

## A new local race of the root-knot nematode *Meloidogyne thamesi* Chitwood in Chitwood, Specht & Havis, 1952 in Hungary

By

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**Abstract.** Root-knot nematodes, *Meloidogyne* species, are widely distributed both in open fields and in greenhouses in Hungary. *Meloidogyne thamesi* is one of the seven *Meloidogyne* species recorded in Hungary so far. It was detected alone or in combination with *Meloidogyne arenaria* in six localities till now including east, west and middle region. *Meloidogyne thamesi gyulai* is described and illustrated from tomato (*Lycopersicon esculentum* MILL. cv. Balca) planted in plastic greenhouses in Gyula (South-East Hungary). Females have a characteristic perineal pattern with moderately high dorsal arch and distinctly broken striae near the tail tip in lateral fields above the anus.

The root-knot nematodes, *Meloidogyne* species, are of worldwide distribution. They are the cause of a major problem all over the world as well as in Hungary (1, 2, 3, 5), especially in the areas between the Danube and the Tisza rivers (appr. 25–30,000 ha) and in greenhouses (appr. 4000 ha). *Meloidogyne thamesi* was reported for the first time in Hungary by BUDAI (1980) as a serious pest of tomato in heated plastic greenhouses in the area between the Danube and the Tisza rivers. *Meloidogyne thamesi* was found in four further localities (Balástya, Kistelek, Bordány, Gyula) out of those twenty six locations (appr. 15%) surveyed between 1990 and 1992 (AMIN, 1993). It was observed on cultivated vegetable crops, such as on tomato, pepper, cucumber and weed host, *Glansoga parviflora* (2), furthermore on pepper at Boglárlelle and on carnation in Szeged (5). *Meloidogyne thamesi* has been reported in the hot Palo Verde Valley of Southern California along the coast and cooler areas (29). In Greece it is one of the most common species on cucumber, grape, tomato, hyacinth, tobacco, carrot and cabbage (15). It is frequent in Turkey as well on different cultivated plants and weeds. In Chile *M. thamesi* is one of the five commonest root-knot nematode species on cultivated plants (25).

*Meloidogyne thamesi* was found in several countries (Table 1) as a major or minor pest associated with very wide range of cultivated crops and host weeds. In the present study a subspecies (or race) causing heavy damage on tomatoes in Gyula is presented and described.

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## Materials and methods

Specimens were obtained from plastic greenhouses (tomato, *Lycopersicon esculentum* MILL. cv. Balca) in Gyula (South-East Hungary, in September, 1992). Larvae and males were recovered from infected tomato roots, females were dissected from the roots in 3% formaldehyde solution. 20 female perineal patterns were prepared and used in the identification as proposed by DABAJ (1990).

### Measurements of different populations of *Meloidogyne thamesi* Chitwood in Chitwood, Specht & Havis, 1952

#### 1. After Whitehead (1968)

**Females.** L=590  $\mu\text{m}$   $\pm$ 51 (514–703); width= 409  $\mu\text{m}$   $\pm$ 53 (331–534); stylet=17  $\mu\text{m}$  (15–18); stylet knobs=3 $\mu\text{m}$ ; dorsal oesophageal gland orifice=4  $\mu\text{m}$  (3–5) behind stylet base; length of medial bulb=35  $\mu\text{m}$  (33–42); width of medial bulb=30  $\mu\text{m}$  (26–33); length of medial valve=16  $\mu\text{m}$  (13–18); width of medial bulb valve=10  $\mu\text{m}$  (9–10).

**Males.** L=1526  $\mu\text{m}$   $\pm$ 194 (1081–1804); a=47.7  $\mu\text{m}$   $\pm$ 3.94 (39.1–59.2); head=8.3  $\mu\text{m}$   $\pm$ 0.59 (6.5–9.4); stylet=24.9  $\mu\text{m}$   $\pm$ 1.69 (20.5–28.1); stylet knobs=4.4  $\mu\text{m}$   $\pm$ 0.48 (3.6–5.4); b<sub>1</sub>=16  $\pm$ 1.64 (12.4–18.2); c=121  $\pm$ 37.8 (83–219); length of medial bulb=23.4  $\mu\text{m}$   $\pm$ 2.56 (18.7–29.5); width of medial bulb 9.9  $\mu\text{m}$   $\pm$ 1.65 (6.5–14.7); length of medial bulb valve=7.1  $\mu\text{m}$   $\pm$ 1.18 (5.0–8.6); spicules=25.7  $\mu\text{m}$   $\pm$ 2.42 (21.6–28.1); gubernaculum=9.2  $\mu\text{m}$   $\pm$ 1.23 (7.9–10.8).

**Larvae.** L=432  $\mu\text{m}$   $\pm$ 17 (410–476); a=32.4  $\pm$ 1.83 (30–37.8); b=2.19  $\pm$ 0.267 (2.01–2.41); b<sub>1</sub>=6.9  $\pm$ 0.3 (6.5–7.4); length of tail=53  $\mu\text{m}$   $\pm$ 2 (50–58); d=5.8  $\pm$ 0.4 (5.3–7.0); c=8.1  $\pm$ 0.27 (7.6–8.6); length of body to middle of primordium=269  $\mu\text{m}$   $\pm$ 11 (252–298); stylet=11.1  $\mu\text{m}$   $\pm$ 0.62 (10.2–12.7); length of medial bulb=12.5  $\mu\text{m}$   $\pm$ 1.08 (10.8–14.4); width of medial bulb=7.1  $\mu\text{m}$   $\pm$ 0.64 (6.1–8.3); length of medial bulb valve=5.2  $\mu\text{m}$   $\pm$ 0.64 (4.3–6.5)

**Eggs.** 92  $\mu\text{m}$   $\pm$ 6.0 (78–101)  $\times$  33  $\mu\text{m}$   $\pm$ 3.3 (27–40).

#### 2. Populations from Hungary

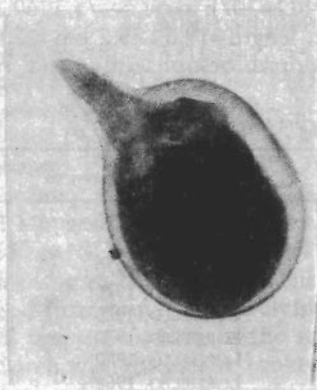
**Females.** Stylet length=16.5  $\mu\text{m}$  (15.1–17.7  $\mu\text{m}$ ); DGO=5.5  $\mu\text{m}$  (4.2–6.3  $\mu\text{m}$ ).

**Males.** Stylet length=22.4  $\mu\text{m}$  (20.1–23.2  $\mu\text{m}$ ); DGO=3.8  $\mu\text{m}$  (3.3–4.0  $\mu\text{m}$ ); spicules=31  $\mu\text{m}$  (29.7–22.2  $\mu\text{m}$ ).

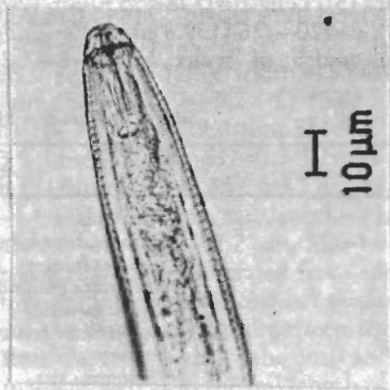
**Larvae.** Length=409  $\mu\text{m}$  (372–441  $\mu\text{m}$ ); tail length=55.4  $\mu\text{m}$  (45.5–62.3  $\mu\text{m}$ ); hyaline part of tail=14.8  $\mu\text{m}$  (12.5–18.6  $\mu\text{m}$ ).

#### 3. *Meloidogyne thamesi gyulai* subsp. n.

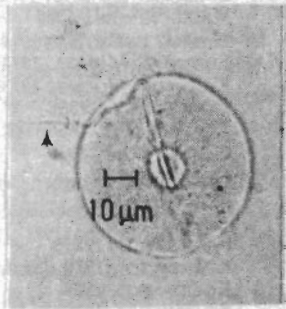
**Females** (17). Length=918–1667  $\mu\text{m}$  (mean 1095  $\mu\text{m}$ , standard deviation, SD=148); width=344–826  $\mu\text{m}$  (633.8  $\mu\text{m}$ , SD=124); a=1.3–2.3 (1.6, SD=0.3); stylet=14.4–15.6  $\mu\text{m}$  (14.7  $\mu\text{m}$ , SD=0.57); width of stylet knobs=2.1–2.4  $\mu\text{m}$  (2.3  $\mu\text{m}$ , SD=0.1); stylet w/h ratio=2–2.3 (2.1, SD=0.15); dorsal oesophageal gland orifice (DGO)=2.4–3.6  $\mu\text{m}$  (2.8  $\mu\text{m}$ , SD=0.5); distance from vulva slit to anus=20.2–26.4  $\mu\text{m}$  (23.9  $\mu\text{m}$ , SD=1.9); excretory pore=24–36  $\mu\text{m}$  (30.9  $\mu\text{m}$ , SD=6) from anterior part; medial bulb center=90–140  $\mu\text{m}$  (99.1  $\mu\text{m}$ , SD=9.4) from anterior part.



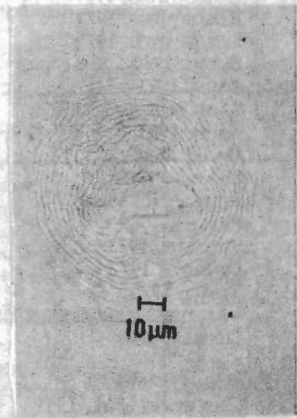
1



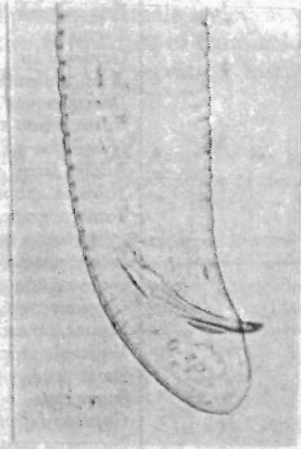
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2



3



5

Fig. 1. *Meloidogyne thamesi gyulai* subsp. n. 1: adult female; 2: stilet (arrow) and medial bulb; 3: perineal pattern; 4: male head; 5: posterior end of male

Males (5). Length=1728—2530  $\mu\text{m}$  (2028  $\mu\text{m}$ , SD=307);  $a$ =51.5—75.3 (60.2  $\mu\text{m}$ , SD=9.8);  $c$ =120—176 (139.8  $\mu\text{m}$ , SD=25.34; Stylet length=19.6—25.2  $\mu\text{m}$  (22.6  $\mu\text{m}$ , SD=1.9); width of stylet knobs=6—7.2  $\mu\text{m}$ , dorsal oesophageal gland orifice

Table 1. Distribution of *Meloidogyne thamesi*

Localities	Hosts	References
Australia	<i>Vitis vinifera</i>	MCLEOD & KHAIR, 1974
Brazil	Cabbage, french bean	JENSEN, 1972
	<i>Spondias lutea</i>	LORDELLO, 1970
	<i>Momardica charantia</i>	LORDELLO, 1970
	<i>Rivina humilis</i>	LORDELLO, 1970
	<i>Lycopersicon peruvianum</i>	LORDELLO, 1970
	<i>Leonurus sibiricum</i>	LORDELLO, 1970
	<i>Theobroma</i> sp.	LORDELLO, 1968
	<i>Allium cepa</i>	LORDELLO & FILHO, 1971
Chile	Vegetable crops	MAURICIO et al., 1982
	<i>Artocarpus incisa</i>	MAURA, 1967
Egypt	<i>Portulaca oleraceae sativa</i>	ELGINDI & MOUSSA, 1971
	<i>Cucumis melo</i> var. <i>aegyptiaca</i>	ELGINDI & MOUSSA, 1971
England	<i>Solanum tuberosum</i>	GOODEY et al., 1956
	<i>Vigna catjang</i>	GOODEY et al., 1956
	<i>Gardenia jasminoides</i>	GOODEY et al., 1959
Germany	<i>Beta vulgaris</i>	GOFFART, 1957
	<i>Cactus</i> sp.	GOFFART, 1957
	<i>Gardenia</i> sp.	GOFFART, 1957
Greece	<i>Brassica oleracea</i>	KOLIOPANOS, 1979
	<i>Daucus carota</i>	KOLIOPANOS, 1979
	<i>Antirrhinum</i> sp.	KOLIOPANOS, 1979
	<i>Hyacinthus</i> sp.	KOLIOPANOS, 1979
	<i>Allium sativa</i>	KOLIOPANOS, 1979
	Tobacco, cabbage, carrot,	KOLOIPANOS, 1979
	Tomato, grape, cucumber	KOLOIPANOS, 1979
Hungary	<i>Lycopersicon esculentum</i>	BUDAI, 1980
	<i>Lycopersicon esculentum</i>	AMIN, 1993
	<i>Galinsoga parviflora</i>	AMIN & BUDAI, 1992
	<i>Capsicum</i> spp., cucumber	AMIN, 1993
	Pepper, carnation	DABAJ, 1990
India	Vegetable crops	DEAKER, 1969
Iraq	Sugar cane	SETHI et al., 1964
	Sugar cane	PRASAD, 1969
	<i>Cucumis sativus</i>	STEPHAN, 1973
Italy	<i>Nicotiana tabacum</i>	DI MURO, 1972
Japan	<i>Morus bombycis</i>	TOIDA, 1973
South Africa	<i>Allium cepa</i>	VAN DER LINDE et al., 1959
Spain	Vegetable crops	DECKER, 1969
USA		
(Kansas)	<i>Clematis paniculate</i>	MULVEY, 1961
(Florida)	<i>Boehmeria utilis</i>	CHITWOOD et al., 1952
(Florida)	<i>Petivaeria hexaglochis</i>	MULVEY, 1961
(Texas)	<i>Rosa</i> sp.	MULVEY, 1961
USA	French been, cabbage	JENSEN, 1972
	Potato	WINSLOW & WILLIS, 1972
	Sugar cane	WILLIAMS, 1969
	<i>Oriza sativa</i>	HOLLIS & KEOBOONRUENG, 1984
	<i>Beta pateellaris</i>	GOLDEN, 1959
	<i>B. procumbens</i>	GOLDEN, 1959
	<i>Beta webbiana</i>	GOLDEN, 1959
	<i>Albizzia julibrissim</i>	SCHNIDLER, 1958
	<i>Vitis Solonis</i>	LINDER, 1960
	<i>V. chamini</i>	LINDER, 1960

(DGO)=2.4–4.2  $\mu\text{m}$  (2.8  $\mu\text{m}$ , SD=0.9) from base of stylet; spicules=31.2–33.6  $\mu\text{m}$  (32.7  $\mu\text{m}$ , SD=1.2); gubernaculum=7.2–9.6  $\mu\text{m}$  (8.4  $\mu\text{m}$ , SD=1.2); tail length=14.4–16.2  $\mu\text{m}$  (15  $\mu\text{m}$ , SD=1).

**Larvae** (67). Length=367–443  $\mu\text{m}$  (421.7  $\mu\text{m}$ , SD=12.3); width=13.8–15.6  $\mu\text{m}$  (14.7  $\mu\text{m}$ , SD=0.46); a=22.8–32.2 (28.3  $\mu\text{m}$ , SD=2.7); b=5.2–6.1 (5.8, SD=2.7); c=8.1–8.7 (8.35), SD=0.18); stylet length=12–13.2  $\mu\text{m}$  (12.3  $\mu\text{m}$ , SD=0.5); dorsal oesophageal gland orifice (DGO)=2.4–3.9  $\mu\text{m}$  (2.9  $\mu\text{m}$ , SD=0.54) from base of stylet; center of medial bulb=52.8–60  $\mu\text{m}$  (54.5  $\mu\text{m}$ , SD=0.45); head height=3–3.6  $\mu\text{m}$  (3.3  $\mu\text{m}$ , SD=0.3); hw/hh ratio=1.3–1.6 (1.5, SD=0.1); tail length=49.2–52.8  $\mu\text{m}$  (51  $\mu\text{m}$ , SD=1.4); hyaline tail terminal=9.6–14.4  $\mu\text{m}$  (12.2  $\mu\text{m}$ , SD=1.9).

*Meloidogyne thamesi gyulai* subsp. n. is described and illustrated from specimens obtained from tomato from Gyula (South-East Hungary). *M. thamesi gyulai* resembles *M. thamesi thamesi*, in the structure of the female perineal pattern showing a round arch with distinctive broken striae near the tail tip above the anus and also in the labial and posterior body structure of males as well as in the tail length of the larvae, but the adult females and males are more than one and a half times longer and their stylets shorter than in *M. thamesi* measured by DABAJ (1990) in Hungary.

For the present, I regard *M. thamesi gyulai* as a local race. Further studies, including electron microscopic investigations and enzyme electrophoresis are necessary to decide whether our nematode is a subspecies of *thamesi* or a separate species close to that.

Specimens on slides: adult female perineal patterns, female stylets as well as males and larvae were deposited in C. A. B. International Institute of Parasitology, England (IIP No. 10/93 [1–14], and Plant Health and Soil Conservation Institute at Hódmezővásárhely, Hungary.

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Table 2. Comparison between *Meloidogyne thamesi gyulai* and *Meloidogyne thamesi thamesi*

Stage/Characters	<i>Meloidogyne thamesi gyulai</i>	<i>Meloidogyne thamesi</i> (WHITEHEAD, 1968)	<i>Meloidogyne thamesi</i> (DABAJ, 1990)
<b>Females:</b>			
Length	1095 $\mu\text{m}$ (918–1667.5)	590 $\mu\text{m}$ (514–703)	—
Width	633.8 $\mu\text{m}$ (344–826)	409 $\mu\text{m}$ (331–534)	—
Stylet length	14.7 $\mu\text{m}$ (14.4–15.6)	17 $\mu\text{m}$ (15–18)	16.5 $\mu\text{m}$ (15.1–17.7)
Stylet knobs	2.3 $\mu\text{m}$ (2.1–2.4)	3 $\mu\text{m}$	—
DOG*	2.8 $\mu\text{m}$ (2.4–3.6)	4 $\mu\text{m}$ (3–5)	5.5 $\mu\text{m}$ (4.2–6.3)
<b>Males:</b>			
Length	2028 $\mu\text{m}$ (1728–2530)	1526 $\mu\text{m}$ (1081–1804)	—
Stylet length	22.6 $\mu\text{m}$ (19.6–25.2)	24.9 $\mu\text{m}$ (20.5–28.1)	22.4 $\mu\text{m}$ (20.1–23.3)
DOG	2.8 $\mu\text{m}$ (2.4–4.2)	—	3.8 $\mu\text{m}$ (3.3–4)
Spicules	32.7 $\mu\text{m}$ (31.2–33.6)	25.7 $\mu\text{m}$ (21.6–28.1)	31 $\mu\text{m}$ (29.7–32.2)
Gubernaculum	8.4 $\mu\text{m}$ (7.2–9.6)	9.2 $\mu\text{m}$ (7.9–10.8)	—
<b>Larvae:</b>			
Length	421.7 $\mu\text{m}$ (367.2–443.7)	432 $\mu\text{m}$ (410–476)	409 $\mu\text{m}$ (372.7–441)
Stylet length	12.3 $\mu\text{m}$ (12–13.2)	11.1 $\mu\text{m}$ (10.2–12.7)	—
DOG	2.9 $\mu\text{m}$ (2.4–3.9)	—	—
Tail length	51.0 $\mu\text{m}$ (49.2–52.8)	53 $\mu\text{m}$ (50–58)	—
Hyaline tail terminal	12.2 $\mu\text{m}$ (9.6–14.4)	—	14.8 $\mu\text{m}$ (12.5–18.6)

\* Dorsal oesophageal gland orifice.

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