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FIRST RECORD OF THE YELLOW BEET CYST NEMATODE (*HETERODERA TRIFOLII*) IN ITALY

by

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Summary. A population of the yellow beet cyst nematode, *Heterodera trifolii*, parasitizing sugarbeet and found in Italy (Piedmont, Alessandria province) is described and illustrated. It is the first record of the species for Italy.

In 1997 in the Piedmont region at San Michele, a hamlet near Alessandria, a population of cyst nematode, morphologically resembling *Heterodera trifolii* Goffart, was recovered from soil samples collected in sugarbeet fields, where the crop appeared severely damaged.

Heterodera schachtii Schmidt, the sugarbeet cyst nematode, was known as the only species of the genus reproducing on sugarbeet, but in 1975 dense populations of *H. trifolii*-like were first discovered in several sugarbeet fields in Brabant, Belgium (Maas *et al.*, 1976). This type of nematode, frequently found associated with beet also in the southern part of the Netherlands (Maas and Heijbroek, 1982), was identified as a host race of *H. trifolii* reproducing on beet and indicated as *H. trifolii forma specialis beta* (Maas *et al.*, 1982). It is commonly called "the yellow beet cyst nematode" (YBCN) with a geographical distribution limited to certain European countries namely the Netherlands, southern Sweden (Andersson, 1984), Switzerland (Vallotton, 1985) and Germany, in a province close to the Netherlands (Schlang, 1990).

The Italian population originating from Piedmont and reproducing on sugarbeet showed most features in common with YBCN. Morphological and morphometrical characters of this population are reported.

Materials and methods

The cyst nematode population was reared in a glasshouse maintained at 26-28 °C on sugarbeet, *Beta vulgaris* L., cv. Asso.

Eggs were measured from fixed material. Juveniles emerging from cysts, placed in distilled water and incubated at 25 °C in the dark, were relaxed at 65 °C for two minutes, fixed in cold 4% formaldehyde and processed to glycerol. Whole cysts were sonicated in distilled water for 30 seconds and fixed in 4% formaldehyde; vulva cones were excised and mounted in Canada balsam.

All measurements are reported in µm; for each value arithmetic mean, standard deviation and range were calculated.

Description

Measurements of the nematode were compared with those of the other YBCN populations described in Europe (Tables I and II).

Eggs with second stage juveniles ($n=20$): length $116.5\ \mu\text{m} \pm 6.5$ (102.9-127.1); width $52.5\ \mu\text{m} \pm 1.9$ (49.6-56.9); ratio of length and width $= 2.2 \pm 0.2$ (1.8-2.6). Eggs oblong with round ends. Juveniles folded in the egg 4.5 to 6.25 times.

Second stage juveniles ($n=32$): body tapering posteriorly, with tail straight or ventrally bent in relaxed juveniles. Cuticular annulation on body distinct, lateral field not areolated, marked by four incisures approximately $1/4$ - $1/5$ of the body width. Lip region, with one annule, slightly offset from the body. Stylet robust, anchor shaped, anterior surfaces of knobs deeply concave (Fig. 1A). Dorsal oesophageal gland orifice opening $5.1\ \mu\text{m} \pm 1.6$ (3.6-8.5) behind stylet base. Hemizonid, two annules long, located immediately anterior or 1-2 annules behind excretory pore. Genital primordium, long $19.4\ \mu\text{m} \pm 2.7$ (12.1-24.2) and wide $10.2\ \mu\text{m} \pm 1.4$ (7.3-12.1), located at $53.7\% \pm 2.2$ (47.4 ± 58.3) of body length from anterior end. Tail conoid, gradually tapering to a narrowly rounded non annulated tail tip (Fig. 1B), sometimes with a slightly swollen end. In some cases refractive globules (1-6) were present in the hyaline part of the tail.

Cysts: basically lemon shaped with terminal area protruding (Fig. 2). Young females white passing through an intermediate pale yellow phase then changing from white to brown. Ambifenestrated (Fig. 3A); vagina large sheaf-like; underbridge long, very heavy, strongly pigmented with bifurcate ends extending across the cone; prominent and brown bullae as projections irregular in shape and length, scattered below the fenestra (Figs. 3B; 3D). Occasionally a finger-like bulla was visible within the vulval cone on the cyst wall lying just beneath the anal opening (Fig. 3C). This last appearing as a

small narrow slit located in a depressed and elongated area (anal basin) smoother than in remaining cuticle. Between the vulval area and the anal basin few large zig-zag cuticular perineal ridges were visible. Sometimes a second underbridge, just below the fenestra, was observed running at right angle to the other. One cyst contained an average of 195 eggs and juveniles.

Surface females and newly formed cysts were covered by a thin subcrystalline layer.

No males were found.

Discussion and conclusions

The Italian *H. trifolii*-like population attacking sugarbeet, found recently at San Michele (AL), is very similar to *H. trifolii* reproducing on clover (Mulvey and Anderson, 1974; Wouts and Sturhan, 1974; Mulvey and Golden, 1983). However, it can be distinguished by its host preference and biometric data of juveniles and cysts. The fenestra length appears to be shorter than that of other *H. trifolii* populations (30.3 - $48.4\ \mu\text{m}$ vs 36.0 - $60.0\ \mu\text{m}$). The Italian population, except for cyst characters, is very similar in measurements to the English *H. trifolii* population (28-Engl-6) reproducing on clover as described by Hirschmann and Triantaphyllou (1979).

The Italian population has many features in common with the YBCN, discovered for the first time in Belgium (Maas *et al.*, 1976), but differs from the other populations of this species as follows: the mean egg length is shorter than that reported for other European populations (Andersson, 1984; Steele and Whitehand, 1984; Schlang, 1990); the mean values of the juvenile morphometric characters are the same or lower than those from Sweden and Germany, but higher than those from the Netherlands. According to previous descriptions (Maas *et al.*, 1982; Andersson, 1984) the anterior faces of the juvenile stylet knobs from Netherlands and Sweden

TABLE I - *Measurements (mean±standard deviation and range in µm) of juvenile populations of Heterodera trifolii.*

	Italy	Netherlands ⁽¹⁾		Sweden ⁽²⁾	Germany ⁽³⁾
Body length (L)	583.9±28.6 (525.1-671.6)	574±35.2 553±27.3 568±36.9	547.1±7.5 (493.2-628.4) 578.5±3.2 (513.5-617.6)	607±19.6 (560-648)	624±21.9
Body width (W)	22.2±1.4 (16.9-24.2)				20.3±0.6
Body width at median bulb valve level				20.7±0.73 (19.4-22.8)	
Median bulb valve to head end (MB)	90.8±6.0 (76.2-102.9)			92.7±4.5 (80.8-101.2)	91.3±2.6
Junction oesophagus intestine to head end	111.4±5.5 (94.4-123.4)				
Oesophageal glands to head end	192.4±9.4 (171.8-205.7)				
Lip length	5.7±0.6 (4.2-6.1)			5.7±0.32 (5.2-6.4)	
Lip width	10.9±0.1 (10.3-10.9)			11.3±0.41 (10.4-12.0)	
Stylet length (STY)	29.6±1.1 (25.5-30.9)	28±0.8		30.5±0.95 (28.8-32.0)	30.2±0.5
Stylet knobs height	3.6±0.3 (3.0-4.8)			4.6±0.38 (3.8-5.2)	
Stylet knobs width	6.9±0.4 (6.1-7.3)			5.9±0.27 (5.2-6.6)	
Excretory pore to head end	129.0±4.8 (119.8-144.0)				
Tail length	72.3±4.3 (65.3-82.3)		69.9±0.7 (63.5-75.7)	74.2±4.7 (64.4-82.0)	
Body width at anus	14.8±1.1 (13.3-16.9)		14.1±0.2 (12.8-14.9)		
Hyaline part length (H)	40.6±3.6 (35.1-47.2)	38±3.7	37.9±0.7 (33.8-47.3)	42.3±2.6 (36.0-47.6)	42.9±2.1
a	26.4±2.1 (22.9-35.2)				
b	5.2±0.3 (4.8-6.2)				
b'	3.0±0.3 (2.3-3.9)				
L/MB	6.4±0.6 (4.5-8.2)				
c	8.1±0.4 (7.0-8.9)				
c'	4.9±0.3 (4.1-5.5)		5.0±0.1 (4.3-5.5)		
H/STY	1.4±0.1 (1.2-1.6)				
Tail length/H	1.8±0.2 (1.2-2.2)				

Data from: ⁽¹⁾Maas *et. al.* (1982) and Steele and Whitehand (1984); ⁽²⁾Andersson (1984); ⁽³⁾Schlang (1990).

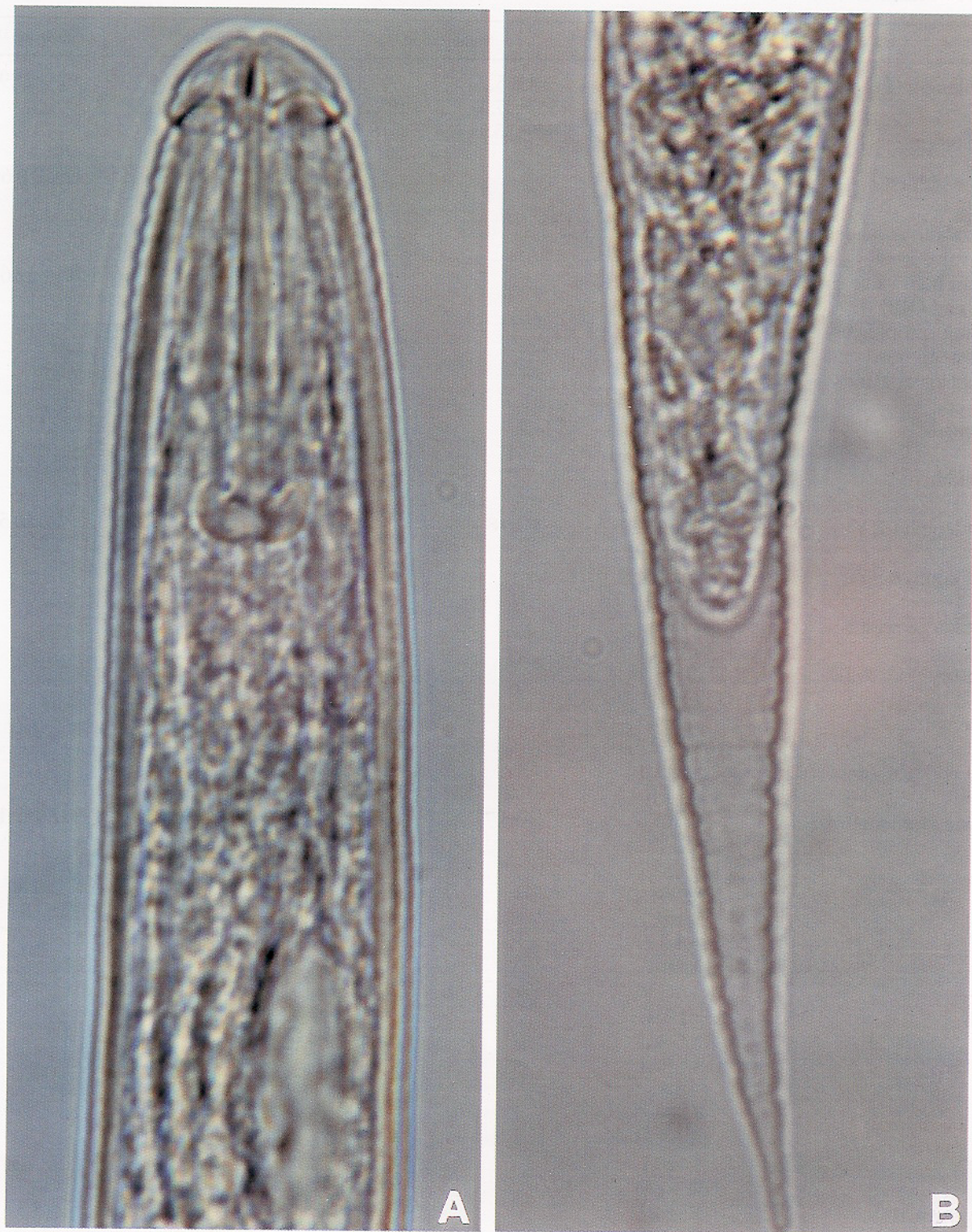


Fig. 1 - Photomicrographs of the yellow beet cyst nematode *Heterodera trifolii* from Italy: A, second stage juvenile anterior region showing stylet knobs deeply concave anteriorly, dorsal; B, second stage juvenile posterior region, lateral.

TABLE II - Measurements (mean±standard deviation and range in µm) of cysts and vulval cone structures of *H. trifolii* populations.

	Italy	Netherlands ⁽¹⁾	Sweden ⁽²⁾	Germany ⁽³⁾
Body length (without neck)	877.7±117.6 ^a (624.0-1080.0)	(568.3-1136.7)	857±162 (550-1105)	873±74.5
Body width	497.5±112.8 ^a (168.0-720.0)	(310.0-671.7)	518±106 (293-702)	487±56.3
Body length/Body width ratio	1.8±0.2 (1.3-2.2)			1.8±0.1
Fenestra length	44.3±5.2 (30.3-54.5)		52±6.0 (42-72.5)	
Fenestra width	38.4±3.9 (30.3±48.4)		38±6.8 (29.5-49.5)	
Vulval bridge width	6.4±1.2 (3.6-8.5)		4.8±1.3 (2.0-8.0)	
Vulval slit length	47.9±4.0 (39.9-56.9)		56.5±4.3 (48.5-67)	
Vulva-anus distance	57.7±8.3 (42.4-78.7)		56±5.3 (44-69)	
Underbridge length	108.6±11.2 (84.7-127.1)		127±19.0 (97-170)	
Underbridge width	25.9±5.3 (15.7-33.9)		36±4.2 (30-48)	
Underbridge depth	80.6±8.1 (66.6-96.8)			

Data from: ⁽¹⁾Steele and Whitehand (1984); ⁽²⁾Andersson (1984); ⁽³⁾Schlang (1990).

^an=50; n=32 for other measurements of the Italian population.

are very deeply concave; this character is not recorded in the German population.

The vulval cyst cone structures, as fenestra, vulval slit and underbridge length, are shorter than those of YBCN Swedish population.

The YBCN, which belongs to the *H. trifolii* parthenogenetic complex appears to be of economic importance only in the Netherlands where it damages beets, cabbages and peas (Sikora and Maas, 1985).

Under controlled conditions the nematode is able to multiply on beets grown either in sandy or in heavy clay soils, its multiplication rate on sugarbeet being nearly three times that of *H. schachtii* (Maas and Heijbroek, 1982). In hat-

ching tests YBCN performed better at warmer temperatures (optimum temperature is 25 °C) than *H. schachtii* and completed more generations during a favorable crop season. Its host range includes species of the families Cruciferae, Chenopodiaceae, Polygoniaceae and Caryophyllaceae, but reproduction also occurs on a few species of Leguminosae (Maas and Heijbroek, 1982; Andersson, 1984; Vallotton, 1985; Schlang, 1990).

In conclusion YBCN can be considered as a new potentially serious pest of sugarbeet and other vegetable crops in Italy. For this reason it would be useful to undertake investigations on its distribution, host range and biology.



Fig. 2 - Cysts of *H. trifolii* from Italy.

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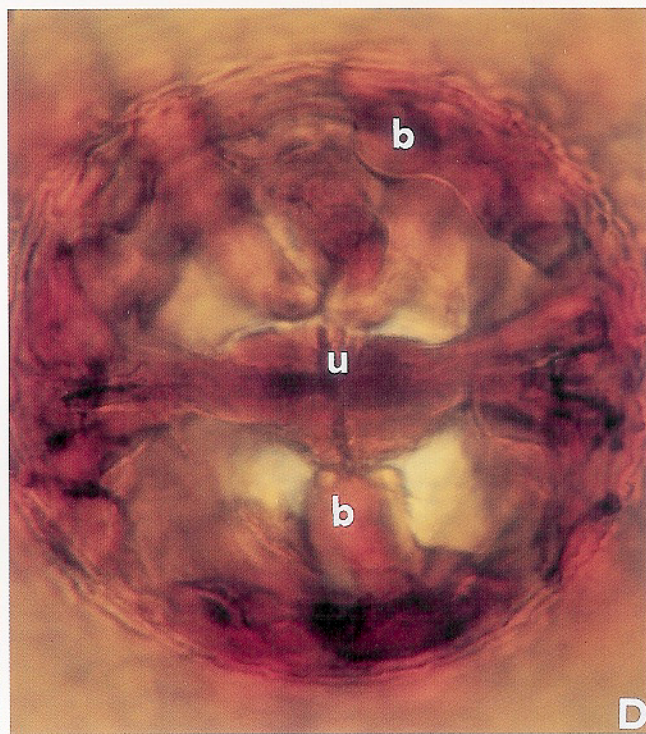
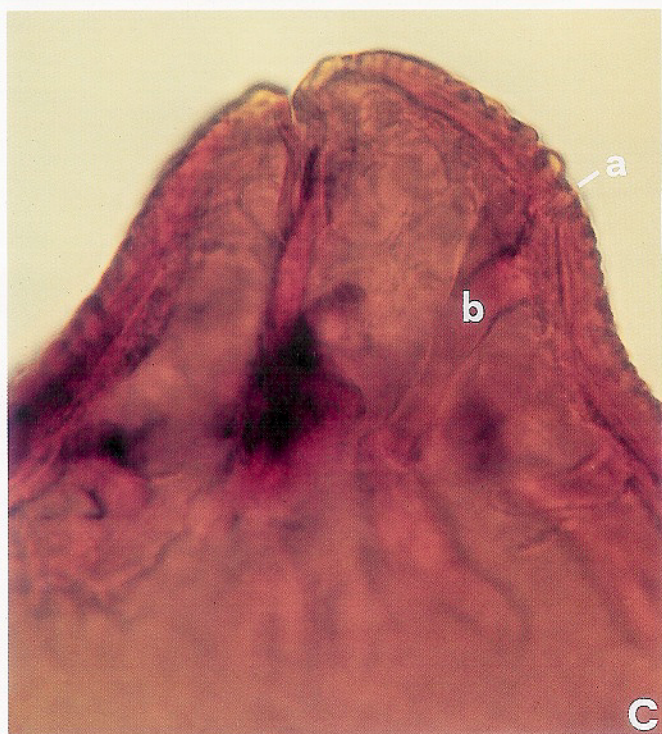
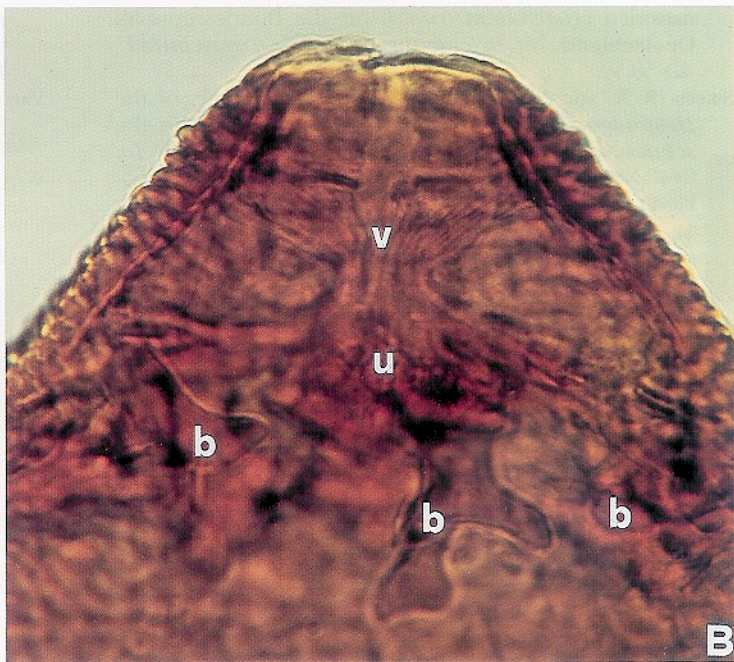
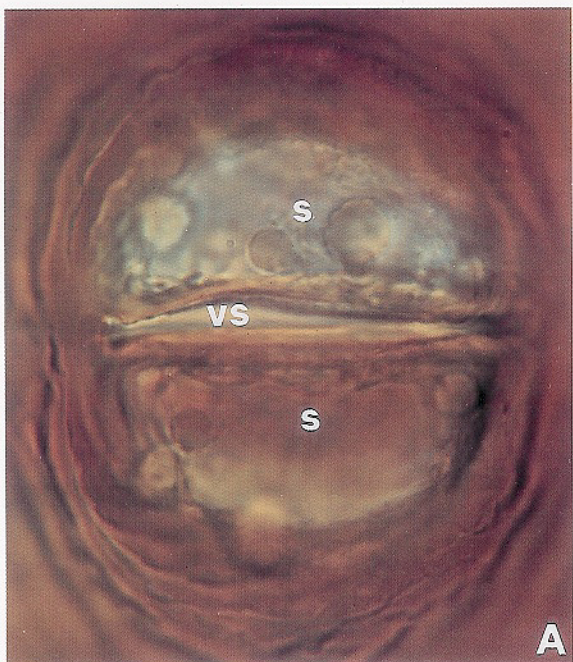


Fig. 3 - Photomicrographs of cyst cones of *H. trifolii* from Italy: A, top view showing semifenestrae (s) and vulval slit (vs); B, dorso-ventral view showing sheaf-like vagina (v), heavy underbridge (u) and bullae (b); C, lateral view showing anal opening (a) and just beneath a finger-like bulla (b); D, as A at lower focus showing underbridge (u) below fenestra and prominent bullae (b).

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