



# Race Composition of Root Knot Nematode (*Meloidogyne*) Species Infecting Cucurbitaceous Crops in Terai region of West Bengal

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**Abstract:** A survey was undertaken to adequately address the threat of root knot nematode species and races on cucurbitaceous vegetables. In this study, the distribution and identification of root knot nematode species and races collected from different cucurbitaceous vegetable growing areas in Cooch Behar and Jalpaiguri district of Terai region were determined by perineal pattern morphology and North Carolina host differential test during 2020-2022. A total of 31 samples were collected from ten blocks and 74.19% were infested with root knot nematode. Plant root samples were processed in part for identification of species and rest of the sample multiplied on the susceptible host for further detection of races. Response of nematode was measured by counting egg mass and root-galling severity index (1-5 scale). Out of the 31 populations analysed, 69.57% were identified as *Meloidogyne incognita* and rest as *Meloidogyne javanica*. According to the differential host test, population of *M. incognita* existing in Dhupguri, Malbazar, Mathabhanga-II, Haldibari, Dinhat-II, Cooch Behar-II and Tufanganj block of both the district were identified as race 1 (31.25%) and 2 (68.75%). However, populations from Maynaguri, Cooch Behar-I and Mekhliganj block belong to the race 5 and 6 of *M. javanica*. It indicated the presence of *M. incognita* race 2 is the most prevalent race throughout the surveyed area.

**Keywords:** Cucurbits, Species, Race, *Meloidogyne incognita*, *Meloidogyne javanica*

Cucurbitaceae form an important family of vegetable crops cultivated extensively in the subtropical and tropical countries. The species of this family are distributed all over the world. Cucumbers, gourds, melons, squashes, and pumpkins are among the annual or perennial herbs that belong to this family and are indigenous to temperate and tropical regions. Most of the edible species of guard family are hosts of root knot nematodes. These nematodes infect cucurbit plant roots and complete their life cycle by feeding inside the roots. Plant parasitic nematodes are hidden enemies and continue to tearing farmers for successful and profitable cultivation of horticultural crops. Root-knot nematode (RKN) are the most economically important group of plant parasitic nematodes worldwide attacking nearly almost every crop (Samara 2022). More than 4100 plant-parasitic nematode species have been identified; the most well-known and widely distributed of these is *Meloidogyne* spp. (Singh and Khanna 2016). Root knot nematodes (*Meloidogyne* spp.) are potential threat to the vegetable crops across the world and can result in losses of up to 80% in severely infested regions (Rathod et al 2016). Based on data from the All-India Co-ordinated Research Projects on Nematodes in Agriculture over the years, it has been estimated that phytonematodes cause crop losses of 21.3%,

amounting to 102,039.79 million per year. Losses in 19 horticultural crops were estimated to be 50,224.98 million, while losses in 11 field crops were estimated to be 51,814.81 million (Kumar et al 2020). To reduce these losses, is important to manage root knot nematode population in field. For proper management accurate nematode identification is very essential at species and race level and use of resistant cultivars are generally race specific. The different race of a species is difficult to identify because of physical similarities, life phases in different habitats, varied host ranges, poorly defined species borders, intraspecific variability, probable hybrid origin and polyploidy (Blok and Powers, 2009). Therefore, the precise identity (i.e., species and race) of the nematode population being tested must be known in order to develop resistant varieties for the root knot nematode. One of the methods most frequently used to determine the races of root knot nematode species is the differential-host test. The present investigation was carried out to identify the species and races of root knot nematode infesting cucurbitaceous vegetable crop in the districts of Terai region.

## MATERIAL AND METHODS

Root-knot nematode (*Meloidogyne* spp.) populations associated with cucurbitaceous crops were collected from

different blocks of Cooch Behar and Jalpaiguri district of West Bengal. A total of 31 root samples were collected, out of which 23 samples from ten blocks (Table 1) were infested with root knot nematode. Plant root samples (galled roots) were processed in part for identification of species based on perineal pattern morphology and rest of the sample multiplied on the susceptible host (tomato cv. Patharkuchi) under net house conditions for further detection of races. This research was conducted in Uttar Banga Krishi Viswavidyalaya during 2020-2022. The differential host test was used to identify the races. For this test plastic pots were filled with sterilised sandy loam soil. The soil sterilized by incorporation of water and formaldehyde solution (37-41%) at 9:1 ratio. Population of each location were tested on NC host differentials (Tomato cv. Rutgers, Pepper cv. California Wonder, Tobacco cv. NC 95, Cotton cv. Deltapine-61 and Peanut cv. Florunner) in different growing season of crops. NC hosts are inoculated with freshly hatched J<sub>2</sub> juveniles of cucurbits collected from different locations. After 75 days of inoculation, host plants uprooted carefully and root system examined for root galling on scale of 1 to 5 based on the number of egg masses

produced by each plant, as shown in Table 2. Each plant cultivar was classified as susceptible (+) or resistant (-) depending on multiplication or egg mass production on the root system at the conclusion of the experiment. After that, the data was compared to NC host differential (Taylor and Sasser 1978) and modified scheme (Khan et al 2014) (Table 3).

## RESULTS AND DISCUSSION

A total of 31 samples were collected from ten blocks out of which 74.19% were infested with root-knot nematode species based on perineal pattern morphology. After

**Table 2.** Gall index scale (Gaur 2001)

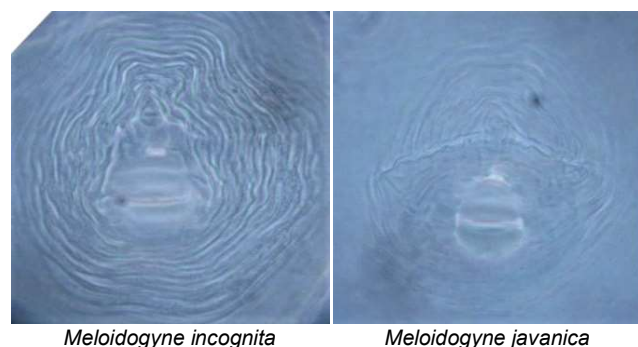
Nematode gall index	Number of egg masses produced by each	Reactions
1	0	Highly resistant
2	1-10	Resistant
3	11-30	Moderately resistant
4	31-100	Susceptible
5	>101	Highly susceptible

**Table 1.** Root knot nematode infested root samples collected from different location

District	Block	Village/ town	Latitude	Longitude
Cooch Behar	Tufanganj	Turkanikothi	26.362594	89.717768
		Turkanikothi	26.363174	89.728014
		Falimari	26.398017	89.805171
	Mekhliganj	Uchal Pukhari	26.483337	89.022671
		Ranirhat	26.521916	88.965938
		Mekhliganj	26.500122	88.957690
	Haldibari	Budhiapara	26.357436	88.776796
	Mathabhanga-II	Singijani	26.494188	89.152617
		Balasundar	26.521154	89.131519
		Khetifulbari	26.511741	89.090565
	Cooch Behar-I	Charak para	26.203880	89.379533
		Cooch Behar-I	26.270039	89.423983
	Cooch Behar-II	Pundibari	26.397540	89.386389
		Singhimari	26.470146	89.344701
Dinhata-II	Atialdanga	26.091067	89.571108	
	Nazirhat	26.192755	89.563648	
Jalpaiguri	Dhupguri	Bamontari	26.670403	88.944926
		Gadong	26.577851	89.042434
		Patkidaha	26.548011	88.986427
	Malbajar	Tesimala	26.857749	88.741053
		Anandapur	26.727363	88.692128
	Maynaguri	Charerbari	26.542397	88.885789
		Bolmari	26.665002	88.767480

comparing the observed data with differential host test reaction chart (Table 3) root-knot nematode (*Meloidogyne*) races infecting cucurbits in Cooch Behar and Jalpaiguri district (Table 4 and 5, respectively). Five host differentials viz., cotton, tobacco, pepper, groundnut and tomato were used for race identification. Out of the infested populations 69.57% were identified as *Meloidogyne incognita* and rest as *Meloidogyne javanica*. Population of *M. incognita* existing in Dhupguri, Malbazar, Mathabhanga-II, Haldibari, Dinhata-II, Cooch Behar-II and Tufanganj block as race-1 (31.25%) and race-2 (68.75%). Populations from Maynaguri, Cooch Behar-I and Mekhliganj block belong to the race-5 and race-6 of *M. javanica*.

The current findings demonstrate the incidence and occurrence of root-knot nematodes (*Meloidogyne* spp.) in the Cooch Behar and Jalpaiguri districts of West Bengal. Most of



*Meloidogyne incognita*

*Meloidogyne javanica*

the cucurbitaceous crops of Cooch Behar and Jalpaiguri districts are affected by *M. incognita* than *M. javanica*. *M. incognita* is identified as the most prevalent and significant species on a locality basis and makes up a major portion of the population of root-knots in these districts. Chandra et al (2010) observed that *Lageneria ciceria*, *Cucumis sativa*, *Momordica charantia*, and *Cucurbita pepo*, the four members of the cucurbitaceae family, were highly or moderately susceptible to *M. incognita*. This report is in accordance with results as most of the localities of cucurbits infected with *M. incognita*. In similar study conducted in Aligarh district of Uttar Pradesh by Ali et al (2021) *Meloidogyne arenaria*, *M. incognita* and *M. javanica* were found in all infested areas associated with eggplant. The dominant species was *M. incognita*, which displayed the highest frequency (86.36%) and second most prevalent species was *M. javanica*. Kalayani et al (2013) reported the concurrent occurrence of *Meloidogyne* spp. in Pothwar region of Pakistan and cucumber had a serious infestation of root-knot nematodes. Chandel et al (2010) in Chhattisgarh, observed highest average population of *Meloidogyne* in bottle gourd followed by bitter gourd and cucumber. On the basis of the differential hosts test, Khan and Murmu (2004) recorded two races of *M. incognita* in crop and weed samples collected from various districts of West Bengal. Populations from Burdwan, Nadia, Birbhum, 24-Pargona (North), Hooghly and Midnapore were identified as *M. incognita* race-2; whereas populations from

**Table 3.** Modified scheme for designation of race/pathotype of *Meloidogyne* based on host differentials

<i>Meloidogyne</i> spp.	Race/ Pathotype	Differential hosts					
		Cotton (Deltapine 61)	Tobacco (NC 95)	Pepper (California Wonder)	Watermelon (Charleston Gray)	Peanut (Florunner)	Tomato (Rutgers)
<i>M. incognita</i>	1	-	-	+	+	-	+
	2	-	+	+	+	-	+
	3	+	-	+	+	-	+
	4	+	+	+	+	-	+
	5	-	-	-	-	-	+
	6	-	+	-	-	-	+
<i>M. javanica</i>	1	-	+	-	+	+	+
	2	-	+	-	+	-	+
	3			-		+	
	4			+		+	
	5	-	-	-	-	-	+
	6		+	+	-	-	+
	7	+	+	+		-	+
<i>M. arenaria</i>	1	-	+	+	+	+	+
	2	-	+	-	+	-	+
	3	-	+	+		-	+

**Table 4.** Identification of root-knot nematode (*Meloidogyne*) races infecting cucurbits in Cooch Behar districts of West Bengal

Location	Host differential										Species	Race
	Cotton		Tobacco		Pepper		Peanut		Tomato			
	Gall Index	Egg mass	Gall Index	Egg mass	Gall Index	Egg mass	Gall Index	Egg mass	Gall Index	Egg mass		
Tufanganj, Turkanikothi	1 (1-1)	0	3.67 (3-4)	24.67 (18-31)	2.33 (2-3)	6.00 (3-9)	1 (1-1)	0	4.00 (4-4)	59.33 (35-88)	<i>M. incognita</i>	2
Tufanganj, Turkanikothi	1 (1-1)	0	4.00 (4-4)	28.33 (22-34)	4.00 (4-4)	49.00 (45-54)	1 (1-1)	0	4.00 (4-4)	74.33 (65-85)	<i>M. incognita</i>	2
Tufanganj, Falimari	1 (1-1)	0	4.00 (4-4)	50.33 (26-64)	3.67 (3-4)	28.00 (24-32)	1 (1-1)	0	4.00 (4-4)	38.67 (34-47)	<i>M. incognita</i>	2
Mekhliganj, Uchal Pukhari	1 (1-1)	0	3.33 (3-4)	19.00 (11-24)	3.67 (3-4)	25.33 (20-32)	1 (1-1)	0	3.00 (3-3)	12.33 (11-14)	<i>M. javanica</i>	6
Mekhliganj, Ranirhat	1 (1-1)	0	1 (1-1)	0	1 (1-1)	0	1 (1-1)	0	3.33 (3-4)	20.67 (15-30)	<i>M. javanica</i>	5
Mekhliganj,	1 (1-1)	0	3.00 (3-3)	8.00 (6-10)	2.67 (2-3)	8.67 (5-12)	1 (1-1)	0	3.67 (3-4)	24.67 (20-33)	<i>M. javanica</i>	6
Haldibari, Budhiapara	1 (1-1)	0	3.33 (3-4)	17.00 (14-21)	3.00 (3-3)	12.33 (8-15)	1 (1-1)	0	3.00 (3-3)	10.67 (9-12)	<i>M. incognita</i>	2
Mathabhanga-II, Singijani	1 (1-1)	0	3.00 (3-3)	10.00 (7-13)	4.00 (4-4)	31.00 (27-35)	1 (1-1)	0	3.33 (3-4)	16.00 (14-19)	<i>M. incognita</i>	2
Mathabhanga-II, Balasundar	1 (1-1)	0	1 (1-1)	0	3.33 (3-4)	17.33 (14-23)	1 (1-1)	0	4.67 (4-5)	79.67 (73-84)	<i>M. incognita</i>	1
Mathabhanga-II, Khetifulbari	1 (1-1)	0	1 (1-1)	0	3.67 (3-4)	26.67 (21-32)	1 (1-1)	0	4.00 (4-4)	60.00 (53-65)	<i>M. incognita</i>	1
Cooch Behar-I, Charak para	1 (1-1)	0	3.00 (3-3)	11.00 (8-15)	4.00 (4-4)	38.67 (35-42)	1 (1-1)	0	5.00 (5-5)	97.67 (86-110)	<i>M. incognita</i>	6
Cooch Behar-I,	1 (1-1)	0	1 (1-1)	0	1 (1-1)	0	1 (1-1)	0	3.67 (3-4)	20.67 (12-27)	<i>M. javanica</i>	5
Cooch Behar-II, Pundibari	1 (1-1)	0	3.00 (3-3)	14.67 (12-17)	1 (1-1)	0	1 (1-1)	0	3.33 (3-4)	19.33 (16-22)	<i>M. javanica</i>	2
Cooch Behar-II, Singhimari	1 (1-1)	0	2.67 (2-3)	8.33 (5-14)	1 (1-1)	0	1 (1-1)	0	3.67 (3-4)	25.33 (21-28)	<i>M. incognita</i>	2
Dinhata-II, Atialdanga	1 (1-1)	0	1 (1-1)	0	3.33 (3-4)	17.33 (15-19)	1 (1-1)	0	3.00 (3-3)	9.33 (6-14)	<i>M. incognita</i>	1
Dinhata-II, Nazirhat	1 (1-1)	0	3.00 (3-3)	11.00 (6-15)	2.67 (2-3)	11.33 (4-16)	1 (1-1)	0	4.00 (4-4)	43.00 (42-44)	<i>M. incognita</i>	2

\*Based on reproduction; Figures in parentheses are the range; \*\*Cotton: cv. Deltapine-61, Tobacco: cv. NC-95, Pepper: California wonder, Peanut: cv. Florunner, Tomato: cv. Rutgers

**Table 5.** Identification of root-knot nematode (*Meloidogyne*) races infecting cucurbits in Jalpaiguri districts of West Bengal

Location	Host differential										Species	Race
	Cotton		Tobacco		Pepper		Peanut		Tomato			
	Gall Index	Egg mass	Gall Index	Egg mass	Gall Index	Egg mass	Gall Index	Egg mass	Gall Index	Egg mass		
Dhupguri, Bamontari	1 (1-1)	0	1 (1-1)	0	3.00 (3-3)	13.00 (10-16)	1 (1-1)	0	4.00 (4-4)	31.33 (27-35)	<i>M. incognita</i>	1
Dhupguri, Gadong	1 (1-1)	0	4.33 (4-5)	102.00 (86-112)	2.67 (2-3)	9.00 (4-12)	1 (1-1)	0	3.67 (3-4)	43.33 (24-55)	<i>M. incognita</i>	2
Dhupguri, Patkidaha	1 (1-1)	0	3.00 (3-3)	10.00 (8-12)	2.33 (2-3)	4.33 (3-6)	1 (1-1)	0	3.67 (3-4)	26.00 (20-31)	<i>M. incognita</i>	2
Malbazar, Tesimala	1 (1-1)	0	1 (1-1)	0	3.33 (3-4)	15.33 (13-21)	1 (1-1)	0	4.00 (4-4)	41.00 (21-56)	<i>M. incognita</i>	1
Malbazar, Anandapur	1 (1-1)	0	4.00 (4-4)	27.67 (21-36)	3.00 (3-3)	7.33 (6-9)	1 (1-1)	0	4.00 (4-4)	61.00 (52-70)	<i>M. incognita</i>	2
Maynaguri, Charerbari	1 (1-1)	0	3.00 (3-3)	12.33 (10-14)	3.67 (3-4)	25.67 (18-34)	1 (1-1)	0	2.67 (2-3)	10.00 (4-14)	<i>M. javanica</i>	6
Maynaguri, Bolmari	1 (1-1)	0	1 (1-1)	0	1 (1-1)	0	1 (1-1)	0	4.00 (4-4)	48.00 (43-52)	<i>M. javanica</i>	5

See Table 4 for details

Murshidabad, Malda and Cooch Behar were designated as *M. incognita* race-1. The present study indicates the widespread and diverse nature of the *M. incognita* and *M. javanica* populations that are associated with cucurbitaceous crops in both the districts in Terai region of West Bengal. These findings could be helpful in creating cropping system strategies and in creating species or race-specific resistant varieties for sustainable crop cultivation.

### CONCLUSION

*M. incognita* race-2 is very much prevalent throughout the surveyed area of Cooch Behar and Jalpaiguri district. Their high densities occurrence may pose a serious threat to the crop. Therefore, the immediate attention of growers and researchers is needed to manage the damage caused by root-knot nematodes.

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