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HETERODERA LATIPONS N. SP., A CEREAL CYST NEMATODE FROM THE MEDITERRANEAN REGION

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Heterodera latipons n. sp., which was found on the roots of wheat and barley in Israel and Tripoli, can also infest oats and rye. The cysts resemble those of *H. turcomanica* Kirjanova & Shagalina, 1965, but lack the gland-like structures on the cyst wall and the eggs are larger, 112 × 48 μ, instead of 77 × 40 μ. Eggs and larvae are smaller than those of *H. avenae* and the fenestration of the cyst cone is different.

Stunted, chlorotic wheat plants with *Heterodera* cysts on the roots were sent in March 1960 by Dr. E. Pucci, Chief of the Phytopathology Section, Nazara of Agriculture, Tripoli, for identification of the nematodes. The material was examined by Mr. J. J. Hesling who observed morphological differences between the cysts and contained larvae and those of *H. avenae* Woll. 1924 (Hesling, 1965). He also observed that the cysts were dispersed fairly regularly along the wheat roots rather than several together in a "knot" of lateral roots as with *H. avenae* on oats. Minz (1956) recorded *H. avenae* on wheat in Israel in soil conditions thought to be too hot and dry for it. In 1960 Ing. Minz, Head of the Division of Nematology, Rehovot, kindly sent soil from the infested area (Gilat) which had been stored dry since 1956: in May 1961 it was planted with wheat, variety Capelle, in pots. Six cysts found on the wheat roots differed morphologically from *H. avenae* but resembled those from Tripoli.

In April 1962 barley roots and soil were received from Dr. Pucci, collected as was the first lot from Azzahra, 40 km from Tripoli. The material contained two distinct types of cysts and larvae, one resembling those found in 1960, and the other was *H. avenae*. The finding of the two types living together on barley confirmed the opinion that a species distinct from *H. avenae* existed on cereals in the Mediterranean region. More material was then obtained from Israel (again by the kind co-operation of Ing. Minz) and cultures were set up. A study of the nematodes that developed made it clear that the species was an undescribed one. The following description is based on specimens from roots of wheat grown in soil infested with cysts from Gilat, Israel. Females, larvae and males were killed by gentle heat, fixed in T.A.F., transferred to warm lactophenol with 0.005% cotton blue and then by Baker's method to glycerine for permanent mounts. Cyst cones were mounted in either euparal or Canada balsam.

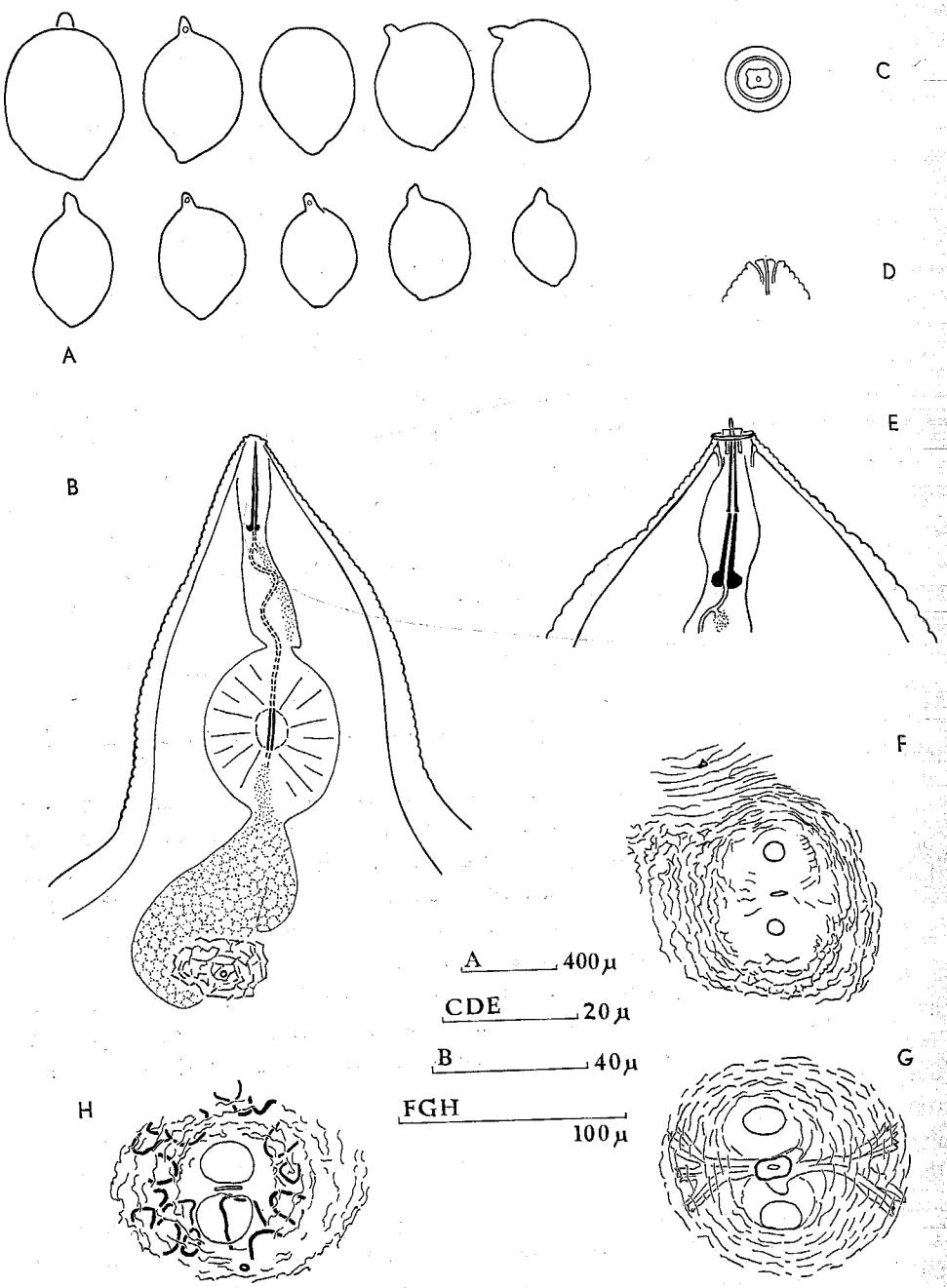

Fig. 1. *Heterodera latipons* n. sp. Female. A. Mature females. B. Anterior end with excretory pore C. Face view. D. Head, dorso-ventral. E. Head and stylet, lateral. F. Cuticle of vulval region and anus in white cyst. G. Fenestralia and underbridge in brown cyst. H. Fenestralia and bullae in *H. avenae* brown cyst.

C

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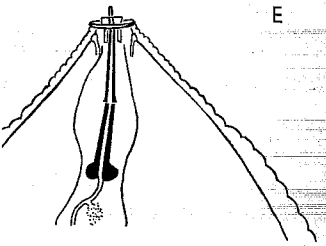

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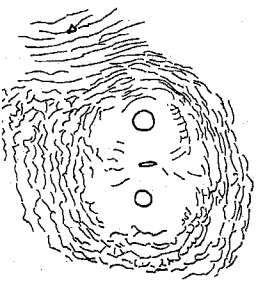

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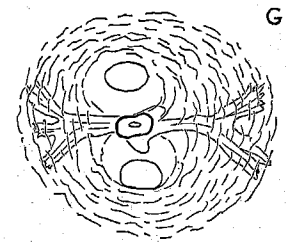


G

. Anterior end with excretory pore
al. F. Cuticle of vulval region and
cyst. H. Fenestralia and bullae in

Female

Measurements of mature females in glycerine:

L (excluding neck) (n = 25): 348-645 (525) μ.

Breadth (25): 277-510 (414) μ.

Neck (20): 58-103 (83) μ.

Stylet (11): 21-28 (25) μ.

Opening of dorsal oesophageal gland duct from stylet base (14): 2.7-4.7 (3.7) μ.

Measurements of holotype female: L = 541 μ, breadth = 438 μ, neck = 103 μ, corpus = 35 × 30 μ, anus to vulva (shortest distance) = 49 μ, valve plates 10 μ long, 9 μ wide.

Mature females and cysts ovoid, with a small terminal vulval cone and well-defined neck sometimes inclined at an angle to the long axis of the body. Ratio of length to breadth of body about 1.3. Pattern of cuticle an angular network of ridges tending to run parallel to one another in the neck region (Fig. 3 a and b). Excretory pore on the "shoulder" where body begins to enlarge behind neck, with cuticular pattern tending to encircle it (Fig. 1, B). Cuticle 9-15 μ thick on body, 5-8 μ on neck and abruptly thinner (0.4-0.8 μ) forward from a point opposite middle of stylet (Fig. 1, E).

Head with a four-lobed "cap" (Fig. 1, C) followed by a narrow, forwardly-projecting annule. Amphid openings, seen only in dorso-ventral view, between cap and this annule (Fig. 1, D). Anterior cephalids close behind head (Fig. 1, E), posterior ones not seen.

Mature females covered with a white sub-crystalline layer that is easily detached when the body wall becomes tough and brown. Older females become filled with eggs: a small egg sac was sometimes observed but without eggs. As with many *Heterodera* species, a golden-brown, transparent exudate collected round the head and neck of some females when they were removed from their feeding sites.

Oesophagus and reproductive organs typical of the genus. Procorpus constricted at its junction with the median muscular corpus which measures 29-47 μ (36 μ, mean of 10) long by 23-40 μ (32 μ) broad. The valve plates are 7-10 (9) μ long by 7-9 (8) μ broad. Vulva terminal and anus sub-terminal about 50-60 μ distant (Fig. 1, F).

Cysts

Dark to mid-brown beneath the white sub-crystalline layer, fully exposed on the roots or slightly embedded, leaving a small "crater" in the root when they are dislodged. Fenestration different from that of all other described species in that the semi-fenestrae are separated by a distance greater than the fenestral width, and the vulval slit is short (Fig. 3, c, d). There is a strong underbridge with a pronounced thickening in the middle and the ends splayed (Fig. 1, G, Fig. 3 e, f

and Fig. 4 b). Bullae usually absent, but a few sometimes present at the level of the underbridge (Fig. 3 e).

Measurements of ten specimens:

fenestral length (1): 58-76 (67) μ
fenestral width (w): 15-27 (21) μ
semi-fenestral length (c): 13-19 (17) μ
vulval slit (s): 6-9 (7) μ
width of vulval bridge (b): 18-39 (33) μ
underbridge length (ul): 80-125 (103) μ
underbridge width (uw): 7-14 (11) μ

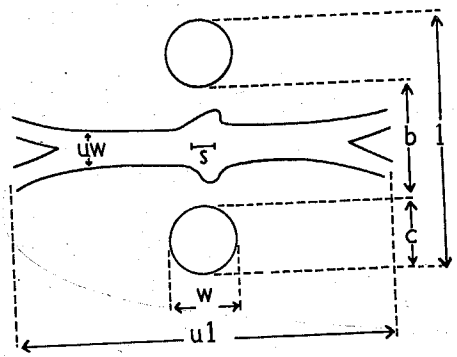


Fig. 2. Diagram of fenestral region to show how the parts are measured. l = fenestral length; w = fenestral width; c = semifenestral length; s = vulval slit; b = width of vulval bridge; ul = underbridge length; uw = underbridge width.

Eggs

25 embryonated eggs from mature females:
length: 100-124 (112) μ
breadth: 44-56 (48) μ
Larva folded four times.

Male

Measurements:
L (n = 25): 960-1406 (1167) μ
body width (25): 25-32.5 (28.5) μ
a (25): 32-51 (41)
b (10): 8.9-11.3 (10.3) (oesophagus measured to base of median bulb)
stylet length (20): 22-29 (26.7) μ
stylet knobs (10): 4.2-5 (4.6) μ across; 1.7-2.3 (2.0) μ high
spicules (10): 32-36 (34) μ, measured along arc.

Head offset, 11.6 μ wide, 6.2 μ high (mean of 10), with four post-labial annules. Amphid openings small, lateral head sectors slightly narrower than the others with a small papilla on each sector. Basal annule with 18-19 longitudinal

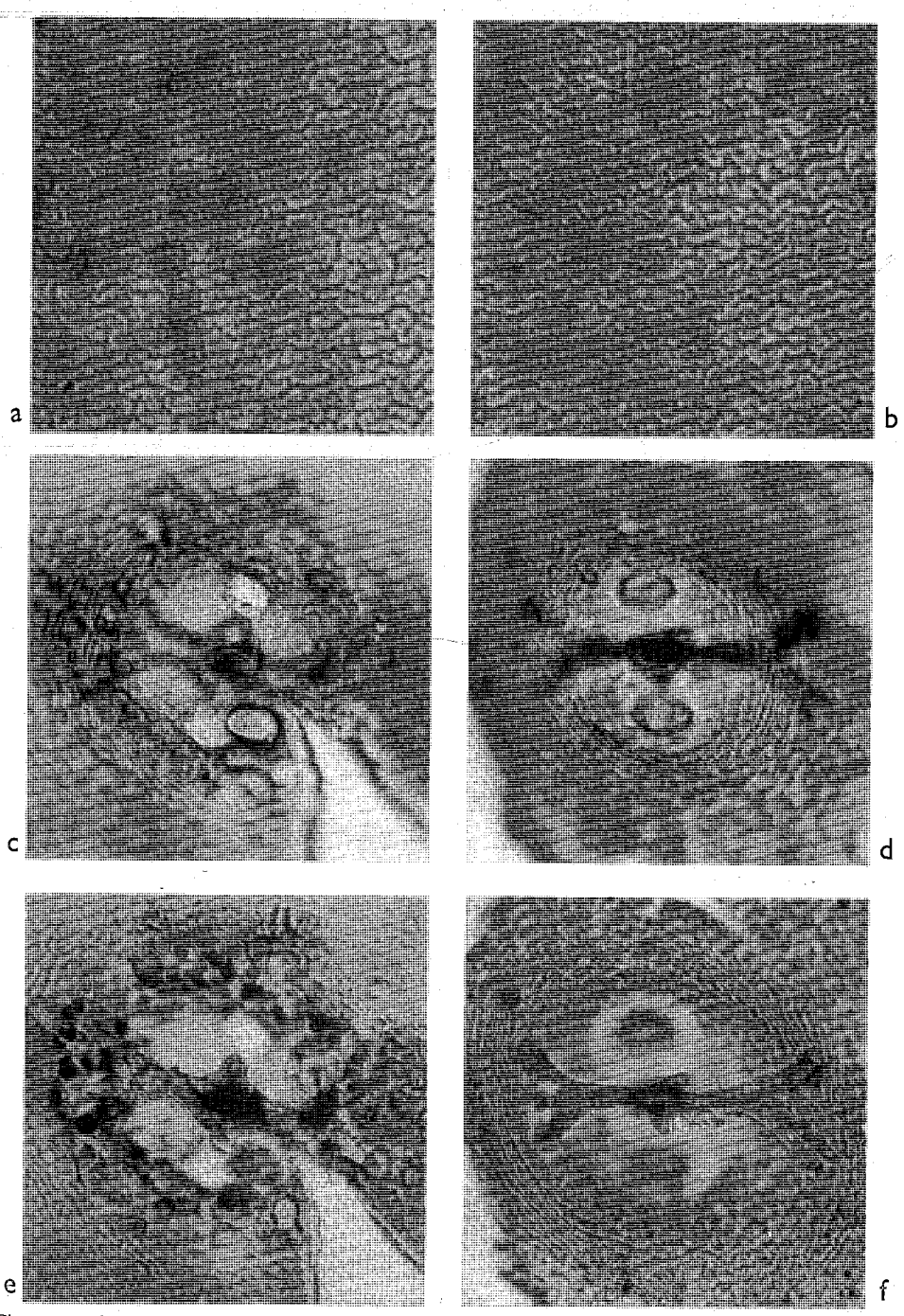
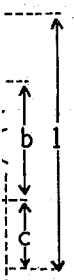


Fig. 3. *H. latipons* n. sp. a) Cuticular pattern towards mid-body. — b) Cuticular pattern in neck region. — c) End view of vulval cone showing vulval slit and semifenestrae. — d) End view of vulval cone showing underbridge and semifenestrae. — e) Inside view of c showing underbridge and bullae. — f) Inside view of d with underbridge but no bullae. (Photo: S. A. Clark)

etimes present at the level



measured. l = fenestral length;
it; b = width of vulval bridge;
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10), with four post-labial
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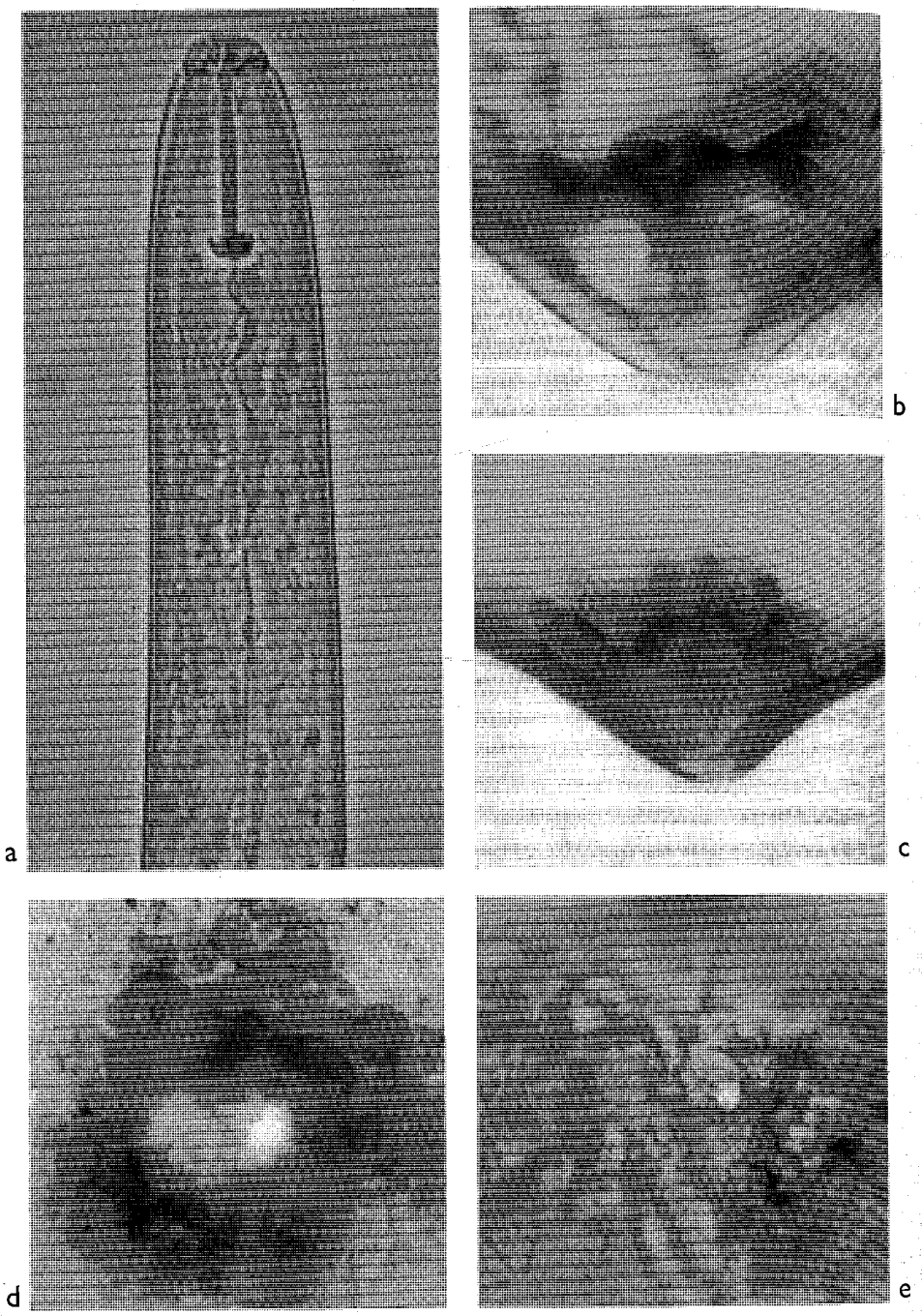
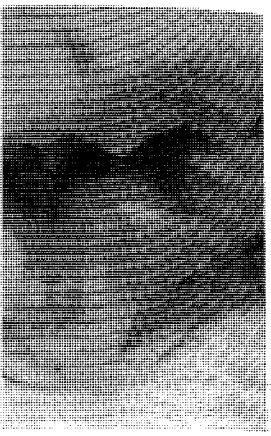


Fig. 4. *H. latipons* n. sp. anterior end of infective larva. — b) *H. latipons* n. sp. vulval cone in dorso-ventral view showing vagina and underbridge. — c) *H. avenae* vulval cone with bullae crowded into cone. — d) *H. avenae* inside view of vulval cone. — e) *H. avenae* surface of vulval cone showing vulval slit and semifenestrae relatively close together. (Photo: a & c., C. C. Doncaster; b, d, & e, S. A. Clark)



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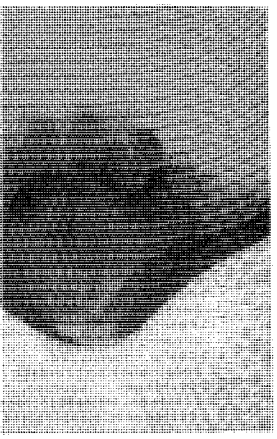

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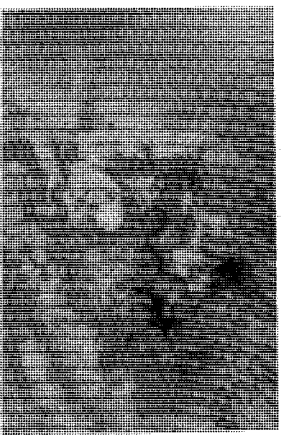

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I. latipons n. sp. vulval cone in
avenae vulval cone with bullae
- e) *H. avenae* surface of vulval
er. (Photo: a & c., C. C. Don-

grooves (Fig. 5, L). Four longitudinal incisures on lateral field; outer bands irregularly areolated throughout the body (Fig. 5, C). Hind part of body always twisted in dead specimens, as shown by the direction of the lateral field (Fig. 5, E). Mouth spear with well-defined knobs, which are concave anteriorly: anterior conical part about equal in length to shaft and knobs together.

Anterior cephalids at the level of the second or third neck annule and posterior ones at mid-stylet level. In three specimens the dorsal oesophageal gland duct opened 3-5 μ behind the stylet knobs. Hemizonid about three annules wide and at two body widths behind the median bulb; excretory pore 3-6 annules behind it (Fig. 5, B). No hemizonion seen. The specimens examined have a single testis, apparently uniformly packed with sperm. Spicules slightly bow-shaped, with a broad anterior end, but narrow and apparently twisted in the posterior part (fig. 5, D & E). Gubernaculum trough-shaped, about 8 μ long. Phasmids ad-anal and tail less than one anal body-width long.

Larvae (n = 25)

L: 401-478 (454) μ
breadth: 19-22 (20.5) μ
a: 20-25 (22.5)
anterior end to centre of median bulb: 59-75 (67) μ
b^m (= overall body length/distance from lips to valve plates in median oesophageal bulb): 6-8 (6.8)
tail: 42-54 (47.8) μ
c: 8-11 (9.5)
body width at anus: 14-16 (15) μ
tail length/anal body width: 3.0-3.7 (3.2)
length of hyaline tail tip: 20-31 (26.5) μ
stylet: 23-25 (23.8) μ
hyaline tail tip/stylet length: 0.8-1.3 (1.1)
opening of dorsal gland duct from stylet base: 4-5 (4.6) μ
head width (n = 10): 8.4-9.2 (9) μ
head height (10): 3.8-4.2 (4) μ

Body slightly curved dorso-ventrally when killed by heat. Offset head with three post-labial annules. In many specimens the cuticle in the neck region appears slightly inflated for a distance of 7-8 annules behind the head (Fig. 4, a). Lateral field 1/4 to 1/5 width of body with four incisures, starting at about mid-stylet level and ending mid-way along the tail; outer bands areolated (Fig. 5, I, K). Phasmids 2-3 annules behind anus. Stylet with well-developed, anteriorly concave knobs. Oesophageal gland lobe overlying intestine latero-ventrally for a distance equal to about 39% of body length; dorsal gland anterior to and appearing more finely granular than the two sub-ventrals. Hemizonid distinct but no hemizonion seen. Excretory pore opening immediately behind or apparently at same level as

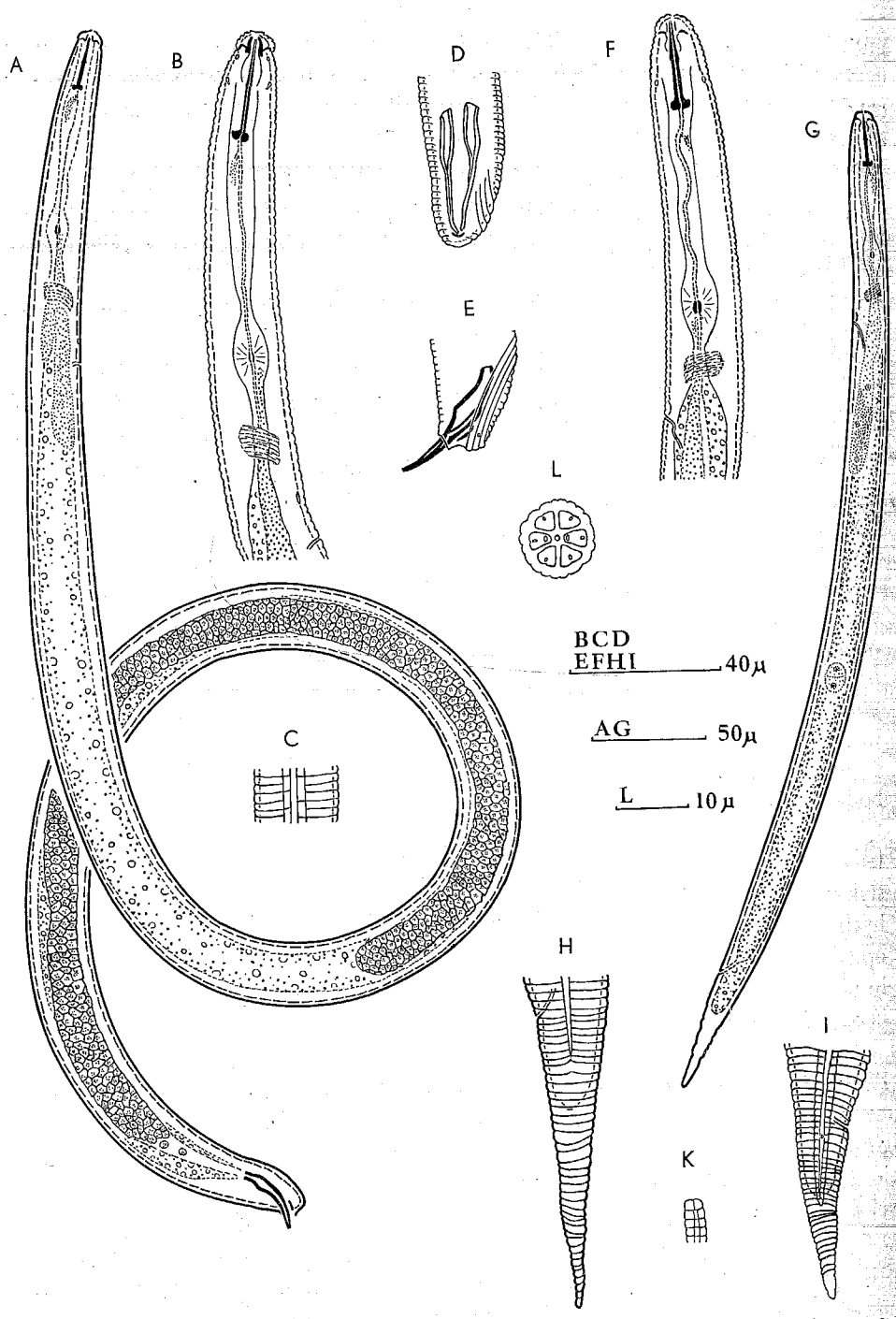
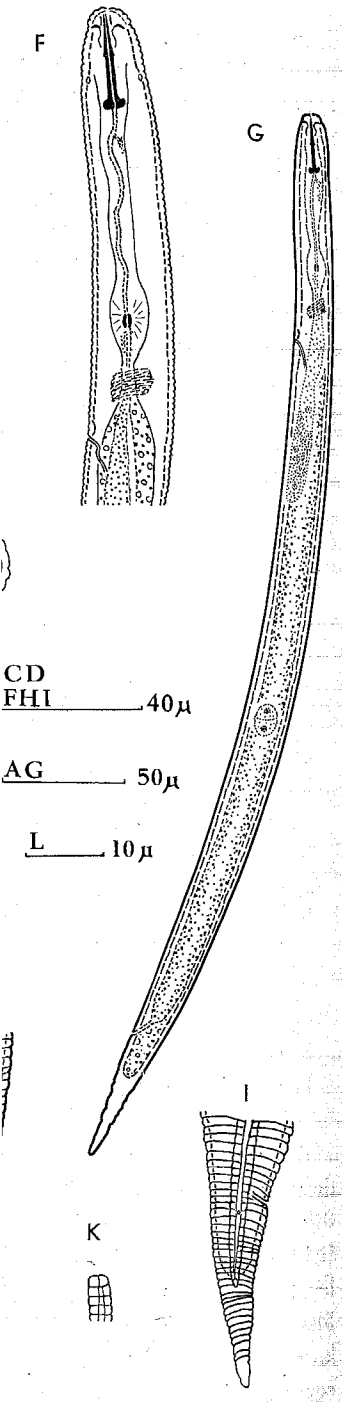


Fig. 5. *Heterodera latipons* n. sp. A. Whole male. B. Male oesophageal region. C. Lateral field of male at mid body. D. Spicules ventral. E. Spicules lateral. F. Larval oesophageal region. G. Whole larva. H. *H. avenae* larval tail. I. *H. latipons* larval tail. K. Anterior end of lateral field in *H. latipons* larva. L. Face view of male head at level of fourth annule.



ophageal region. C. Lateral field of
rval oesophageal region. G. Whole
Anterior end of lateral field in
evel of fourth annule.

hemizonid. Posterior cephalids obscure but probably at the eighth neck annule; anterior ones not seen. Rectum nearly as long as anal body width. Gonad initial consisting of two cells, situated at about 60% of body length from anterior end.

Differential diagnosis

H. latipons n. sp. differs from all known species of the genus, except *H. turcomanica* Kirjanova & Shagalina, 1965, in having a strong underbridge and almost circular semi-fenestrae separated by a distance greater than the diameter of a single semi-fenestra. The vulval slit is also shorter than that of any other species except *H. turcomanica,* in which it is 9-14 μ long, and *H. avenae* in which it is 12 μ. The cysts of the new species differ from those of *H. turcomanica* in the absence of the small gland-like sacs beneath the cuticle that are described for that species, and in the frequent absence of bullae. The eggs of *H. turcomanica* averaged 77 × 40 μ as compared with 112 × 48 μ in *H. latipons.* Neither hatched larvae nor males of *H. turcomanica* were found and the host plant is not known.

The cysts of *H. latipons* resemble those of *H. avenae* more than any species, except *H. turcomanica,* but in *H. avenae* the semi-fenestrae are closer together, there is no underbridge and there are always prominent bullae crowded into the cone (Fig. 1, H and Fig. 4, c, d & e). Larvae of *H. avenae* are longer (575 μ) and have a narrow lateral field with only two longitudinal incisures (Fig. 5, H).

The name *latipons* describes the characteristic wide bridge between the semi-fenestrae in the cyst.

Type host: wheat (*Triticum aestivum* L.): also on oats (*Avena sativa* L.), barley (*Hordeum vulgare* L.) and rye (*Secale cereale* L.).

Distribution

Type locality: Gilat, Israel. Also found at Azzahra, Tripoli and in Bulgaria.

Type slides

Holotype female on slide no. 76/11/1, Nematology Department, Rothamsted Experimental Station.

Paratypes (males, larvae and cyst cones) on slide nos 76/11/2-4 in the same collection. Other specimens deposited at Wageningen (Laboratorium voor Nematologie, Landbouwhogeschool); Nematology Section, U.S.D.A., Beltsville, Maryland, U.S.A.; University of California, Davis, U.S.A. and in the Canadian National Collection of Nematodes, Ottawa.

I am grateful to Prof. Minz and Mrs. Strich-Harari of Rehovot, Israel and Dr. E. Pucci of Tripoli for sending specimens; to Mr. J. J. Hesling of the Glasshouse Crops Research Institute, Littlehampton, for putting his notes at my disposal and to Mr. C. C. Doncaster and Mrs. Sybil A. Clark of Rothamsted for the photographs in Figs. 3 and 4.

RÉSUMÉ

Heterodera latipons *n. sp., un parasite des céréales de la région méditerranéenne*

Heterodera latipons n. sp. rencontré en Israel et en Tripolitaine sur les racines de blé et d'orge, peut également attaquer l'avoine et le seigle. Les kystes ressemblent à ceux de *H. turcomanica* Kirjanova & Shagalina, 1965; il n'y a toutefois pas de structures glanduleuses sur la paroi du kyste et les oeufs sont plus grands (112 × 48 μ contre 77 × 40 μ). Les oeufs et les larves sont plus petits que ceux de *H. avenae* et les fenestrae du cône vulvaire sont différentes.

LITERATURE

HESLING, J. J. (1965). *Heterodera*: morphology and identification. In: Plant Nematology, edit. J. F. Southey, *Tech. Bull. Minist. Agric. Fish. Fd,* No. **7,** 103-130 [See p. 118].

KIRJANOVA, E. S. & SHAGALINA, L. M. (1965). [The Turkmen cyst-forming nematode — *Heterodera turcomanica* Kirjanova et Schagalina, sp. nov. (Nematodes: Heteroderidae)] *Izv. Akad. Nauk turkmen. SSR* [*Ser. biol. Nauk*], **6,** 73-75. [In Russian].

MINZ, G. (1956). Cyst-forming nematodes in Israel. *Pl. Dis. Reptr* **40,** 971-973.

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