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Occurrence and population status of root-knot nematode, (*Meloidogyne incognita)* on black gram in Udaipur district of Rajasthan

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Abstract
A survey was conducted during August to November 2024 in Udaipur district of Rajasthan to assess the occurrence and population status of root-knot nematode, *Meloidogyne incognita*, in black gram (*Vigna mungo*). A total of 66 soil and root samples were collected from ten localities and processed using Cobb's sieving and Baermann's funnel techniques. Observations on number of galls per plant, egg masses per plant, and larval population per 200 cc soil revealed widespread infestation. The overall occurrence of *M. incognita* was 78.78%, with mean values of 47.16 galls per plant, 33.06 egg masses per plant, and 659.29 juveniles per 200 cc soil. The highest incidence was recorded in Madar and Thoor villages (100%), whereas the lowest was in Madar (40%). Variation in nematode occurrence was attributed to crop variety, soil type, age of crop, and agro-ecological conditions. The study confirms that black gram fields in Udaipur district are severely infested with *M. incognita*, posing a significant threat to crop productivity, and highlights the need for integrated nematode management strategies.

Keywords: Survey, Root-knot nematode, black gram, *Meloidogyne incognita*

1. Introduction
Pulses occupy a unique position in every known system of farming all over the world. The pulses form an integral part of the cropping system of farmers all over the country because, these crops fit well in the crop rotation and occupy an important position in the human dietary, being a good source of vegetable protein (17-43%) and supplement to cereal-based diet (Swaminathan, 1974) [16]. India is the world's leading producer and consumer of pulses, which accounts for 25-28 percent of the world's overall production (Marimuthu *et al*., 2024) [10]. Black gram is the richest source of phosphoric acid amongst pulses and its high value of essential amino acids *i.e.*,lysine, cystine and methionine makes an excellent complement to terms of balanced human nutrition. This crop is a biological nitrogen fixation in the soil, maintains soil fertility and thus plays a dynamic role in promoting sustainable agriculture. The nutritional value of black gram as per 100 gram is protein (25.21g), carbohydrate, (58.99g), fat (1.64g), fibre (18.3g), calcium (138mg), iron (7.57mg), phosphorus (379mg) and vitamins are thiamine, riboflavin, niacin, B-6, and B-12 (USDA National nutrient data base). Black gram is one of the most significant pulse crops grown in India, black gram is grown under a variety of agroclimatic conditions. Maharashtra, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Tamil Nadu, Karnataka and Rajasthan are the main states in the nation that grow beans.

In Rajasthan, black gram is mainly grown on arid and semi-arid districts like Chittorgarh, Udaipur, Bhilwara, Ajmer, Jhalawar, Kota, Bundi and Baran, etc. Despite of being such an important crop, the average productivity of crop in the state is quite low than it is potential. In Rajasthan, black gram occupies 295.59 ha area with a production of 149.23 lakh tones and productivity of 504.8 kg per ha in 2023-24 (Rajasthan.gov.in-Statement-1final estimates of area). There are plenty of biotic and abiotic factors which affects the production of black gram badly. Out of biotic factors Root-knot nematode, *Meloidogyne* spp. is a most significant pest of food and commercial crops over the world. The infestation with *Meloidogyne* spp. in pulse crops is an important constraint in the production and quality.

All pulse crops especially chickpea, pigeon pea, mung bean, urd bean, pea and lentil are severely invaded by *M. incognita*, *M. javanica*. Several nematodes that parasitize the plants emphasize and minimize pulse production, particularly *Meloidogyne incognita*, *M. javanica*, *Heterodera cajani* and *Rotylenchulus reniformis.* Nematodes, *M. incognita* and *M. javanica* cause substantial damage to various pulse crops, notably pigeon pea, moong bean, urd bean, cowpea, chickpea, lentil, common bean, field pea, lathyrus, horse gram and rice bean, as previously observed (Singh and Jagadeeswaran, 2013) [15]. Plant parasitic nematodes on an average cause a loss of 12.3% in forty main crops worldwide (Sasser and Freckman, 1987) [13]. Root-knot nematodes supply the root tissue to numerous sicknesses that involve fungal and bacterial disease as post-infections, which leads to extensive damage due to complex disease. Kumar *et al.*, (2010) [8] collected Soil and root samples of cowpea growing areas from Churu, Jhunjhunu, Udaipur, Rajsamand and Chittorgarh district of Rajasthan showed high prominence value of *Meloidogyne* and *Rotylenchulus reniformis* and *Tylenchorhynchus* spp.

2. Materials And Methods

Multiple surveys were carried out in various parts of Udaipur and surrounding region of Udaipur district.

2.1 Survey

A survey was carried out in Udaipur district to find out occurrence and population status of root-knot nematode (*M. incognita*) on black gram. Soil and root samples were collected from surveyed areas and brought to the laboratory for processing. Two-hundred cubic centimetre soil was processed for estimation of nematode by Cobbs sieving and decantation method followed by Baermann's funnel technique. Roots were stained using 0.1% acid fuchsin lactophenol solution, rinsed in water to remove excess amount of stain and keep in clear lactophenol at least for 24 hours before examination (Mc Beth *et al.*, 1941) [11]. Various observations were taken *viz.*, number of galls/plant, number of egg masses/plant and nematode population/200cc soil etc. At the time of survey, GPS coordinates (longitude and latitude) were also taken to determinate the geographic location on maps of different localities where samples were collected (Table-1).

2.2 Soil Sampling

Randomly selected soil and root samples were collected from various points (2-5) within the root zone of a cultivated black gram field. A soil auger was employed to collect samples at a depth of approximately 10-20 cm. Subsequently, a composite sample consisting of 250 g of soil and 5 g of root was meticulously placed in a polythene bag, duly labelled with essential information such as the host's name, location, collection date, and prevailing soil condition. These samples, accompanied by the pertinent data sheet (Table: 1), were preserved in a refrigerated environment and subsequently subjected to analysis.

2.3 Processing of Samples

At first, 250 g soil collected from the various locations were washed under tap water in pot. Thereafter processed by cobb's decanting and sieving technique, after that processed under Baerman's funnel technique. After 2 days of processing, suspension was drawn into the beaker and kept for the settling the nematodes at the bottom. Supernatant suspension gently separated from the beaker to isolate maximum nematode population. Nematode suspension made according to the nematode population up to 100 ml and from that 5 ml taken with the help of pipette to population counting in counting dish. After 3 times counting of nematodes from different 5 ml suspension an average population find out from that 3 suspension. Root-knot nematodes juveniles were counted under stereoscopic microscope.

2.3 Estimation of nematode population in 200CC soil

The soil samples collected from the various locations were brought to the laboratory. Two hundred cubic centimetre soil was processed using Cobb's sieving and decanting technique (Cobb, 1918) [4] followed by Baermann's funnel assembly (Christie and Perry, 1951) [3]. After 24 hours the suspense on was drawn in a beaker from the funnel and kept for some time to allow the nematode to settle down. The excess water was gently poured out of the beaker without disturbing the nematodes already settled at bottom. The volume of suspension was made to 100 ml and then after thoroughly bubbling 10 ml of suspension was drawn with the help of a pipette and poured over a counting dish for counting. Population count was done under a stereoscopic binocular microscope and determine accordingly.

2.4 Counting of number of gall and egg masses per plant

After collecting, these roots stained by using acid fuchsin and lactophenol. Roots were completely observed under stereoscopic binocular microscope for counting of galls, and egg masses and of nematode per plant by using tele counter.

Table 1: Name of localities and GPS coordination of surveyed root-knot nematode growing areas in and around Udaipur district of Rajasthan

S. No.	Name of Locality	Locality No.	Latitude	Longitude
Udaipur District				
1	Madar	L1	24.6703	73.6229
2	Thoor	L2	24.6650	73.6475
3	Badgaon	L3	24.6274	73.6878
4	Chikalwas	L4	24.6456	73.6566
5	Dadiya	L5	24.6569	73.6560
6	Loyara	L6	24.6562	73.6593
7	Mada	L7	24.6413	73.5152
8	Kacchwa	L8	24.7447	73.5388
9	Gogunda	L9	24.7586	73.5361
10	Iswal	L10	24.6308	73.6801

A. Occurrence of root knot nematode

The percent occurrence of *M. incognita* was calculated by under given formula:

$$\%\text{Occurrence} = \frac{\text{Number of samples containing species}}{\text{Total number of samples collected}} \times 100$$

3. Results and Discussion

A survey was carried out to investigate the distribution and occurrence of root-knot nematode, *M. incognita* associated with black gram in different villages of Udaipur district. A total of sixty-six soil and roots samples were collected from black gram crop from different locations. Observations *viz.*, number of galls per plant, number of egg mass per plant and larval population per 200 cc soil were recorded and

presented in Table-1 and illustrated through fig-1. Results expressed that the occurrence of root-knot nematode was observed 78.78 percent from Udaipur district with an average population of 47.16 galls per plant, 33.06 egg masses per plant, 659.29 larvae per 200 cc soil.

3.1 Madar

Among ten soil and root samples, root-knot nematode, *M. incognita* was obtained from all the ten samples with 100 percent occurrence. An average population of 65.33 galls/ plant, 55.66 egg masses/plant and 728.33 larvae/200 cc soil were recorded from Madar village.

3.2 Badgaon

From Badgaon village a total 8 samples were collected out of them seven samples found presence of root-knot nematode with 87.50 percent occurrence. An average population of 59.33 galls/ plant, 38.33 egg masses/plant and 720.33 larvae/200 cc soil.

3.3 Chikalwas

Six soil and root samples collected from Chikalwas village and found four samples positive for root-knot nematode with 66.66% occurrence. An average population of 42.00 galls per /plant, 35.33 egg masses per plant and 668.66 larvae/200 cc soil were recorded from same samples.

3.4 Dadiya

Five soil and root samples collected from Dadiya village and three samples found positive for root-knot nematodes with 60 percent occurrence. An average population of 37.33 galls/plant, 21.00 egg masses/plant and 612.66 larvae/200 cc soil were recorded from Dadiya.

3.5 Loyara

Five soil and root samples were collected from Loyara village. Root-knot nematode, *M. incognita* was recorded positive three samples with 60 percent occurrence. An average population of 38.66 galls per plant, 25.66 egg masses per plant and 716.00 larvae/200 cc soil were recorded from the samples.

3.6 Mada

Soil and root five samples collected from Mada village. Root-knot nematode, *M. incognita* was recorded in two samples with 40 percent occurrence. An average population of 35.66 galls/plant, 20.33 egg masses/plant and 516.66 larvae/200 cc soil were recorded from Mada.

3.7 Kacchwa

Five samples collected from Kacchwa village. Root-knot nematode, *M. incognita* was recorded in three samples with 60 percent occurrence. An average population of 40.33 galls/plant, 29.33 egg masses/plant and 695.00 larvae/200 cc soil were recorded from Kacchwa.

3.8 Gogunda

A total eight collected samples from Gogunda. Root-knot nematode, *M. incognita* was observed in seven samples with 87.5 percent occurrence. On an average population of 55.66 galls/ plant, 28.33 egg masses/plant and 591.66 larvae/ 200 cc soil were recorded in Gogunda.

3.9 Thoor

A total eight collected samples from Thoor. Root-knot nematode, *M. incognita* was observed in eight samples with 100 percent occurrence. On an average population of 61.66 galls/ plant, 41.00 egg masses/plant and 721.66 larvae/ 200 cc soil were recorded in Thoor.

3.10 Iswal

A total six collected samples from Iswal. Root-knot nematode, *M. incognita* was observed in five samples with 83.33 percent occurrence. On an average population of 58.00 galls/ plant, 35.66 egg masses/plant and 622.00 larvae/ 200 cc soil were recorded in Iswal.

Plate 1: Survey of root-knot nematode, *M. incognita* on black gram in Udaipur district of Rajasthan

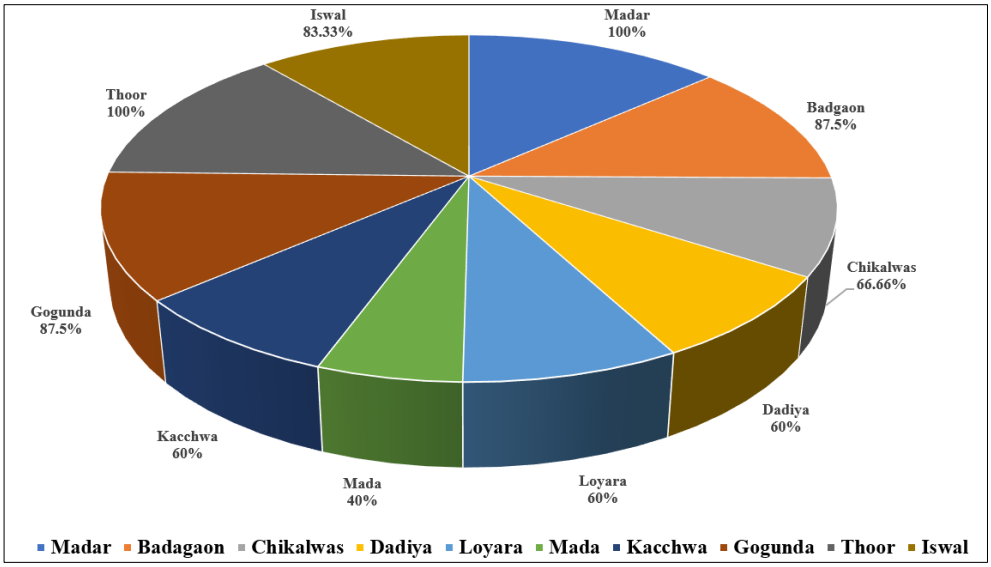

Fig 1: Occurrence percent of root-knot nematode (*Meloidogyne incognita*) on black gram in around Udaipur district of Rajasthan

Table 2: Distribution and occurrence of root-knot nematode (*Meloidogyne incognita*) on black gram in and around Udaipur district of Rajasthan

Locality	Locality No.	No. of samples	Infected sample	Absolute frequency occurrence (%)	Average nematode population		
					No. of galls/ plant	No. of egg masses/ plant	No. of larvae/200 cc soil
Madar	L-1	10	10	100	65.33	55.66	728.33
Badgaon	L-2	8	7	87.50	59.33	38.33	720.33
Chikalwas	L-3	6	4	66.66	42.00	35.33	668.66
Dadiya	L-4	5	3	60.00	37.33	21.00	612.66
Loyara	L-5	5	3	60.00	38.66	25.66	716.00
Mada	L-6	5	2	40.00	35.66	20.33	516.66
Kacchwa	L-7	5	3	60.00	40.33	29.33	695.00
Gogunda	L-8	8	7	87.50	55.66	28.33	591.66
Thoor	L-9	8	8	100.00	61.66	41.00	721.66
Iswal	L-10	6	5	83.33	58.00	35.66	622.00
Total	10	66	52	78.78	-	-	-
Mean		6.6	5.2	-	47.16	33.06	659.29

Root-knot nematode, *Meloidogyne incognita* was first reported from cucumber growing garden in Nuneham England by Berkeley (1855) [2]. Later in India, first reported by Barber (1901) [1] on tea roots from Devala territory of Kerala. However, in India very little work has been done under survey. So, filly time gap of knowledge a survey was conducting during August 2024 to November 2024 in and around Udaipur district of Rajasthan.

The outcomes of this survey were similar with the Mishra (2001) [12] who, reported the association of root-knot nematode, cyst nematode, lesion nematode, reniform nematode and various ectoparasitic nematode groups with all the pulse crop in pulse producing areas of India. Similarly, Kumar *et al.*, (2010) [8] collected Soil and root samples of cowpea growing areas from Churu, Jhunjhunu, Udaipur, Rajsamand and Chittorgarh district of Rajasthan showed high prominence value of *Meloidogyne* and *Rotylenchulus reniformis* and *Tylenchorhynchus* spp. Singh (2015) [14] reported thirteen nematode genera (*Hoplolaimus*, *Tylenchorhynchus*, *Helicotylenchus*, *Tylenchus*, *Heterodera cajani*, *Pratylenchus*, *Basiria*, *Aphelenchus*, *Meloidogyne*, *Filenchus*, *Boleodorus*, *Rotylenchulus* and *Scutellonema*) associated with pigeon pea from Bundelkhand region of Utter Pradesh (India). Manandhar *et al.* (2023) [9] collected 211 soil samples in different crop fields among them, 137 samples were diagnosed for different plant parasitic nematodes (*Meloidogyne, Helicotylenchus, Pratylenchus, Telemachus, Tylenchorhynchus, Criconemoides, Hoplolaimus, Aphelenchoides, Belonolaimus, Hirschmann ella, Longidorus and Rotylenchulus*). This research gave similar results to the work of previous researchers. The variation in occurrence and root-knot nematode population may be due to variation in varieties, age of crop, soil texture, soil temperature and relative humidity as well as other agro-ecological conditions during survey. Most of the black gram groves in area of and around Udaipur were infected with the root-knot nematode, *Meloidogyne incognita* with the occurrence of 78.78 percent.

4. Conclusion

A survey was carried out in the month of August to November 2024 in district Udaipur of Rajasthan, to record the prevalence of root-knot nematode in black gram. A total of 66 soil and root samples were collected from black gram growing area and farmer's field from Udaipur district. In surveyed areas, out of Ten localities, incidence of root-knot nematode, *Meloidogyne incognita* was recorded from 10 localities. Extreme infestation of root-knot nematode was marked from Madar and Thoor village per 200 cc soil, respectively. Occurrence of *M. incognita* was obtained 78.78 percent with an average of 47.16 galls per plant, 33.06 egg masses per plant and 659.29 juveniles/ 200 cc soil. These findings emphasize the occurrence and infestation of

Root-knot nematode *M. incognita* in black gram crop in Udaipur district of Rajasthan.

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