

A Key and Diagnostic Compendium to the Species of the Genus *Hoplolaimus* Daday, 1905 (Nematoda: Hoplolaimidae)

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Abstract: An identification key to 29 valid species of *Hoplolaimus* is given. A compendium of the most important diagnostic characters for use in identification of species is included as a practical alternative and supplement to the key. Diagnosis of *Hoplolaimus* is emended and lists of species of the genus, their synonymies, species inquirendae, nomina nuda, and species transferred to other genera are given. *Hoplolaimus sheri*, *H. chambus*, *H. casparus*, and *H. capensis* are recognized as valid species.

Key words: Compendium, diagnostic, Hoplolaimidae, *Hoplolaimus*, identification, key, lance nematode, morphology, Nematoda, taxonomy.

The genus *Hoplolaimus* was established on the basis of a single female by Daday in 1905 when he described *H. tylenchiformis* from a mud hole on Banco Island in the Paraguay river at Asuncion, Paraguay (1). Sher (11) provided the first comprehensive work on the genus, giving historical, morphological, and systematic sections and also a key to eight valid species. Golden (4) included *Hoplolaimus* under the subfamily Hoplolaiminae Filipjev, 1934 along with *Aorolaimus* Sher, 1963, *Scutellonema* Andr assy, 1958, and *Peltamigratus* Sher, 1963. Krall (6) reviewed all the previous work done on the family Hoplolaimidae Filipjev, 1934 and provided details on the morphology and development, phylogenetic relationship, and host-parasite relationship of the species. He accepted three subfamilies within Hoplolaimidae: Hoplolaiminae Filipjev, 1934 with four genera; Rotylenchinae Golden, 1971 with three genera; and Rotylenchoidinae Whitehead, 1958 with two genera. He also gave a key to 18 species of *Hoplolaimus*. Fortuner (3) more recently presented a diagnosis and systematic relationship of the family Hoplolaimidae. Only two subfami-

lies were included within Hoplolaimidae: Hoplolaiminae with eight valid genera, including *Hoplolaimus*, and Rotylenchinae with three genera.

The purpose of this study is to examine in detail representative specimens and published data on *Hoplolaimus* species, to determine the interrelationship of the species, to define the valid and most significant differentiating characters, and to prepare a new key and compendium to facilitate identification of the species.

MATERIALS AND METHODS

Paratype specimens of 10 species (*H. aegypti*, *H. aorolaimoides*, *H. californicus*, *H. clarissimus*, *H. columbus*, *H. concaudajuvencus*, *H. indicus*, *H. magnistylus*, *H. sheri*, and *H. stephanus*) and nontype specimens of five other species (*H. galeatus*, *H. pararobustus*, *H. seinhorsti*, *H. seshadrii*, and *H. tylenchiformis*) were examined from the USDA Nematode Collection at Beltsville, Maryland. Specimens of each species, which ranged in numbers from 1 to over 50, were mounted in glycerine and accompanied by pertinent records. Examinations were made with a compound light microscope, usually at highest magnification, and morphometric data were obtained with an eyepiece micrometer. In evaluation of the species, our own data and the original descriptions of most species, as well as any subsequent redescription or other relevant data, were utilized. All measurements are

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in micrometers (μm) unless otherwise stated.

SYSTEMATICS

Genus *Hoplolaimus* Daday, 1905

Syn. *Nemonchus* Cobb, 1913

Hoplolaimoides Shakil, 1973

Basirolaimus Shamsi, 1979

(Diagnostic data on females and male spicules in Table 2.)

Emended diagnosis: Hoplolaiminae. Female. Large sized nematodes (1–2 mm).

Lip region high, offset, with prominent transverse and longitudinal striae (except *H. cephalus*); cephalic framework massive, basal annule divided into squares. Stylet massive, 31–61 μm , with compact tulip-shaped basal knobs bearing anterior tooth-like projections (except *H. aorolaimoides* with poorly developed anterior projections). Dorsal esophageal gland opening near base of spear knobs (25% or less of spear length). Excretory pore posterior to hemizonid in species with four lines in lateral field (except *H. sacchari*), anterior to

TABLE 1. *Hoplolaimus* species transferred to other genera with their present names and status.

Species	Present name and status
<i>H. aberrans</i> Whitehead, 1960	<i>Scutellonema clathricaudatum</i> (Whitehead, 1959) Germani et al., 1986
<i>H. annulifer</i> de Man, 1921	<i>Criconema annuliferum</i> (de Man, 1921) Micoletzky, 1925
<i>H. aquaticus</i> (Micoletzky, 1913) Menzel, 1917	<i>Hemicycliophora aquatica</i> (Micoletzky, 1913) Loos, 1948
<i>H. bradys</i> Steiner & LeHew, 1933	<i>Scutellonema bradys</i> (Steiner & LeHew, 1933) Andr�ssy, 1958
<i>H. gracilidens</i> Sauer, 1958	<i>Rotylenchus gracilidens</i> (Sauer, 1958) Sauer, 1958
<i>H. quernei</i> (Certes, 1889) Menzel, 1917 (partially)	<i>Criconema giardi</i> (Certes, 1889) Micoletzky, 1925
<i>H. quernei</i> nec Certes, 1889 from Schneider, 1923; from Stefanski, 1924	<i>Ogma menzeli</i> (Stefanski, 1924) Schuurmans Stekhoven & Teunissen, 1938
<i>H. quernei</i> (Certes, 1889) Menzel, 1917 (partially)	<i>Ogma menzeli</i> (Stefanski, 1924) Schuurmans Stekhoven & Teunissen, 1938
<i>H. heideri</i> (Stefanski, 1916) Menzel, 1917	<i>Criconemoides heideri</i> (Stefanski, 1916) Taylor, 1936 (Now species inquirenda)
<i>H. informis</i> Micoletzky, 1922	<i>Criconemella informis</i> (Micoletzky, 1922) Luc & Raski, 1981
<i>H. leiomerus</i> de Guiran, 1963	<i>Aorolaimus leiomerus</i> (de Guiran, 1963) de Guiran & Sher, 1968
<i>H. menzeli</i> Stefanski, 1924	<i>Ogma menzeli</i> (Stefanski, 1914) Schuurmans Stekhoven & Teunissen, 1938
<i>H. morgense</i> (Hofm�nner in Hofm�nner & Menzel, 1914) Taylor, 1936	<i>Criconemoides morgense</i> (Hofm�nner in Hofm�nner & Menzel, 1914) Taylor, 1936 (Now species inquirenda)
<i>H. murrayi</i> (Southern, 1914) Menzel, 1917	<i>Ogma murrayi</i> Southern, 1914
<i>H. octangularis</i> (Cobb, 1914) Menzel, 1917	<i>Ogma octangularis</i> (Cobb, 1914) Schuurmans Stekhoven & Teunissen, 1938
<i>H. rusticus</i> (Micoletzky, 1915) Menzel, 1917	<i>Criconemella rustica</i> (Micoletzky, 1915) Luc & Raski, 1981
<i>H. rusticus</i> var. <i>peruensis</i> Steiner, 1920	<i>Criconemella peruensis</i> (Steiner, 1920) Luc & Raski, 1981
<i>H. similis</i> (Cobb, 1918) Micoletzky, 1922	<i>Criconemoides similis</i> (Cobb, 1918) Chitwood, 1949 (Now species inquirenda)
<i>H. sinensis</i> Rahm, 1937	<i>Criconemoides sinensis</i> (Rahm, 1937) Goodey, 1951 (Now species inquirenda)
<i>H. squamosus</i> (Cobb, 1913) Menzel, 1917	<i>Hemicriconemoides squamosus</i> (Cobb, 1913) Siddiqi & Goodey, 1963 (Now species inquirenda)
<i>H. thienemanni</i> Schneider, 1925	<i>Hemicycliophora thienemanni</i> (Schneider, 1925) Loos, 1948
<i>H. uniformis</i> Thorne, 1949	<i>Rotylenchus robustus</i> (de Man, 1876) Filipjev, 1936
<i>H. zavadskii</i> Tulaganov, 1941	<i>Criconemella zavadskii</i> (Tulaganov, 1941) De Grisse & Loof, 1965

hemizonid in species with no or fewer than four incisures. Esophagus well developed; esophageal glands overlapping intestine dorsally and laterally, containing 3–6 nuclei. Epiptygma present, distinct or indistinct, single or double. Vulva median; two outstretched genital branches. Tail short, terminus hemispherical to bluntly rounded, annulated. Phasmids large, scutellum-like, one prevulval, one postvulval (in *H. abelmoschi* adjacent to vulval area, one anterior and one posterior; in *H. puertoricensis* prevulval; and in *H. californicus* and *H. tabacum* postvulval). Lateral field with 0–4 incisures.

Male. When present, generally similar to females (except for reproductive structures) but slightly smaller. Tail short. Spicules well developed, arcuate with distal flanges, variable in size. Bursa extending to tail tip. Gubernaculum large, protrusible, with titillae and telamon.

LIST OF VALID *HOPLOLAIMUS* SPECIES

(*Hoplolaimus* species transferred to other genera with their present name and status in Table 1.)

Type species

1. *Hoplolaimus tylenchiformis* Daday, 1905
syn. *Criconema tylenchiformis* (Daday)
Micoletzky, 1917
lapsus calami *H. paradoxus* Daday,
1905

Other species (with synonyms)

2. *Hoplolaimus abelmoschi* Tandon & Singh, 1973
Basirolaimus abelmoschi (Tandon & Singh, 1973) Siddiqi, 1986
3. *H. aegypti* Shafiee & Koura, 1969
B. aegypti (Shafiee & Koura, 1969)
Shamsi, 1979
H. aegypti by Luc, 1981
B. aegypti by Siddiqi, 1986
4. *H. aorolaimoides* Siddiqi, 1972
5. *H. californicus* Sher, 1963
Hoplolaimoides californicus (Sher, 1963)
Shakil, 1973

- Hoplolaimus californicus* (Sher, 1963)
Siddiqi, 1986
6. *H. capensis* Van den Berg & Heyns, 1970
H. pararobustus by Siddiqi, 1986
7. *H. casparus* Van den Berg & Heyns, 1970
H. pararobustus by Siddiqi, 1986
8. *H. cephalus* Mulk & Jairajpuri, 1976
B. cephalus (Mulk & Jairajpuri, 1976)
Shamsi, 1979
H. cephalus (Mulk & Jairajpuri, 1976)
Luc, 1981
B. cephalus by Siddiqi, 1986
9. *H. chambus* Jairajpuri & Baqri, 1973
B. chambus (Jairajpuri & Baqri, 1973)
Shamsi, 1979
H. chambus (Jairajpuri & Baqri, 1973)
Luc, 1981
H. columbus by Khan, 1978 in Siddiqi,
1986
10. *H. citri* (M. L. Khan & S. H. Khan,
1985) n. comb.
B. citri M. L. Khan & S. H. Khan, 1985
11. *H. clarissimus* Fortuner, 1973
B. clarissimus (Fortuner, 1973) Shamsi,
1979
H. clarissimus by Luc, 1981
B. clarissimus by Siddiqi, 1986
12. *H. columbus* Sher, 1963
B. columbus (Sher, 1963) Shamsi, 1979
H. columbus by Luc, 1981
B. columbus by Siddiqi, 1986
13. *H. concaudajuvenecus* Golden & Minton,
1970
14. *H. dimorphicus* Mulk & Jairajpuri, 1976
B. dimorphicus (Mulk & Jairajpuri,
1976) Shamsi, 1979
H. dimorphicus by Luc, 1981
B. dimorphicus by Siddiqi, 1986
15. *H. dubius* Chaturvedi, Singh & Khera,
1979
B. dubius (Chaturvedi, Singh & Khera,
1979) Siddiqi, 1986
16. *H. galeatus* (Cobb, 1913) Thorne, 1935
Nemonchus galeatus Cobb, 1913
Hoplolaimus coronatus Cobb, 1923
17. *H. imphalensis* M. L. Khan & S. H.
Khan, 1985
18. *H. indicus* Sher, 1963
B. indicus (Sher, 1963) Shamsi, 1979
H. indicus by Luc, 1981

- H. arachidis* (Maharaju & Das, 1982) Siddiqi, 1986
- B. arachidis* (Maharaju & Das, 1982) Siddiqi, 1986
- B. indicus* by Siddiqi, 1986
- 19. *H. jalalabadiensis* (M. L. Khan & S. H. Khan, 1985) n. comb.
- B. jalalabadiensis* M. L. Khan & S. H. Khan, 1985
- 20. *H. magnistylus* Robbins, 1982
- 21. *H. pararobustus* (Schuermans Stekhoven & Teunissen, 1938) Sher, 1963
- Tylenchorhynchus robustus* Schuurmans Stekhoven, 1936
- Tylenchorhynchus pararobustus* Schuurmans Stekhoven & Teunissen, 1938
- Rotylenchus pararobustus* (Schuermans Stekhoven & Teunissen) Filipjev & Schuurmans Stekhoven, 1941
- Hoplolaimus proporicus* Goodey, 1957
- Gottholdsteineria pararobusta* (Schuermans Stekhoven & Teunissen) Andrassy, 1958
- Hoplolaimus angustalatus* Whitehead, 1959
- Hoplolaimus kittenbergeri* Andrassy, 1961
- 22. *H. puertoricensis* Ramirez, 1964
- B. puertoricensis* (Ramirez, 1964) Siddiqi, 1986
- 23. *H. sacchari* (Shamsi, 1979) Luc, 1981
- B. sacchari* Shamsi, 1979
- B. sacchari* by Siddiqi, 1986
- 24. *H. seinhorsti* Luc, 1958
- B. seinhorsti* (Luc, 1958) Shamsi, 1979
- H. seinhorsti* (Luc, 1958) Luc, 1981
- B. seinhorsti* by Siddiqi, 1986
- 25. *H. seshadrii* Mulk & Jairajpuri, 1976
- B. seshadrii* (Mulk & Jairajpuri, 1976) Shamsi, 1979
- H. seshadrii* by Luc, 1981
- B. seshadrii* by Siddiqi, 1986
- 26. *H. sheri* Suryawanshi, 1971
- B. sheri* (Suryawanshi, 1971) Siddiqi, 1986
- H. seinhorsti* by Siddiqi, 1986
- 27. *H. singhi* Das & Shivaswamy, 1977
- B. singhi* (Das & Shivaswamy, 1977) Siddiqi, 1986
- 28. *H. stephanus* Sher, 1963
- 29. *H. tabacum* Firoza, Nasira & Maqbool, 1990

Species inquirenda:

Hoplolaimus steineri Kannan, 1961 (by Krall, 1978)

Nomina nuda:

Hoplolaimus gadsdenensis Thames in Sher, 1963

Hoplolaimus neocoronatus Whitten in Sher, 1961

DISCUSSION

In our opinion, the few characters differentiating *Hoplolaimus* and *Basirolaimus* do not justify retaining the genus *Basirolaimus*. Instead, we consider these as useful supplemental diagnostic characters for differentiation of species within the *Hoplolaimus* group. We agree with Luc (7), Robbins (8), and Fortuner (2) in the synonymization of *Basirolaimus* with *Hoplolaimus*.

Shakil (9) proposed the genus *Hoplolaimoides* for *Hoplolaimus californicus*, which has both scutella posterior to the vulva. If *Hoplolaimoides* were accepted, a second new genus should be proposed for *Hoplolaimus puertoricensis* in which both scutella are anterior to the vulva (2); and further, a third new genus might be established for *Hoplolaimus concaudajuvencus* where larval heteromorphism is present, which is a useful character of possible phylogenetic relationship of *Hoplolaimus* to allied groups of nematodes. We agree with Siddiqi (12) in synonymizing *Hoplolaimoides* with *Hoplolaimus*.

The known range of variation for many *Hoplolaimus* species (no. or %) is limited to observations of specimens in single populations from the type locality. Further and more extensive morphological studies, including SEM, of specimens in a broader spectrum of habitats is needed to further clarify the relationships and identities of these species.

HOPLOLAIMUS SPECIES KEY

- 1. Lateral field with 4 incisures; excretory pore posterior to hemizonid (except *H. sacchari*) 2
- 1. Lateral field with 0-3 incisures;

- excretory pore anterior to hemizonid 10
2. Esophageal glands with 3 nuclei... 3
2. Esophageal glands with 6 (or 5) nuclei 9
3. Stylet 30–35 μm , basal knobs with poorly developed anterior projections *H. aorolaimoides*
3. Stylet 38–61 μm , basal knobs with pronounced anterior projections .. 4
4. Both scutella located below center of body *H. californicus*
4. Scutella anterior and posterior to vulva..... 5
5. Larvae heteromorphic; tails of J1 and J2 conically pointed with an acute terminus; female stylet knobs markedly tulip-shaped, heavily dentate anteriorly and tending to close upon stylet shaft *H. concaudajuvencus*
5. Larvae not heteromorphic; tails of J1 and J2 rounded; female stylet knobs open tulip-shaped and not as dentate or closed anteriorly ---- 6
6. Stylet 56 (52–61) μm ; intestine not overlapping rectum ---- *H. magnistylus*
6. Stylet 42–52 μm ; intestine overlapping rectum 7
7. Lip region with 3 or 4 annules; female tail usually bluntly rounded *H. tylenchiformis*
7. Lip region with 4 or more annules; tail usually rounded 8
8. Head annules 5; basal annule with 32–36 longitudinal striae; spicule 40–52 μm *H. galeatus*
8. Head annules 4; basal annule with 24–28 longitudinal striae; spicule 30–38 μm *H. stephanus*
9. Stylet 46–53 μm ; basal annule of head with 18–31 longitudinal striations; hemizonid anterior to excretory pore; spicule 56–62 μm *H. clarissimus*
9. Stylet 33–35 μm ; basal annule of head with 8 longitudinal striations; hemizonid posterior to excretory pore; spicule 39–40 μm -- *H. sacchari*
10. Esophageal glands with 3 nuclei... 11
10. Esophageal glands with 6 (or 5) nuclei 16
11. Lateral field absent 12
11. Lateral field with 1 or 2 incisures (except *H. pararobustus* sometimes shows 2 or 3 incomplete incisures) 13
12. Body length 1.2 mm; stylet 40 μm ; tail short, c = 46 *H. casparus*
12. Body length 1.4–2.1 mm; stylet 40 μm ; tail long, c = 53–75 ---- *H. singhi*
13. Lateral field with 1 incisure (except *H. pararobustus* sometimes shows 2 or 3 incomplete incisures) 14
13. Lateral field with 2 incisures..... 15
14. Stylet 38–49 μm , basal annule of head with 18–25 longitudinal striations; spicule 45–57 μm ; gubernaculum 19–31 μm *H. pararobustus*
14. Stylet 34–37 μm , basal annule of head with 29–30 longitudinal striations; spicule 37–45 μm ; gubernaculum 18–20 μm *H. imphalensis*
15. Scutella anterior and posterior to vulva; intestine not overlapping rectum; spicule 51–70 μm ; gubernaculum 19–30 μm *H. capensis*
15. Scutella adjacent to vulval area; intestine overlapping rectum; spicule 44–47 μm ; gubernaculum 13–18 μm *H. abelmoschi*
16. Lip region smooth, no annules ---- *H. cephalus*
16. Lip region annulated 17
17. Scutella either pre- or postvulval.. 18
17. Scutella anterior and posterior to vulva..... 19
18. Scutella prevulval ---- *H. puertoricensis*
18. Scutella postvulval *H. tabacum*
19. Parthenogenetic; spermatheca absent or, if present, without sperm; males absent or rare 20
19. Bisexual; spermatheca with sperm; males present 25
20. Epiptygma absent; lateral field narrow, aerolated, with 2 incisures *H. sheri*
20. Epiptygma present; lateral field absent, with breaks only, or 1 incisure (often indistinct) 21
21. Lateral field absent or with 1 in-

- cisure, which is often indistinct; epiptygma single or double 22
21. Lateral field with breaks only; epiptygma double 24
22. Intestine not overlapping rectum; head annules 4; excretory pore usually at level of isthmus; epiptygma single *H. seinhorsti*
22. Intestine completely or partially overlapping rectum; head annules 3; excretory pore posterior to isthmus; epiptygma double 23
23. Head setoff, not bilobed, basal annule with 10–15 longitudinal striae; female tail with 16–22 annules *H. columbus*
23. Head continuous, bilobed, basal annule with 20–22 longitudinal striae; female tail with 14–18 annules *H. seshadrii*
24. Basal annule of lip region with 6 longitudinal striae; $c = 58$ (52–67); $V = 55$ (52–56); tail with 9–13 annules *H. chambus*
24. Basal annule of lip region with 24–25 longitudinal striae; $c = 41$ –52; $V = 56$ –66; tail with 16–22 annules *H. jalalabadiensis* (Khan & Khan, 1985) n. comb.
25. Stylet 45–50 μm ; spicule 54–65 μm *H. aegypti*
25. Stylet 31–45 μm ; spicule 34–47 μm 26
26. Lateral field usually with 1 stria, sometimes 2–4 irregular discontinuous striae 27
26. Lateral field absent 28
27. Intestine overlapping rectum; $o = 15$ (13–18); epiptygma single or double *H. indicus*
27. Intestine not overlapping rectum; $o = 9$ –11; epiptygma single *H. dubius*
28. Lip region with 2–3 annules, basal annule with 18–21 longitudinal

- lines; tail with 6–10 annules
 ----- *H. dimorphicus*
28. Lip region with 4 annules, basal annule with 10–12 longitudinal lines; tail with 12–15 annules
 ----- *H. citri* (Khan & Khan, 1985) n. comb.

LITERATURE CITED

- Daday, E. von. 1905. Untersuchungen über die Süßwasser-Mikrofauna Paraguays. *Zoologica*, Stuttgart 18:1–349.
- Fortuner, R. 1987. A reappraisal of Tylenchina (Nematoda). 8. The family Hoplolaimidae Filipjev, 1934. *Revue de Nématologie* 10:219–232.
- Fortuner, R. 1991. The Hoplolaiminae. Pp. 669–719 in W. R. Nickle, ed. *Manual of agricultural nematology*. New York: Marcel Dekker.
- Golden, A. M. 1971. Classification of the genera and higher categories of the order Tylenchida (Nematoda). Pp. 191–232 in B. M. Zuckerman, W. F. Mai, and R. A. Rohde, eds. *Plant parasitic nematodes*, vol. 1. New York: Academic Press.
- Golden, A. M., and N. A. Minton. 1970. Description and larval heteromorphism of *Hoplolaimus concaudajuvencus* n. sp. (Nematoda: Hoplolaimidae). *Journal of Nematology* 2:161–166.
- Krall, E. L. 1978. Root parasitic nematodes, family Hoplolaimidae. Academy of Sciences of the USSR. Leningrad: Nauka Publishers. (English translation from Russian.)
- Luc, M. 1981. *Basirolaimus* Shamsi, 1979, a junior synonym of *Hoplolaimus* von Daday, 1905 (Nematoda: Tylenchida). *Nematologica Mediterranea* 9:197–199.
- Robbins, R. T. 1982. Description of *Hoplolaimus magnistylus* n. sp. (Nematoda: Hoplolaimidae). *Journal of Nematology* 14: 500–506.
- Shakil, M. 1973. On the proposal for *Hoplolaimoides* n. gen. (Nematoda: Hoplolaimidae). 43rd Annual Session, Abstract, Section of Biological Sciences, Proceedings of National Academy of Sciences, India. p. 17.
- Shamsi, M. A. 1979. *Basirolaimus* gen. n. (Nematoda: Hoplolaimidae) with the description of *Basirolaimus sacchari* n. sp. from India. *Nematologica Mediterranea* 7:15–19.
- Sher, S. A. 1963. Revision of the Hoplolaiminae (Nematoda) II. *Hoplolaimus* Daday, 1905 and *Aorolaimus* n. gen. *Nematologica* 9:267–295.
- Siddiqi, M. R. 1986. Tylenchida, parasites of plants and insects. Slough, UK: Commonwealth Agricultural Bureaux.

TABLE 2. Diagnostic data on species of *Hoplolaimus* females and male spicules.

Species	Length (mm)	Lateral incisures†	Esophageal gland nuclei	Stylet length (µm)	Labial annules	Longitudinal striae on basal lip annule	Excretory pore in relation to hemizonid	Intestinal post-rectal sac	Phasmids in relation to vulva	Tail annules	Males	Spicule length (µm)
<i>H. abelmoschi</i> Tandon & Singh, 1973	1.63 (1.54–1.8)	2	3	43.3 (42–47)	5	25–28	Anterior	Present	Both adjacent, one anterior & one posterior	9–15	Present	46 (44–47)
<i>H. aegypti</i> Shaficec & Koura, 1969	1.3–1.9	1	5 (6th obscure)	45–50	4	13–22	Anterior	Present	One anterior & one posterior	17–27	Present	54–65
<i>H. aorolaimoides</i> Siddiqi, 1972	0.85 (0.80–0.92)	4	3	32.8 (31–35)	4–5 (rarely 3 or 6)	6–13	Posterior	Present	One anterior & one posterior	10 (6–17)	Present	34 (31–37)
<i>H. californicus</i> Sher, 1963	1.14–1.74	4	3	46–53	6	36	Posterior	Present	Both posterior	14	Present	45–55
<i>H. capensis</i> Van den Berg & Heyns, 1970	1.6–2.1	2 (1–4, incomplete)	3	46.3–58.4	5–6	Unknown	Anterior	Present	One anterior & one posterior	9–16	Present	51.4–69.8
<i>H. casparus</i> Van den Berg & Heyns, 1970	1.2	0	3	39.7	3	Unknown	Anterior	Absent	One anterior & one posterior	12	Present	39.6–40.4
<i>H. cephalus</i> Mulk & Jairajpuri, 1976	1.18	0	6	34	0 (smooth)	0	Anterior	Absent	One anterior & one posterior	6	Present	33–38
<i>H. chambus</i> Jairajpuri & Baqri, 1973	1.4 (1.24–1.62)	With breaks	6	43 (41–45)	3	6	Anterior	Present	One anterior & one posterior	9–13	Unknown	
<i>H. citri</i> (Khan, M. L. & S. H. Khan) n. comb.	0.84–1.27	0	6	35–37	4	10–12	Anterior	Absent	One anterior & one posterior	12–15	Present	38–47
<i>H. clarissimus</i> Fortuner, 1973	1.60 (1.38–1.83)	4	6	46–52.5	4 (rarely 3 or 5)	18–31	Posterior	Present	One anterior & one posterior	20–26	Present	58.5 (55.5–61.5)
<i>H. columbus</i> Sher, 1963	1.26–1.80	1	6	40–48	3	10–15	Anterior	Present	One anterior & one posterior	16–22	Rarely present	36.6–52.5
<i>H. concaudajuvencus</i> † Golden & Minton, 1970	1.12–2.04	4	3	54.9 (50.4–56.6)	5–6	36	Posterior	Absent	One anterior & one posterior	10 (7–14)	Present	50 (45–56)

TABLE 2. *Continued*

Species	Length (mm)	Lateral incisures†	Esophageal gland nuclei	Stylet length (µm)	Labial annules	Longitudinal striae on basal lip annule	Excretory pore in relation to hemizonid	Intestinal post-rectal sac	Phasmids in relation to vulva	Tail annules	Males	Spicule length (µm)
<i>H. dimorphicus</i> Mulk & Jairajpuri, 1976	1.15-1.64	0?	6	34-36	2-3	18-21	Anterior	Absent	One anterior & one posterior	6-10	Present	36-41
<i>H. dubius</i> Chaturvedi, Singh & Khera, 1979	1.05-1.27	1 (or 2-4 irregular)	6	31-42	3	14	Anterior	Absent	One anterior & one posterior	10-15	Present	37-44
<i>H. galeatus</i> (Cobb 1913) Thorne, 1935	1.24-1.94	4	3	43-52	5	32-36	Posterior	Present	One anterior & one posterior	10-16	Present	40-52
<i>H. imphalensis</i> Khan, M. L. & S. H. Khan, 1985	0.95-1.35	1	3	34-37	3-4	29-30	Anterior	Present	One anterior & one posterior	12-14	Present	37-45
<i>H. indicus</i> Sher, 1963	0.95-1.63	1 (or 2-3 incomplete)	6	33-47	3-4	6-20	Anterior	Present	One anterior & one posterior	14 (8-22)	Present	34-42
<i>H. jalalabadiensis</i> (Khan, M. L. & S. H. Khan, 1985) n. comb.	1.17-1.66	With breaks	6	37-44	3-4	24-25	Anterior	Present	One anterior & one posterior	16-22	Unknown	
<i>H. magnistylus</i> Robbins, 1982	1.58 (1.36-1.97)	4	3	55.7 (52-61)	5 (4-6)	28 (22-34)	Posterior	Absent	One anterior & one posterior	12-17	Present	53.9 (52-58)
<i>H. pararobustus</i> (Sch. Stekh. & Teunissen, 1938) Sher, 1963	0.95-1.60	1 (2-3)	3	38-49	4-5	18-25	Anterior	Present	One anterior & one posterior	7-15	Present	40-57
<i>H. puertoricensis</i> Ramírez, 1964	1.3-1.7	0?	5	41-45	3	6-9	Anterior	Absent	Both anterior	19	Unknown	
<i>H. sacchari</i> (Shamsi, 1979) Luc, 1981	1.1 (1.1-1.2)	4	6	34 (34-35)	3	8	Anterior	Present	One anterior & one posterior	9-10	Present	39 (39-40)

<i>H. seinhorsti</i> Luc, 1958	1.06–1.56	1	6	40–49	4	8–12	Anterior	Absent	One anterior & one posterior	10–15	Unknown	
<i>H. seshadrii</i> Mulk & Jair- ajpuri, 1976	1.45–1.77	0‡	6	42–43	3	20–22	Anterior	Present	One anterior & one posterior	14–18	Unknown	
<i>H. sheri</i> Suryawan- shi, 1971	1.16–1.48	2	6	40–45	4	20	Anterior	Absent	One anterior & one posterior	12	Unknown	
<i>H. singhi</i> Das & Shivaswamy, 1977	1.43–2.07	0	3	43–56	4	Unknown	Anterior?	Absent	One anterior & one posterior	7	Present	51.8
<i>H. stephamus</i> Sher, 1963	1.01–1.45	4	3	43–50	4	24–28	Posterior	Present	One anterior & one posterior	12	Present	30–38
<i>H. tabacum</i> Firoza, Na- sira & Maq- bool, 1990	1.3 (1.3–1.4)	1	6	44.4 (43.2–45.0)	3–4	Unknown	Anterior	Present	Both posterior	12–15	Unknown	
<i>H. tylenchi-</i> <i>formis</i> Daday, 1905	0.86–1.39	4	3	42–51	3–4	20–24	Posterior	Present	One anterior & one posterior	8–14	Present	31–38

† Species with four incisures in the lateral field have excretory pore located below hemizonid (except *H. sacchari*). Species with 0–3 incisures, or with breaks only in the lateral field have excretory pore located above the hemizonid.

‡ Larval heteromorphism present; J1 and J2 conically pointed with an acute terminus.