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Occurrence of barley root knot nematode, *Meloidogyne naasi* in orange jessamine (*Cestrum aurantiacum* L.) in Nilgiris, Tamil Nadu, India: A new record

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Abstract

A survey was taken up (2015-2016) in the present study to record the root knot nematode species existing in Tamil Nadu in crops such as tomato, brinjal, chillies, carrot, cabbage, potato, beetroot, guava, pomegranate, tea, coffee and some turf grasses. Among the various root knot nematode species encountered, *Meloidogyne naasi* commonly called the barley root knot nematode or cereal root knot nematode was recorded from the Nilgiris, from a place called Kuruthukuli in roots of Orange Jessamine (*Cestrum aurantiacum* L.), a common weed plant in Nilgiris. The population occurred as a mixture of *M. naasi*, *M. incognita* and *M. hapla* in the roots of same plant which showed profuse typical and conspicuous tip galls. The perineal pattern was exactly rounded with rough striae and the phasmids are prominent, stylet length of female is 12.83µm (11.5 – 14µm), backward sloping knobs with a mean body length of second stage juveniles is 432µm (433 -456µm), tail length of J₂ is 61.6µm (56 – 65µm) and stylet length of male is 18.5µm (16 – 19µm). These characters matched with the original description of *M. naasi* by Franklin 1965 and hence the species was confirmed morphologically. Studies will be made to further confirm the same at molecular level.

Keywords: root knot nematode, barley or cereal root knot nematode, *meloidogyne naasi*, *cestrum aurantiacum* l., orange jessamine, posterior cuticular pattern (PCP)

1. Introduction

Root knot nematode, *Meloidogyne naasi* (Franklin, 1965) is one of the important nematodes in temperate zones such as, barley, wheat, sorghum and in some grasses. It produces small minute galls at tip of the roots [8]. *Meloidogyne naasi* is reported from the United Kingdom, Belgium, the Netherlands, France, Germany, former Yugoslavia, Iran, the United States and the former Soviet Union, occurring mostly in temperate climates [20]. However, it has also been found in Mediterranean areas on barley in the Maltese islands [12] and in New Zealand and Chile on small grains [17]. It is probably the most important root knot nematode affecting grain in most European countries in contrast to the United States [20]. *M. naasi* does not appear to be widespread in temperate semi-arid regions, such as West Asia and North Africa [30].

Cestrum is a genus comprising of 150-250 species of flowering plants in the family Solanaceae, it is native to warm temperate to tropical regions of the America, from the southern most United States (Florida, Texas: day-blooming cestrum, *C. diurnum*) south to the Bío-Bío Region in central Chile (green cestrum, *C. parqui*) [13]. They are colloquially known as cestrums or jessamines (from "jasmine", due to their fragrant flowers). They are shrubs growing to 1–4 m (3 ft 3 in–13 ft 1 in) tall. Most are evergreen; a few are deciduous. All parts of the plants are toxic, causing severe gastroenteritis if eaten [14]. *Cestrum aurantiacum* (orange Cestrum, "orange jessamine", orange-flowering jessamine, and yellow Cestrum; syn. *Caprariolan ceolata* L. f.) is an invasive species native to North and South America [13]. This plant is used as an ornamental plant, and it is a poisonous plant if eaten by animals. It is regarded as medicinal in Peru. Probably it was introduced into Nilgiris during the British rule as an introduced crop.

An attempt was made through a survey to record the various species of root knot nematode occurring in the state of Tamil Nadu and among the several crops surveyed.

2. Materials and Methods

2.1. Morphological Characterization

A survey was taken up during 2015-2016 to record the root knot nematode species existing in Tamil Nadu in crops such as tomato, brinjal, chillies, carrot, cabbage, potato, beet root, guava, pomegranate, tea, coffee and some turf grasses. Soil (200cc) and root materials (5g) from the infected crops were brought to the laboratory of Department of Nematology, TNAU, Coimbatore. Second stage juveniles (J_2) and males were extracted from soil by Cobb's decanting and sieving [3] method followed by modified Baermann funnel techniques [25]. Root materials were washed and stained by using acid fuchsin lactophenol. The second stage juveniles and males were fixed in 4% formaldehyde and processed to glycerine by the formalin glycerine method for morphological studies [11]. Drawings of second stage juvenile, head and tail of J_4 male, head of female and PCP were drawn using Camera Lucida. Measurements of all stages were made with an ocular micrometer. Microphotographs of all stages were taken with the help of image analyser (Labomed).

2.2 Posterior Cuticular Pattern (PCP): The PCPs of ten fully matured females from *Cestrum aurantiacum* L. isolate

were prepared [33].

3. Results

3.1 Posterior Cuticular Pattern (PCP): The PCP showed concentric rings (circular) with rounded pattern. Phasmids were prominent. Fairly low dorsal arch was observed which was roughly circular formed from broken striae that were well marked with prominent phasmids (Fig. 3). Camera lucida drawing and variations in perineal pattern of *M. naasi* were observed as shown in Fig. 3 and 4.

3.2 Female: Fully formed females were white, pear shaped, variable in size and posterior rounded. Spears were slender, dorsally curved and well developed. Backwardly sloping knobs. Excretory pore was on 7th to 11th annule behind the head (Fig.2).

3.3 Male and second stage juvenile: Heads of males were offset, spear with rounded knobs, with one testis, spicules paired, ventrally curved, tapering to a point with small saucer shaped gubernaculum. Median oesophageal bulbs were fusiform with 4 or 5 vesicle like structures.

Dorsal gland opens 2-3 μ m behind spear base (fig.2)

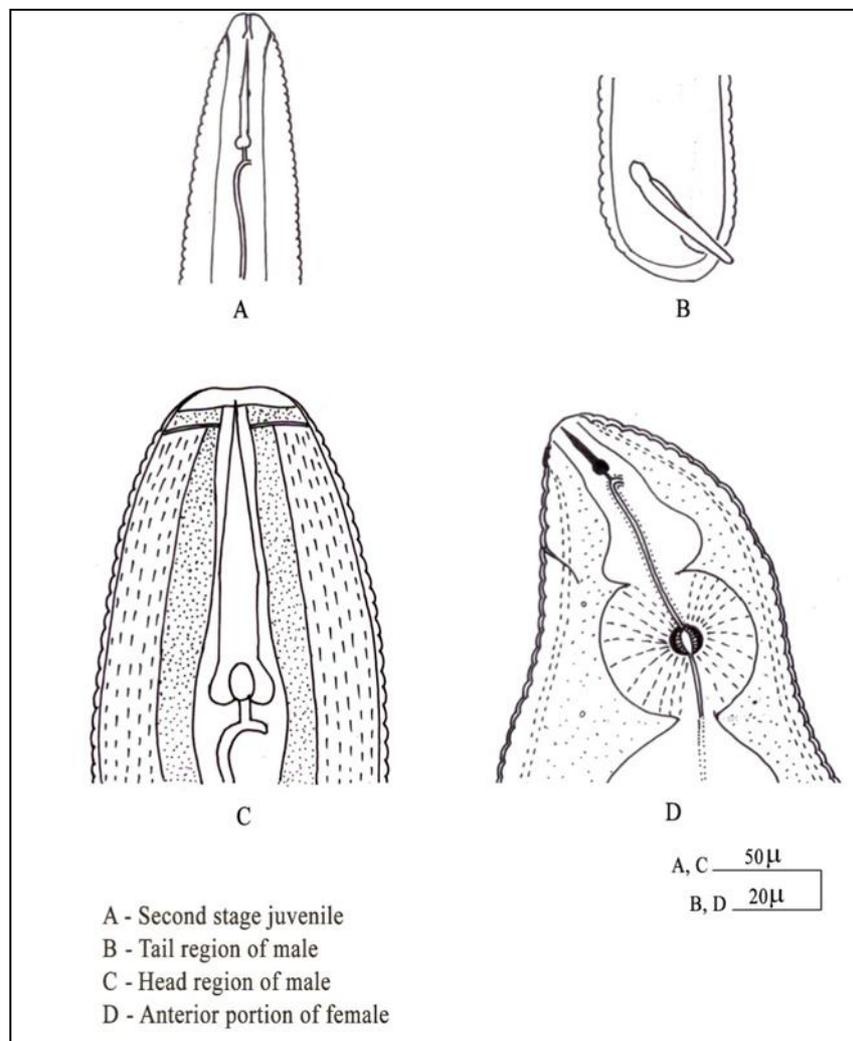


Fig 1: Camera Lucida drawings of *Meloidogyne naasi*

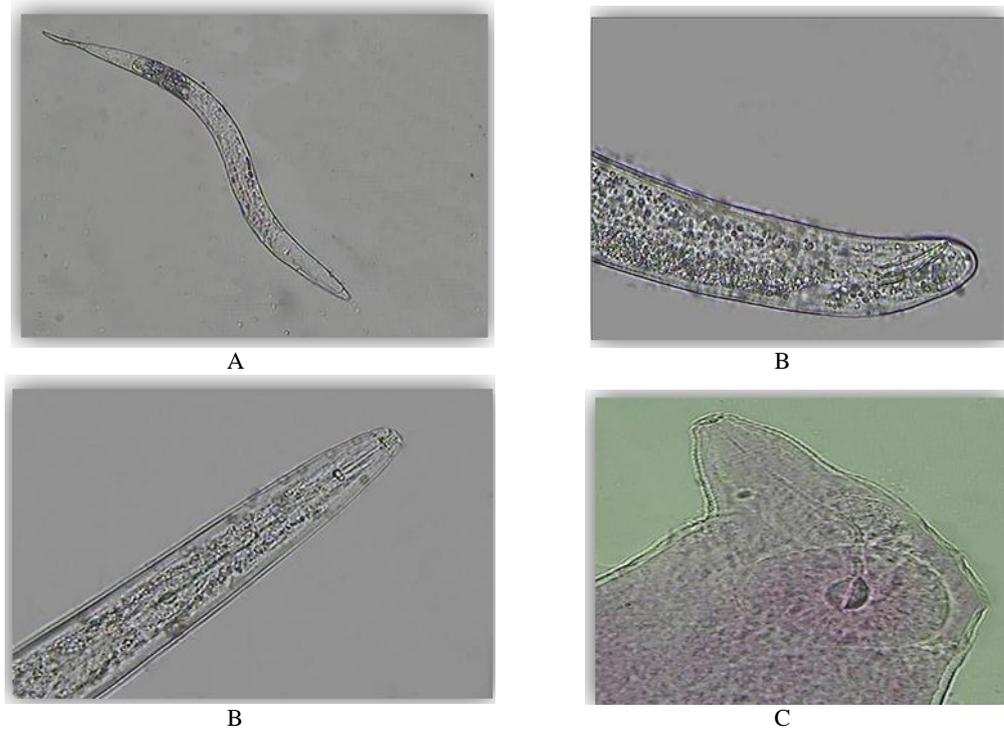


Fig 2: Image analyser photographs of *Meloidogyne naasi*: A- Second stage juvenile, B- Male – head region, C- Male – Head region, D- Female - anterior region

Table 1: Comparison of dimensions of females of *Meloidogyne naasi* Franklin [8] with original description

S. No	Dimensions	Original measurements (µm) *	Authors measurements - µm**		
			Mean	SD	CV %
1	Body length	557 (455 – 705)	626 (505 - 696)	105.21	12.5
2	Body width	330 (227 - 398)	330.66 (243 - 394)	78.38	6.5
3	Stylet length	13 (11 - 15)	12.83 (11.5 - 14)	1.25	4.5
4	DOGO	3 (2 - 4)	3.06 (2.7 – 3.5)	0.40	3.7
5	Length of median bulb	34 (28 - 46)	31.66 (30 43)	10.59	3.2
6	Vulval slit length	22 (17 - 25)	21.66 (19 - 24)	2.51	4.7
7	Vulva to anus distance	23 (24 – 26)	25.03 (23 – 27.5)	2.28	5.3

Original measurements* - Franklin [8]

** Study isolate

DOGO-Dorsal Oesophageal Gland Orifice

Table 2: Comparison of dimensions of males of *M. naasi* Franklin [8] with original description

S. No	Dimensions	Original measurements (µm) *	Authors measurements - µm**		
			Mean	SD	CV (%)
1	Body length	1148 (860 - 1316)	1252.33 (1197 - 1305)	54	16
2	Body width	30 (23 - 34)	32 (30 – 33.5)	1.80	8
3	a	40 (32 - 48)	32 (40 - 46)	3.01	5.4
4	Stylet length	18 (16 - 19)	42.8	1.04	11
5	DOGO	3 (2 - 4)	1.7 (2 -3)	0.5	8
6	Spicule length	28 (25 - 30)	27.83	1.89	6

Original measurements* - Franklin [8]

** Study isolate

DOGO-Dorsal Oesophageal Gland Orifice

Table 3: Comparison of dimensions of second stage juveniles of *M. naasi* Franklin [8] with original description

S. No	Dimensions	Original measurements (µm) *	Authors measurements - µm**		
			Mean	SD	CV %
1	Body length	435 (418 - 465)	432 (433 -456)	13.02	13
2	Body width	15 (14 – 18)	15.33 (14.5 – 16.5)	1.04	11
3	a	28 (25 – 30)	28 (26.5 – 29.5)	1.5	15
4	Stylet length	14 (13 - 15)	12 (13 – 14.5)	1.2	12
5	Tail length	70 (52 - 78)	61.6 (56 - 65)	4.82	7.0

Original measurements* - Franklin [8]

** Study isolate

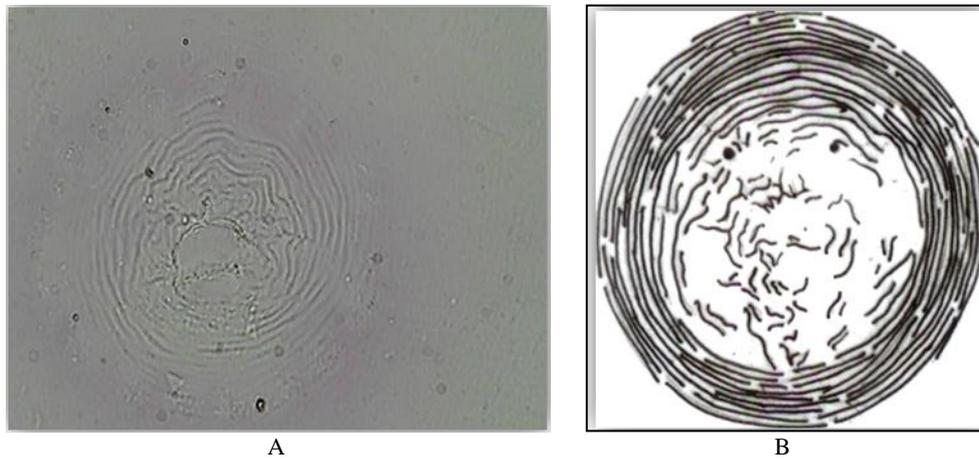


Fig 3: Posterior Cuticular Patterns of *M. naasi*: A- Image of perineal pattern of *M. naasi*
B- Camera lucida drawing of Posterior Cuticular Pattern of *M. naasi*

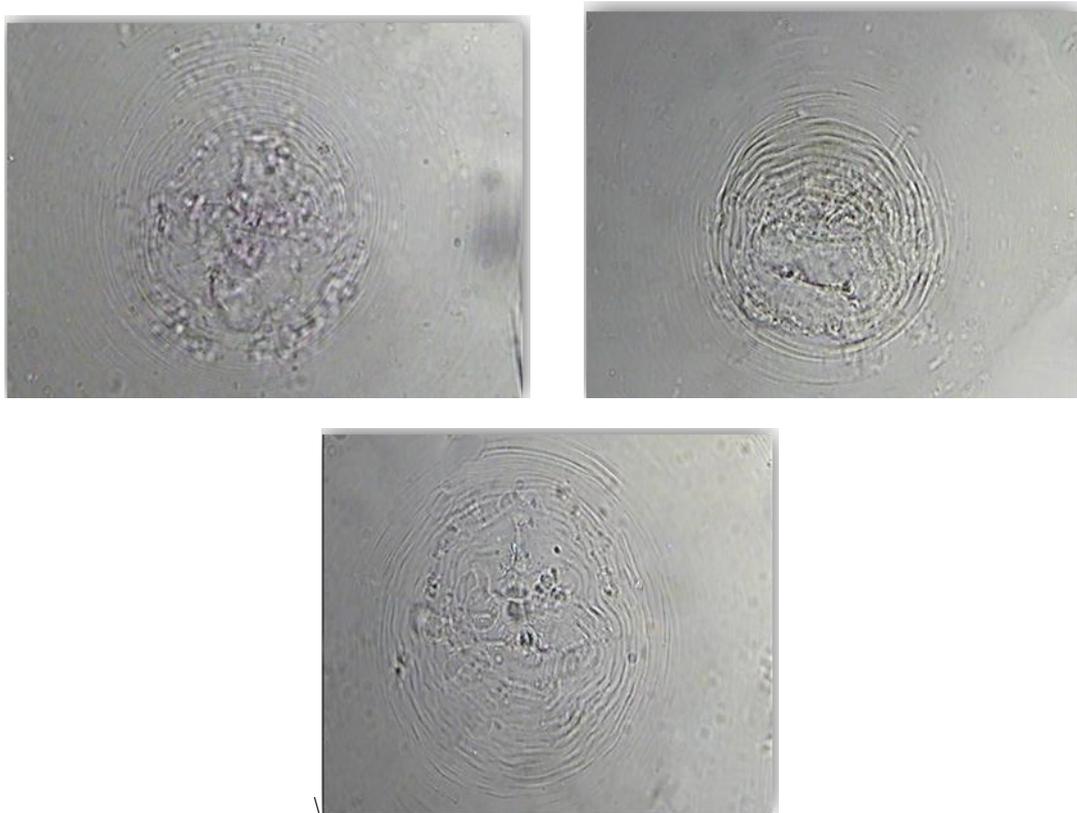


Fig 4: Variations in posterior cuticular patterns of *M. naasi*

4. Discussion

Among the various species encountered, *Meloidogyne naasi* commonly called the barley root knot nematode or cereal root knot nematode, so far not recorded from South India, was recorded from the Nilgiris, from a place called Kuruthukuli in roots of Orange Jessamine (*Cestrum aurantiacum*), a common weed plant in Nilgiris. The population occurred as a mixture of *M. naasi*, *M. incognita* (Southern root knot nematode) and *M. hapla* (Northern root knot nematode) in the roots of same plant which showed profuse typical and conspicuous tip galls. However there was no report from India probably it could be the first report.

Cestrum is a genus belonging to 150-250 species of flowering plants in the family Solanaceae. They are native to warm temperate to tropical regions of the Americas, from the southernmost United States (Florida, Texas: day-blooming cestrum, *C. diurnum*) south to the Bío Region in central Chile (green cestrum, *C. parqui*) [13]. They are colloquially known

as cestrums or jessamines (from "jasmine", due to their fragrant flowers). *Meloidogyne naasi* was described from spring sown barley (*Hordeum vulgare*) in Gloucestershire, England by Franklin [8] and has been reported from Kansas [23, 7], Michell *et al* [24], the southern USA [5], Argentina [6], Chile [19], United Kingdom and Ireland [8, 4, 18], Belgium [25], Hungary [2, 1], the Netherlands [22], Germany [31, 32], Italy and Malta [22, 21], France [25], Yugoslavia [10], the SR Serbia [16], Libya [28] and New Zealand [27]. It was pathogenic to creeping bentgrass in greenhouse experiments at the University of Illinois, Urbana-Champaign [29]. This host plant was highly prevalent in the hilly areas of Nilgiris.

Females were smaller than other root knot nematode species with spherical shape. PCP had fairly low dorsal arch and was roughly circular and was formed from the broken striae that are usually well marked round the prominent phasmids (Fig. 2) just as in the original description of Franklin [8]. However, variations among the females of *M. naasi* with regard to the

PCP were recorded in this study (Fig. 4). Some patterns had well prominent phasmids while in certain others it was not clearly prominent. However, all patterns had exactly rounded patterns. The other morphological and morphometric characters such as stylet length of female being 12.83 μm (11.5 - 14 μm), backward sloping knobs with a mean body length of second stage juveniles of 432 (433 -456) μm , tail length of J_2 being 61.6 μm 56 - 65 μm and stylet length of male being 18.5 μm 16 - 19 μm , confirmed the species to be *M. naasi* as per the original description by Franklin^[8] (Table 1, 2 and 3). Accordingly, the coefficient of variation was less for DOGO (3.7%), length of median bulb (3.2%) and vulval slit length (4.7%) in females and was again less in 'a' value (5.4%) and spicule length (6%) in males making the individuals in the present study closer to the original description.

Cestrum aurantiacum L. though not an economically important plant, occurrence of barley/ cereal root knot nematode, *M. naasi* needs to be monitored as the plant may serve as an alternate host for this nematode in the absence of the original hosts in the Nilgiris.

5. Conclusion

Barley root knot nematode, *Meloidogyne naasi* has been recorded for the first time India on Orange jessamine (*cestrum aurantiacum* L.). The morphometrics agrees with the original description by Franklin 1965 with minimum variations. The variation was highest (16%) with the length of male and least (3.2%) with the length of median bulb.

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