^e
S.Ed. (±)	1.55	0.421	0.142	0.269	0.039
CD _{0.05}	3.22	0.870	0.294	0.558	0.080

Mean followed by the same letter in the subscript(s) are statistically *at par*.

Table 2: Effect of different inoculum level of *Meloidogyne incognita* on number of galls, egg masses and nematode population on bitter gourd (Mean of 5 replications)

Inoculum level (J ₂ /kg soil)	No. of galls/ root system*	No. of egg masses/root system*	Soil population (200 cc of soil)*	Reproductive Rate (%)
T ₁ : Check	00 (0.70) ^e	00 (0.70) ^e	00 (0.70) ^d	0.00
T ₂ : Associated check	00 (0.70) ^e	00 (0.70) ^e	00 (0.70) ^d	0.00
T ₃ :10	9.0 (3.07) ^d	4.60 (2.23) ^d	393.40 (19.654) ^c	39.34
T ₄ :100	95.40 (9.78) ^b	33.20 (5.79) ^b	1311.60 (36.205) ^b	13.11
T ₅ :1000	151.80 (12.33) ^a	68.40 (8.30) ^a	2461.60 (49.598) ^a	2.46
T ₆ :10,000	35.50 (5.95) ^c	14.60 (3.87) ^c	2672.80 (51.682) ^a	0.26
S.Ed. (±)	0.169	0.168	1.052	
CD _{0.05}	0.352	0.348	2.183	

*Values of number of galls, egg masses and final nematode population within parentheses are square root ($\sqrt{x + 0.5}$) transformed data. Mean followed by the same letter in the superscript(s) are statistically at par.

**Fig 1:** General View of the pot-experiment on Bitter gourd**Fig 2:** Growth of Bitter gourd under different inoculum levels of *Meloidogyne incognita***Fig 3:** Effect of different inoculum level on plant height of bitter gourd

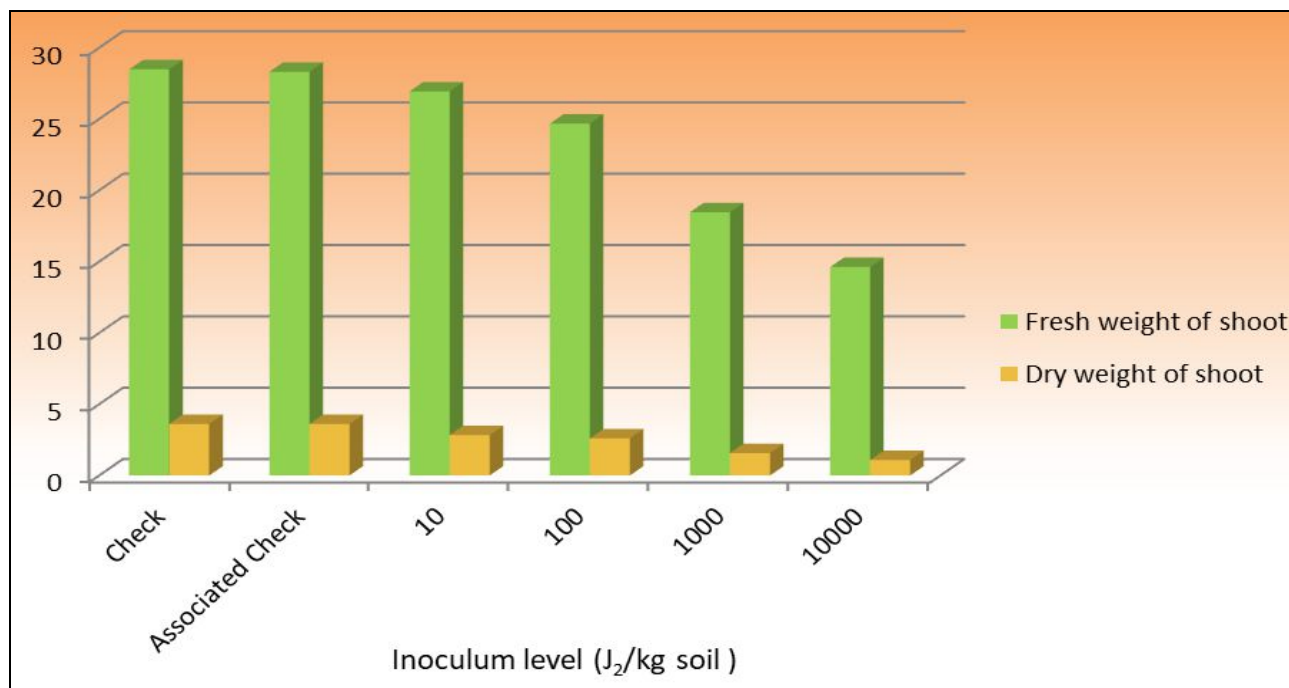


Fig 4: Effect of different inoculum level on fresh and dry weight of shoot of bitter gourd

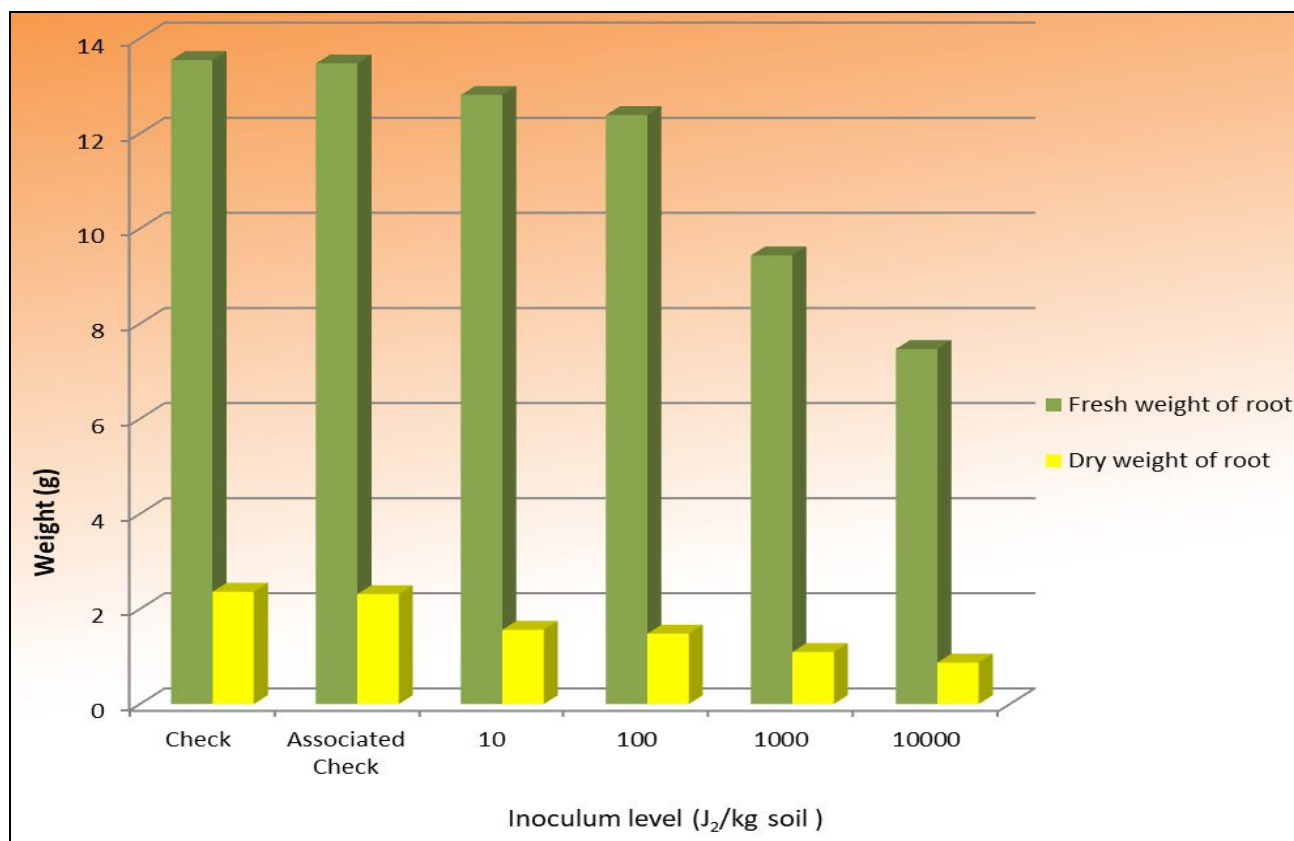


Fig 5: Effect of different inoculum level on fresh and dry weight of root of bitter gourd

Discussion

The results obtained in the study of pathogenicity of root-knot nematode, *Meloidogyne incognita* on Bitter gourd indicated that with increase of inoculum level of nematode population the plants became more stunted. This finding is in agreement with the findings obtained by Sable and Darekar (1985)^[18] and Pankaj (1990)^[15] on bitter gourd, Dhankar *et al.* (1986)^[6] on watermelon. Similar, findings had also been reported by Krishnaveni and Subramanian (2002)^[11] on cucumber, Savitri (2006)^[19] on Gherkin

(small variety of cucumber) and Ash gourd, Venkatesan (2009)^[22] on bitter gourd, Singh (2011)^[20] on bottle gourd. Further, it was observed that there was a significant reduction in plant height of Bitter gourd at and above 100 nematodes per pot. Similar, results were obtained by Bharali (1996)^[2] on cucumber, Savitri (2006)^[19] on Ash gourd and Venkatesan (2009)^[22] on bitter gourd. With increasing inoculum level of the nematode, plant growth parameters were severely affected which might be due to the destruction of roots by feeding of nematode, thereby,

affecting the water and nutrient uptake. There was a corresponding reduction in fresh and dry weight of shoot of the plants with increase in level of inoculum from 10 to 10,000 nematodes per pot. Similar, results were reported by Mahapatra *et al.* (1999) ^[12] on pointed gourd and Singh (2011) ^[20] on bottle gourd. The results further revealed that there was a progressive decrease in shoot weight and root weight (fresh and dry) of the plants inoculated with 100 or above nematodes per pot. This finding is in conformity with that of Pankaj (1990) ^[15] on bitter gourd, Darekar and Bele (1990) ^[4] and Bharali (1996) ^[2] who reported significant reduction in fresh and dry root weight on cucumber, Mahapatra *et al.* (1999) ^[12] on pointed gourd and Savitri (2006) ^[19] on Ash gourd. Similar findings had been reported by Kayani *et al.* (2018) ^[8] and Ami and Shingaly (2020) ^[1] on cucumber.

Further, it was observed that the plants have at highest inoculum level (10,000 J₂ per pot) had a poor stand, root system was very much reduced and feeder roots were completely absent. Similar, results were reported by Dhankhar *et al.* (1986) ^[6] on water melon and Bharali (1996) ^[2] on cucumber. It was observed that number of galls and egg masses increased gradually with the increase in inoculum level from 10 to 1000 and declined at 10,000 inoculum level of *M. incognita* per pot. There was a progressive increase in nematode population in pot soil with increase in inoculum level from 10 to 1000 nematodes per pot. Maximum number of galls and egg masses were recorded in plants inoculated with 1000 nematodes per pot. Similar, findings were obtained by Paruthi and Gupta (1985) ^[16] and Khan *et al.* (1992) ^[9] on bottle gourd; Dhankhar *et al.* (1986) ^[6] on water melon and Bharali (1996) ^[2] on cucumber.

There was a progressive increase in nematode population in pot soil with the increase in inoculum level from 10 to 10,000 J₂ per pot. The gradual increase in nematode population results in gradual decrease in reproductive rates. The population growth rate was found to be inversely proportional with inoculum levels, maximum (39.34) and minimum (0.26) reproductive rate of nematodes were recorded in the lowest inoculum level (10 J₂) and highest inoculum levels (10,000 J₂) per pot respectively. A gradual increase in nematode population with increase in inoculum level was reported by Venkatesan (2009) ^[22] on bitter gourd; Singh (2011) ^[20] on bottle gourd. This finding was in conformity with Verma and Anwar (1995) ^[23] who reported highest multiplication rate on the lowest inoculum level in pointed gourd and Singh (2011) ^[20] on bottle gourd. As suggested by Triantaphyllu and Hirschmann (1960) ^[21] variation in growth rate of *M. incognita* was caused by competition for food and overcrowding and development was retarded where numerous larvae enter the same root system.

Conclusion

In the investigation on the study of pathogenicity of *M. incognita* on bitter gourd, it was observed that bitter gourd plants became stunted with an increase in inoculum levels of *M. incognita*. Initial inoculum levels of 100 J₂ of *M. incognita* per kg of soil caused significant reduction in all plant growth parameters and proved to be pathogenic to the bitter gourd plants. The number of galls and egg masses increased gradually in the plants with an initial inoculum level of 10 to 1000 J₂ of *M. incognita* per kg of soil, but it

declined at highest inoculum level of 10,000 J₂ per kg of soil. The final nematode population per pot increased gradually with the increase in inoculum level of *M. incognita*. The reproductive rate of *M. incognita* was maximum at lowest inoculum level (10 J₂ per pot) and minimum at highest inoculum level (10,000 J₂ per pot).

Acknowledgement

Sincere thank is extended to the Head of Department, Nematology, AAU, Jorhat-13 for permitting and providing facilities for carrying out the research work. Deep sense of thankfulness goes to the advisor and the members of advisory committee for kind help and encouragement throughout the research work. A sincere thank is extended to Officer-in Charge, Germplasm Exchange & Policy Unit, National Bureau of Plant Genetic Resources, Indian Council of Agricultural Research, New Delhi for providing the required planting materials.

Competing Interests

Authors have declared that no competing interest exists.

References

1. Ami S, Shingaly S. Pathogenicity of root-knot nematode *Meloidogyne javanica* on cucumber plants at different inoculum levels under greenhouse conditions. Journal of Life and Bio Sciences Research. 2020;1(3):76-81.
2. Bharali A. Pathogenicity and management of *Meloidogyne incognita* on cucumber [M.Sc. Thesis]. Jorhat: Assam Agricultural University; 1996.
3. Christie JR, Perry VG. Removing nematodes from soil. Proceedings of the Helminthological Society of Washington. 1951;18:106-108.
4. Darekar KS, Bele PP. Influence of *Meloidogyne incognita* on growth parameters of cucumber. International Nematology Network Newsletter. 1990;7(1):17-18.
5. Desai UT, Musmade AM. Pumpkins, squashes, and gourds. In: Salunkhe DK, Kadam SS, editors. Handbook of Vegetable Science and Technology. New York: Marcel Dekker Inc.; 1998. p. 291-354.
6. Dhankhar RKS, Sharma C. Pathogenicity of *Meloidogyne incognita* on watermelon (*Citrullus vulgaris* Schrad). Indian Journal of Nematology. 1986;16(2):274.
7. Jeffrey C. A review of the Cucurbitaceae. Botanical Journal of the Linnean Society. 1980;81(3):233-247.
8. Kayani MZ, Mukhtar T, Hussain MA. Interaction between nematode inoculum density and plant age on growth and yield of cucumber and reproduction of *Meloidogyne incognita*. Pakistan Journal of Zoology. 2018;50(3):845-852.
9. Khan AA, Singh K, Kumar R. Influence of race 2 of *Meloidogyne incognita* on growth characters of bottle gourd. Current Nematology. 1992;3(1):29-30.
10. Krishnappa K. In: An advance treatise on *Meloidogyne* biology and control. 1985;1:381.
11. Krishnaveni M, Subramanian S. Pathogenicity of *Meloidogyne incognita* on cucumber (*Cucumis sativus* L.). In: Proceedings of National Symposium on Biodiversity and Management of Nematodes in Cropping Systems for Sustainable Agriculture; Jaipur, India; 2002 Nov 11-13. p. 89-92.

12. Mahapatra SN, Swain PK, Behera B. Pathogenicity and management of root-knot nematode (*Meloidogyne incognita*) in pointed gourd (*Trichosanthes dioica*). Indian Journal of Agricultural Science. 1999;69(4):275-277.
13. Miniraj N, Prasanna KP, Peter KV. Bitter gourd (*Momordica spp.*). In: Kalloo G, Bergh BO, editors. Genetic Improvement of Vegetable Plants. Oxford: Pergamon Press; 1993. p. 239-246.
14. Okabe H, Miyahara Y, Yamauchi T. Studies on the constituents of *Momordica charantia* L. Characterization of the new cucurbitacin glycosides of the immature fruits. (2) Structures of the bitter glycosides, momordicosides K and L. Chemical and Pharmaceutical Bulletin. 1982;30(12):4334-4340.
15. Pankaj S. Effect of initial inoculum levels of *Meloidogyne incognita* on bitter gourd and round melon. Indian Journal of Nematology. 1990;20:64-66.
16. Paruthi IJ, Gupta DC. Pathogenicity of root-knot nematode, *Meloidogyne javanica* on bottle gourd (*Lagenaria siceraria*) using two methods of inoculation. Indian Journal of Nematology. 1985;15(1):52-54.
17. Raman A, Lau C. Anti-diabetic properties and phytochemistry of *Momordica charantia* L. (*Cucurbitaceae*). Phytomedicine. 1996;2(4):349-362.
18. Sable AN, Darekar KS. Pathogenicity of *Meloidogyne incognita* to bitter gourd (*Momordica charantia* L.). International Nematology Network Newsletter. 1985;2:13-14.
19. Savitri D. Studies on root-knot nematode, *Meloidogyne* species on cucurbitaceous vegetables [M.Sc. Thesis]. Hyderabad: Acharya N.G. Ranga Agricultural University; 2006.
20. Singh T. Investigations on root-knot nematode (*Meloidogyne spp.*) on bottle gourd [M.Sc. Thesis]. Anand: Anand Agricultural University; 2011.
21. Triantaphyllou AC, Hirschmann H. Post-infection development of *Meloidogyne incognita* Chitwood 1949 (Nematoda-Heteroderidae). Annales de l'Institut Phytopathologique Benaki. 1960;3(1):1-11.
22. Venkatesan M. Investigations on root-knot nematode (*Meloidogyne spp.*) in bitter gourd [M.Sc. Thesis]. Anand: Anand Agricultural University; 2009.
23. Verma AC, Anwar A. Pathogenicity of *Meloidogyne incognita* on pointed gourd (*Trichosanthes dioica* Roxb.). Indian Journal of Mycology and Plant Pathology. 1995;25:70.
24. Welihinda J, Karunanayake EH, Sheriff MHH, Jayasinghe KSA. Effect of *Momordica charantia* on glucose tolerance in maturity onset diabetes. Journal of Ethnopharmacology. 1986;17(3):277-282.