

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(7): 1841-1846
www.biochemjournal.com
Received: 02-06-2026
Accepted: 06-07-2026

Parwati
Ph.D. Research Scholar, Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

HK Sharma
Associate Professor, Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

BL Baheti
Professor, Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

RN Bunker
Professor, Department of Plant Pathology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

Devendra Jain
Assistant Professor, Department of MBBT, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

LN Mahawer
Professor, Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

CP Nama
Assistant Professor, Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

RN Kumhar
Assistant Professor, Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

Deepak Kumar Bhankhar
Assistant Professor, Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

Seema Yadav
Ph.D. Research Scholar, Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

Rajkumar Verma
Ph.D. Research Scholar, Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

Corresponding Author:
Parwati
Ph.D. Research Scholar, Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

Distribution and occurrence of root-knot nematode, *Meloidogyne* spp., associated with Brinjal (*Solanum melongena* L.) in different agro-climatic zones of Rajasthan, India

Parwati, HK Sharma, BL Baheti, RN Bunker, Devendra Jain, LN Mahawer, CP Nama, RN Kumhar, Deepak Kumar Bhankhar, Seema Yadav and Rajkumar Verma

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i7Sv.9313>

Abstract

A survey was conducted during 2025-2026 to determine the distribution and occurrence of root-knot nematodes (*Meloidogyne* spp.) associated with brinjal (*Solanum melongena* L.) in major brinjal growing areas of Rajasthan. A total of 582 soil and root samples were collected from six districts representing two agro-climatic zones (I-B and IV-A). Observations were recorded on percentage occurrence, number of galls per plant, egg masses per plant, eggs and juveniles per egg mass and final nematode population per 200 cc of soil. Root-knot nematodes were detected in all surveyed districts, indicating their widespread distribution. The highest occurrence was recorded in Sri Ganganagar (76.67%) followed by Udaipur (73.00%), Hanumangarh (70.67%), Bhilwara (69.51%), Rajsamand (68.97%) and Chittorgarh (63.33%). The maximum infestation was observed in Thur village of Udaipur with 114.28 galls per plant, 102.14 egg masses per plant and 1102 juveniles per 200 cc soil followed by Anupgarh village of Sri Ganganagar. The study confirms that *Meloidogyne* spp. is widely distributed in the major brinjal-growing regions of Rajasthan and highlights the need for regular surveillance and location-specific integrated nematode management strategies to reduce crop losses and improve brinjal productivity.

Keywords: Agro-climatic zones, occurrence, root-knot nematode

Introduction

Brinjal (*Solanum melongena* L.) is one of the most important solanaceous vegetable crops cultivated throughout tropical and subtropical regions of the world. It is valued for its nutritional quality, adaptability to diverse agro-climatic conditions and economic importance. Crop fruits are good sources of calcium, phosphorus, iron and vitamins, particularly vitamin B. It is valued for its tender unripe fruits, used as a cooked vegetable, rich in medicinal values generally being used as an excellent remedy for those suffering from liver complaints and white brinjal is said to be good for diabetic patients. The green leaves of brinjal plant are the main source of Vitamin 'C' (Nayak and Pande, 2015) [13].

India is the second largest producer of brinjal after China and contributes substantially to global production. According to the National Horticulture Board (2023), brinjal is cultivated on 711.3 thousand hectares with an annual production of 13.56 million tonnes in India. In Rajasthan, the crop occupies about 5.14 thousand hectares with a production of 23.36 thousand tonnes and is extensively cultivated in districts such as Sri Ganganagar, Udaipur, Jaipur, Kota, Alwar and Ajmer. Brinjal fruits are rich in carbohydrates, minerals, dietary fibre and vitamins, making the crop an important component of human nutrition and vegetable production.

Brinjal productivity is constrained by several biotic stresses, among which plant-parasitic nematodes are considered one of the major limiting factors. More than 100 species of plant-parasitic nematodes have been reported to infect vegetable crops; however, root-knot nematodes (*Meloidogyne* spp.) are regarded as the most destructive because of their wide host range, worldwide distribution and high reproductive potential.

Among the economically important species, *Meloidogyne incognita* is the predominant species associated with brinjal cultivation in India. Vegetable crop losses owing to *Meloidogyne* spp., primarily *M. incognita* and *M. javanica*, have been estimated to be 17 to 20% for brinjal (*Solanum melongena* L), 18 to 33% for melon and 24 to 38% for tomato (Sasser, 1979). In India, yield losses in brinjal are reported to be 18% (Bhatti and Jain, 1977) ^[4]. Infection by root-knot nematodes results in the formation of characteristic root galls, which interfere with water and nutrient uptake, leading to stunted growth, chlorosis, wilting, reduced plant vigour and significant yield losses. Under severe infestation, the nematodes also interact with other soil-borne pathogens, resulting in disease complexes that further aggravate crop damage.

The distribution and severity of root-knot nematodes are greatly influenced by soil type, temperature, moisture, cropping pattern and cultivation practices. Continuous cultivation of susceptible host crops under favourable environmental conditions promotes rapid multiplication and establishment of nematode populations in agricultural fields. Therefore, information on the distribution and occurrence of *Meloidogyne* spp. is essential for identifying infestation hotspots, assessing the level of nematode pressure and formulating effective integrated nematode management strategies. Several workers have reported the widespread occurrence of root-knot nematodes in vegetable-growing regions of different countries, including Pakistan, Jordan, Ethiopia and Tanzania.

Rajasthan encompasses diverse agro-climatic conditions that may influence the distribution and population dynamics of root-knot nematodes. Despite the economic importance of brinjal cultivation in the state, systematic information on the occurrence and severity of *Meloidogyne* spp. in different districts is inadequate. Such information is essential for understanding the geographical distribution of the pathogen and for developing region-specific management strategies. Therefore, the present investigation was undertaken to determine the distribution and occurrence of root-knot nematodes (*Meloidogyne* spp.) associated with brinjal in major brinjal-growing districts of the I-B and IV-A agro-climatic zones of Rajasthan. The study aimed to assess the incidence and intensity of nematode infestation under field conditions and to generate baseline information that could support future integrated nematode management programmes for sustainable brinjal production.

Materials and Methods

Survey

An extensive field survey was conducted during 2025 and 2026 to determine the distribution and occurrence of root-knot nematodes (*Meloidogyne* spp.) associated with brinjal in two major agro-climatic zones (Zone I-B and Zone IV-A) of Rajasthan. The survey covered six important brinjal-growing districts, namely Sri Ganganagar, Hanumangarh, Rajsamand, Bhilwara, Chittorgarh and Udaipur.

A total of 582 soil and root samples were collected randomly from farmers' fields. The samples were properly labelled, transported to the laboratory and stored under refrigerated conditions until processing.

Soil Sampling

Soil samples were collected randomly from the rhizosphere of the plants with the help of khurpi from 4-5 places in each

at a depth of 20-30 cm, homogenized, filled in a polythene bag, labeled and tagged with supporting information, viz. date of sampling, locality, host plant. These samples were then tied with the rubber band brought to the laboratory and stored in a refrigerator at about 10 °C. The samples were processed within a week.

Processing of Samples

Initially, 200 cc of soil from each sample was refined by using Cobb's decanting and sieving technique (Cobb, N.A, 1918) ^[7], followed by Baermann's funnel technique (Christie and Perry 1951) ^[6]. After 24-48 hours, suspension was drawn in a beaker from the funnel and kept for some hours to allow the nematode to settle down at the bottom. The supernatant liquid was gently removed to get a concentrated nematode population. The suspensions were made up to 100 ml, bubbled and only 5 ml was drawn with the help of a pipette and poured in a counting disc. An average of three times was taken and then multiples to total suspension counts exercise was taken. The root-knot nematode and other plant parasitic juveniles were counted under a stereoscopic binocular microscope.

Estimation of Root Population

Infested roots were washed thoroughly and stained with 0.1 percent acid fuchsin lactophenol at 80°C for 2-3 minutes (McBeth *et al.* 1941) ^[11]. After a gentle wash in tap water, roots were kept in clear lactophenol for at least 24 hours and then they were examined under a stereoscopic binocular microscope. After staining, the roots were teased out and the number of root-knot nematodes and other plant parasitic nematodes was recorded under a stereoscopic binocular microscope.

Results and Discussion

The present investigation was undertaken to determine the distribution and occurrence of root-knot nematode, *Meloidogyne* spp. associated with brinjal cultivation in I-B and IV-A agro-climatic climatic zones of Rajasthan.

Among the surveyed districts, the highest occurrence of root-knot nematode was recorded in Sri Ganganagar (76.67) followed by Udaipur district (73.00%), Hanumangarh (70.67%), Bhilwara (69.51), Rajsamand (68.97%) and Chittorgarh (63.33%). Similarly, higher nematode infestation in terms of number of galls per plant, number of galls egg mass per plant and final nematode population per 200cc soil was observed in Udaipur and Sri Ganganagar districts. The maximum number of galls (114.28 galls/plant), egg masses (102.14 egg masses/plant) and final nematode population (1102 larvae/200 cc soil) were recorded from Thur village of Udaipur district, whereas Anupgarh village of Sri Ganganagar district recorded 113.87 galls/plant, 97.75 egg masses/plant and 1080 larvae/200 cc soil.

The findings of the present investigation are in close agreement with the observations of Gul and Saeed (1990) ^[9] reported the wide distribution of *Meloidogyne* species on several vegetable crops including eggplant, tomato and okra in Pakistan. Similarly, Yousef and Jacob (1994) ^[17] observed that *M. incognita* and *M. javanica* were among the most damaging nematodes associated with vegetable crops in Jordan.

The present observations further corroborate the findings of Rao *et al.* (2007) ^[14] reported the occurrence of

Meloidogyne spp. along with other plant-parasitic nematodes in vegetable crops including brinjal in Andhra Pradesh. Similar observations were made by Chandel *et al.* (2010) ^[5] who recorded high populations of *M. incognita* in vegetable nurseries and protected cultivation systems of Himachal Pradesh. Anwar and McKenry (2010) ^[2] also identified *M. incognita* and *M. javanica* as the predominant root-knot nematode species associated with vegetable crops in Punjab.

The higher frequency and incidence of root-knot disease observed in the present study are comparable with the reports of Esfahani (2009) ^[8] and Anamika *et al.* (2011) ^[1] documented substantial levels of root-knot nematode infestation in different vegetable-growing regions. The widespread distribution of *Meloidogyne* spp. reported by these researchers suggests that root-knot nematodes continue to be a major constraint in vegetable production under diverse environmental conditions.

The present findings on brinjal are in close conformity with the observations of Yadav and Kumar (2016) ^[16] reported severe root-knot disease incidence in brinjal fields of Agra with disease frequencies exceeding 80 percent in several localities. Their findings indicate that brinjal serves as a

highly suitable host for *Meloidogyne* spp. resulting in significant nematode multiplication and spread.

Particularly relevant to the present investigation are the reports from Rajasthan. Bhati and Baheti (2020) ^[3] observed 100 percent occurrence of *M. incognita* in polyhouse-grown cucumber across different locations of Rajasthan, while Kumari *et al.* (2023) ^[10] reported severe infestation of *M. incognita* in protected cultivation systems of Udaipur district. Furthermore, Meena *et al.* (2024) ^[12] recorded *Meloidogyne* spp. as the most predominant plant-parasitic nematode in Jaipur district. These findings strongly support the present observations and indicate that *Meloidogyne* spp. is widely distributed throughout different agro-ecological regions of Rajasthan.

Overall, the present survey confirms that root-knot nematodes are among the most important plant-parasitic nematodes associated with brinjal cultivation in Rajasthan. This might be due to variation in soil type, crop and variety, environmental conditions, cropping pattern *etc.* The widespread occurrence and high frequency of *Meloidogyne* spp. observed in the surveyed areas emphasize the need for regular monitoring and the adoption of integrated nematode management strategies to minimize crop losses and sustain brinjal productivity.

Table 1: Distribution and occurrence of root-knot nematode, *Meloidogyne* spp. on brinjal in I-B and IV-A agroclimatic zones of Rajasthan

S. No.	Location	Coordinates (Latitude °N & Longitude °E)	No. of samples Collected	Number of samples containing <i>Meloidogyne</i> spp.	Occurrence (%)	Number of galls per plant	Number of egg masses per plant	Number of larvae per 200 cc soil
I-B Agro climatic Zone								
Sri Ganganagar district								
1.	Lalgarh jattan	29.842030 74.025513	9	8	88.90	105.37	87.62	1021.50
2.	Satyam nagar	29.923318 73.899775	8	5	62.50	48.40	35.60	461.20
3.	power house road, sriganganagar	29.925749 73.900001	10	8	80.00	52.14	40.28	518.00
4.	7SGM	29.9142 73.8804	9	8	88.89	85.44	72.00	920.78
5.	Sardargarh	29.3729854 73.7427761	9	7	77.78	58.42	43.14	564.00
6.	Sarupsar	29.354775 73.700671	10	8	80.00	35.00	23.37	393.00
7.	Anupgarh	29.184099 73.213799	7	7	100.00	113.87	97.75	1080.00
8.	27 Apd-B	29.176412 73.185245	13	9	69.23	25.00	16.44	342.78
9.	17 Lm	29.098607 73.2455005	15	9	60.00	66.25	57.37	746.50
	Sub Total*/Mean		90*	69*	76.67	65.54	52.62	671.93
Hanumangarh district								
10.	Kolha	29.554839 74.330886	6	4	66.67	70.25	61.00	823.50
11.	Munda	29.471840 74.408780	11	7	63.67	66.14	54.43	721.00
12.	Fatehpur	29.923415 74.341142	7	6	85.71	53.37	41.62	535.75
13.	Rawatsar	29.278912 74.409345	15	11	73.33	68.90	56.00	737.18
14.	8 KWD	29.243403 74.429965	8	8	100	123.17	111.33	1197.83
15.	10 AM	29.244038 74.446323	6	4	66.67	59.00	47.75	611.00
16.	Bherusari	29.306850 74.273695	8	8	88.89	96.40	82.00	904.20
17.	Dhanasar	29.184350 74.339880	9	7	77.78	32.14	21.28	382.14

18	Baramsar	29.072850 74.301970	9	4	44.44	41.50	29.00	407.00
19	Sergarh	29.659540 74.431238	5	3	60.00	62.33	53.67	709.33
20	Pilibanga	29.488796 74.074799	10	6	60.00	42.50	31.83	422.00
21	Panditawali	29.445214 74.135490	6	2	33.33	17.28	7.00	189.00
22	Doultanwali	29.403226 74.099770	8	5	62.50	28.75	17.87	367.37
23	15 Pbn	29.474650 74.062140	7	5	71.42	21.00	9.60	214.20
24	Kalibanga	29.470199 74.128419	8	7	87.50	34.00	22.00	387.50
25	Jakhdawali	29.349351 74.209128	9	8	88.89	72.37	61.00	789.75
	Sub Total*/Mean		133*	95*	70.67	55.57	44.21	587.42
Rajsamand district								
26	Simal	25.1638627 73.9664042	10	6	60.00	48.16	32.00	442.33
27	Jetpura	25.2006947 73.9251351	7	5	71.42	30.25	21.75	362.00
28	Bnai	25.1285901 73.9360460	8	6	75.00	52.16	41.67	537.83
29	Lalbagh	24.9388919 73.8134338	9	3	33.33	10.00	4.67	151.00
30	Beghpura	25.074360 73.917950	10	7	70.00	61.14	50.28	615.00
31	Piplantri	25.111609 73.790439	9	6	66.67	65.50	51.00	622.33
32	Selma	25.770211 73.966210	8	6	75.00	72.00	58.83	711.66
33	Barjal	25.432611 73.911472	8	7	87.50	88.43	74.00	824.14
34	Kothariya	24.953652 73.860327	9	8	88.89	92.00	79.40	867.60
35	Delwara	25.775213 73.746315	9	6	66.67	51.16	38.00	490.33
	Sub Total*/Mean		87*	60*	68.97	57.08	45.16	562.42
Bhilwara district								
36	Hansiyas	25.2638726 74.7622136	9	6	66.67	40.66	29.17	415.00
37	Barla	25.2896182 74.8207223	9	7	77.78	74.12	62.00	793.75
38	Kawaliyas mafi	25.3403068 74.8068087	15	11	73.33	88.00	73.91	819.18
39	Ban ka khera	25.3232922 74.8096398	8	5	62.50	34.00	22.80	376.40
40	Mandal	25.439236 74.584404	10	8	80.00	92.57	77.00	841.28
41	Amarpura	25.399300 74.543300	8	5	62.50	46.20	33.60	440.20
42	Ameshar	25.748930 74.448700	9	6	66.67	37.33	24.50	391.00
43	Motipura	25.723450 75.289650	8	6	75.00	59.67	47.00	626.83
44	Kadisahana	25.654390 74.986990	6	3	50.00	23.33	11.67	225.33
	Sub Total*/Mean		82*	57*	69.51	55.09	42.40	547.66
Chittorgarh district								
45	Hapha kheri	24.8245880 74.3666870	10	4	40.00	33.25	21.75	357.00
46	Daulatpura road	24.8219354 74.8991950	10	7	70.00	21.28	10.00	214.42
47	Mahapura	24.8056164 74.8623898	8	6	75.00	29.33	16.50	316.67
48	Kapasan	24.879453 74.322775	9	5	55.55	42.40	31.60	419.20
49	Nimbahera	24.620001 74.680000	10	5	50.00	33.00	20.80	368.20

50	Chauthpura	24.970970 74.173570	8	6	75.00	59.17	46.00	587.83
51	Damakheda	24.824228 74.310181	9	7	77.78	82.00	69.40	743.60
52	Nagari	24.955700 74.682500	9	7	77.78	99.80	81.20	882.40
53	Kherpura	25.101130 74.922150	9	5	55.55	65.00	52.43	692.57
54	Aachora	24.846610 74.671040	8	5	62.50	48.57	35.14	461.00
	Sub Total*/Mean		90*	57*	63.33	51.38	38.48	504.29
Udaipur district								
55	Gogunda	24.758160 73.526610	10	7	70.00	69.00	57.44	723.78
56	Thur	24.6608996 73.6562239	10	9	90.00	114.28	102.14	1102.00
57	Badgaon	24.627447 73.687652	8	7	87.50	98.42	82.57	891.42
58	Vallabnagar	24.673031 74.003312	8	7	87.50	103.57	92.00	1013.00
59	Bhuwana	24.614678 73.706676	13	7	53.84	41.00	28.14	420.28
60	Debari	24.598500 73.788300	11	7	63.63	41.00	30.00	421.28
61	Bujhada	24.568470 73.633450	9	6	66.67	13.33	5.67	154.00
62	Nai	24.549710 73.638557	9	7	77.78	29.28	18.00	362.42
63	Bedla	24.644970 73.681140	13	11	84.61	71.91	59.18	734.00
64	Bhinder	24.502734 74.188368	9	5	55.55	34.40	21.60	373.80
	Sub Total*/Mean		100*	73*	73.00	61.62	49.67	619.59
	Grand Total		582	411	70.61	57.71	45.42	582.22

Conclusion

The survey established that root-knot nematodes (*Meloidogyne* spp.) are widely distributed throughout the major brinjal-growing districts of Rajasthan. Sri Ganganagar recorded the highest occurrence of infestation, while Udaipur exhibited the greatest severity in terms of gall formation, egg masses and final nematode population/200cc soil. The results identify important hotspot areas for nematode infestation and provide baseline information for developing location specific integrated nematode management strategies. Regular surveillance and implementation of sustainable management practices are essential for minimizing crop losses and improving brinjal production under Rajasthan conditions.

Reference

- Anamika K, Simon S, Singh KP, Ghosh G. Distribution of root-knot nematode in major field crops in UP (India). Archives of Phytopathology and Plant Protection. 2011;42:191-197.
- Anwar SA, McKenry MV. Incidence and reproduction of *Meloidogyne incognita* on vegetable crop genotypes. Pakistan Journal of Zoology. 2010;42(2):135-141.
- Bhati SS, Baheti BL. Occurrence and population status of root-knot nematode, *Meloidogyne incognita* on cucumber under protected cultivation in Rajasthan. Journal of Entomology and Zoology Studies. 2020;8(4):1441-1444.
- Bhatti DS, Jain RK. Estimation of loss in okra, tomato and brinjal yield due to *Meloidogyne incognita*. Indian Journal of Nematology. 1977;7(1):37-41.
- Chandel YS, Kumar S, Jain RK, Vashisth S. An analysis of nematode problem in greenhouse cultivation in Himachal Pradesh and avoidable losses due to *Meloidogyne incognita* in tomato. Indian Journal of Nematology. 2010;40:198-203.
- Christie JR, Perry VG. Removing nematode from soil. Proceedings of the Helminthological Society of Washington. 1951;18:106-108.
- Cobb NA. Estimating the nematode population of soil. U.S. Department of Agriculture, Bureau of Plant Industry, Agricultural Technical Circular. 1918;1:1-48.
- Esfahani MN. Distribution and identification of root-knot nematode species in tomato fields. Mycopathology. 2009;7:45-49.
- Gul A, Saeed M. A survey of root-knot nematode (*Meloidogyne* spp.) in North West Frontier Province of Pakistan. Sarhad Journal of Agriculture. 1990;6:495-502.
- Kumari M, Thakur S, Sharma MK. Prevalance of root-knot nematode, *Meloidogyne incognita* under protected cultivation in district Udaipur of Rajasthan. The Pharma Innovation Journal. 2023;12(8):1434-1437.
- McBeth CW, Taylor AL, Smith AL. Note on staining nematodes in root tissues. Proceedings of the Helminthological Society of Washington. 1941;8:26.
- Meena R, Chandawat BS, Midha RL. Occurrence and distribution of plant parasitic nematodes in mungbean in Jaipur district, Rajasthan, India. Annual Research and Review in Biology. 2024;39(7):32-39.
- Nayak DK, Pandey R. Screening and evaluation of brinjal varieties/cultivars against root-knot nematode

- (*M. incognita*). International Journal of Advanced Research. 2015;3(10):476-479.
14. Rao GMVP, Sudheer MJ, Priya P. Community analysis of plant parasitic nematodes associated with vegetable crops in selected districts of Andhra Pradesh. Indian Journal of Nematology. 2007;37(2):221-223.
 15. Sasser JN. Economic importance of *Meloidogyne* in tropical countries. In: Lamberti F, Taylor CE, editors. Root-knot Nematodes (*Meloidogyne* Species): Systematics, Biology and Control. London, UK: Academic Press; 1979. p. 359-374.
 16. Yadav BC, Kumar S. Survey and identification of root-knot nematodes associated with brinjal crops in Fatehabad, Agra. Current Agriculture Research Journal. 2016;4(1):114-119.
 17. Yousef DM, Jacob S. A nematode survey of vegetable crops and some orchards in the Ghor of Jordan. Nematologia Mediterranea. 1994;22(1):11-16.