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Hoplolaimidae Filip'ev, 1934 (Nemata) from Rwandan banana fields

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During a survey of banana fields in Rwanda, eight species of Hoplolaimidae were collected, viz. *Helicotylenchus dihystera* (Cobb, 1893) Sher, 1961, *Helicotylenchus egyptiensis* Tarjan, 1964, *Helicotylenchus multicinctus* (Cobb, 1893) Golden, 1956, *Helicotylenchus variocaudatus* (Luc, 1960) Fortuner, 1984, *Hoplolaimus pararobustus* (Schuurmans Stekhoven & Teunissen, 1938) Sher, 1963, *Rotylenchulus borealis* Loof & Oostenbrink, 1962, *Scutellonema cavenessi* Sher, 1963, and *Scutellonema paralabiatum* Siddiqi & Sharma, 1994. Except for *H. multicinctus,* seven are new records for the country. Morphometrics, notes and illustrations are given for four species, *H. dihystera, H. egyptiensis, H. multicinctus* and *R. borealis,* while *H. variocaudatus* and *S. paralabiatum* are described in full. *Helicotylenchus affinis* (Luc, 1960) Fortuner, 1984, is made a junior synonym of *H. variocaudatus* while *Rotylenchoides attenuatus* Siddiqi, 1995, and *Rotylenchoides subterminalis* Siddiqi, 1995, are transferred to the genus *Helicotylenchus* Steiner, 1945.

Key words: descriptions, *Helicotylenchus variocaudatus,* Hoplolaimidae, Rwanda, *Scutellonema paralabiatum,* SEM, taxonomy.

During 2000 a diagnostic survey was conducted by the Institute for Agronomic Sciences of Rwanda (ISAR) in collaboration with the International Institute of Tropical Agriculture (IITA) in all the major banana (*Musa* spp.) growing areas of Rwanda. The objective was to identify the factors influencing banana production decline as well as the incidence and influence of plant pathogens and pests, including the banana weevil (*Cosmopolites sordidus* (Germar)) and nematodes. Sixty farms were sampled from twelve districts in the provinces of Gisengi, Kibuye, Cyangugu, Kigale Rural and Kibungo. Eight species of Hoplolaimidae were found, viz. *Helicotylenchus dihystera* (Cobb, 1893) Sher, 1961, *Helicotylenchus egyptiensis* Tarjan, 1964, *Helicotylenchus multicinctus* (Cobb, 1893) Golden, 1956, *Helicotylenchus variocaudatus* (Luc, 1960) Fortuner, 1984, *Hoplolaimus pararobustus* (Schuurmans Stekhoven & Teunissen, 1938) Sher, 1963a, *Rotylenchulus borealis* Loof & Oostenbrink, 1962, *Scutellonema cavenessi* Sher, 1963b, and *Scutellonema paralabiatum* Siddiqi & Sharma, 1994. Except for *H. multicinctus,* seven are new records for the country. Morphometrics, notes and illustrations are given for four species as well as redescriptions, illustrations and SEM micrographs of *H. variocaudatus* and *S. paralabiatum. Helicotylenchus affinis* (Luc, 1960) Fortuner, 1984, is made a junior synonym of *H. variocaudatus,* and *Rotylenchoides attenuatus* Siddiqi, 1995, and *Rotylenchoides subterminalis* Siddiqi, 1995, are transferred to the genus *Helicotylenchus* Steiner, 1945.

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Materials and methods

In the laboratory in Butare the specimens were extracted from the soil collected from around banana roots using the Baermann tray method of Kleynhans (1997) with slight modification. One-hundred millilitres of soil from each sample was placed on tissue paper on a 20-cm diameter sieve contained in a dish, submerged in 300 ml water and left uncovered for 48 hours. The nematode suspension in each dish was then poured into a beaker, left for two hours to settle after which the volume of water was reduced to 25 ml, placed in small bottles and transported to Pretoria. At the Nematology Unit (ARC-Plant Protection Research Institute) the material was killed in FPG (distilled water, 4 % formaldehyde and 1 % propionic acid) and mounted in pure glycerol (Netscher & Seinhorst 1969; Hooper & Evans 1993). For scanning electron microscopy the material was preserved in TAF (distilled water, 40 % formalin and triethanolamine), then dehydrated in increasing concentrations of amyl acetate in pure ethanol and finally in pure amyl acetate. Following conventional

critical-point drying and gold/palladium-coating (15 nm), specimens were viewed with a Philips XL30 DX4I stereoscan microscope at 10 kV.

Taxonomic account

Helicotylenchus dihystera (Cobb, 1893) Sher, 1961

Helicotylenchus dihystera (Cobb, 1893) Sher, 1961: 814.

H. dihystera is the type species for the genus *Helicotylenchus* Steiner, 1945, and was described from sugar cane (*Saccharum officinarum* L.), Australia (Cobb 1893a) and since reported from all six biogeographical regions (Sher 1966; Van den Berg & Kirby 1979; Bongers 1988; Marais et al. 1999). *H. dihystera* was found in the Bugarama, Gitesi and Karengera districts on 8 % of the farms. This is the first report of *H. dihystera* from Rwanda.

Measurements

Females (*n* =7). L = 617 ± 6.2 (567–672) µm; a = 28.6 ± 1.6 (24.3–32.1); c = 44.0 ± 2.8 (36.6–58.7); stylet length = 25 ± 0.9 (24–27) µm; m = 48 ± 1.3 (46–51); position of dorsal gland opening behind stylet knobs (DGO) = 14 ± 1.3 (11–17) µm; V = 65 ± 1.2 (63–67); oesophagus length = 114 ± 3.2 (98–125) µm; body width at midbody = 22 ± 1.7 (18–26) µm; body width at anus = 13 ± 1.0 (11–15) µm; number of ventral tail annuli = 8–14; position of phasmids = 11–16 annuli anterior to anus; tail length = 14 ± 1.6 (11–18) µm; excretory pore/L (%) = 18 ± 0.8 (17–19); excretory pore/ oesophagus length (%) = 82 ± 2.6 (71–94).

Remarks

The specimens were identified as *H. dihystera* because of the mostly spiral habitus, stylet length, position of the vulva, phasmids anterior to the anus, inner lines of lateral field ending on tail in a Y-shaped pattern, tail asymmetrically rounded, with rounded terminal projection and the absence of males. The present specimens agree with the amended descriptions of Fortuner et al. (1981), Fortuner (1991) and Marais (2001).

Helicotylenchus egyptiensis Tarjan, 1964

Helicotylenchus egyptiensis Tarjan, 1964: 188.

This species was described from sugar cane, Luxor, Egypt (Tarjan 1964), and has since also been reported from the Australian, Neotropical, Oriental and Palaearctic Regions (Kozhokaru & Korol'chuk 1976; Van den Berg & Kirby 1979; Firoza & Maqbool 1996; Marais et al. 1999). *H. egyptiensis* was found in the Bugarama, Gishoma, Gitesi and Karenga districts of the Gyangugu Province on 8 % of the farms. This is the first report of this species from Rwanda.

Measurements

Females (*n* = 5). L = 661 ± 63.8 (594–731) µm; a = 22.1 ± 2.2 (18.3–23.3); c = 39.5 ± 10.2 (29.3–55.2); c' = 1.0 ± 0.2 (0.8–1.3); stylet length = 29 ± 1.2 (28–31) µm; m = 49 ± 1.2 (47–50); DGO = 13 ± 1.9 (11–16) µm; V = 63 ± 1.5 (60–64); oesophagus length = 127 ± 16.3 (115–139) µm; excretory pore from front = 117 ± 7.6 (111–130) µm; body width at midbody = 30 ± 2.5 (26–32) µm; body width at anus = 17 ± 1.7 (15–19) µm; number of ventral tail annuli = 10–11; position of phasmids = 3–8 annuli anterior to anus; tail length = 18 ± 4.7 (13–25) µm; excretory pore/L (%) = 18 ± 1.5 (16–20); excretory pore/oesophagus length (%) = 76.

Remarks

The specimens are regarded as *H. egyptiensis* because of mostly spiral habitus, lip region anteriorly flattened, stylet length, position of vulva and phasmids, variable tail projection and absence of males. The present specimens agree with the paratype material and descriptions of the paratypes by Tarjan (1964), Sher (1966) and Fortuner et al. (1984). Both dorsal and ventral overlap of the oesophageal glands over the intestine were observed as also reported by Zeidan & Geraert (1990). The upper range for DGO (16 µm) and stylet length (31 µm) is higher than the 13 µm (DGO) and 28 µm (stylet length) reported by Tarjan (1964) and Zeidan & Geraert (1990). The tail punctations described by Tarjan (1964) were, according to Sher (1966), artifacts possibly due to impurities in the fixative or glycerine. The fact that no punctations were seen in the populations from Guadeloupe (Marais et al. 1999) or the Rwandan specimens confirms this.

Helicotylenchus multicinctus (Cobb, 1893) Golden, 1956

Helicotylenchus multicinctus (Cobb, 1893) Golden, 1956: 301.

H. multicinctus was described from banana, Suva, Fiji (Cobb, 1893b), and has since been reported from all biogeographical regions (Sher 1966; Vovlas 1983; Gatsinzi 1991; Marais et al. 1999). This species was found in the Bugarama,

Kayonza, Rubingo, Rukiro and Rusumo provinces on 35 % of the farms. Gatsinzi (1991) reported *H. multicinctus* from Rwanda.

Measurements

Females (*n* = 8). L = 560 ± 7.3 (494–630) µm; a = 25.8 ± 1.6 (24.0–28.5); c = 38.1 ± 8.2 (28.9–49.3); c' = 1.1 ± 0.2 (0.9–1.3); stylet length = 26 ± 1.6 (24–29) µm; m = 48 ± 1.2 (47–49); DGO = 9 ± 1.1 (8–11) µm; V = 68 ± 1.6 (66–71); oesophagus length = 121 µm (*n* = 1); excretory pore from front = 101 ± 5.8 (96–114) µm; body width at midbody = 22 ± 2.2 (18–26) µm; body width at anus = 14 ± 0.9 (12–15) µm; number of ventral tail annuli = 9–16; position of phasmids = 1–4 annuli anterior to anus; tail length = 15 ± 2.6 (11–18) µm; excretory pore/L (%) = 18 ± 0.8 (17–19); excretory pore/oesophagus length (%) = 77 ± 5 (70–83).

Males (*n* = 2). L = 487–495 µm; a = 27.4–34.0; c = 28.5–34.8; c' = 1.4–1.7; stylet length = 22 µm; m = 47–49; DGO = 9 µm; oesophagus length = 117 µm; excretory pore from front = 86–87 µm; body width at midbody = 15–18 µm; body width at cloaca = 10 µm; tail length = 14–17 µm; spicule length = 17–18 µm; gubernaculum length = 7 µm; excretory pore/L (%) = 17–18; excretory pore/oesophagus length (%) = 74.

Remarks

The specimens were identified as *H. multicinctus* because of the C-shaped habitus, stylet length, reduced posterior reproductive branch (74 % of the corresponding anterior branch length), position of the vulva, phasmids located anterior to the anus, lip region rounded, tail rounded to more curved dorsally without a ventral projection and the presence of males. The present specimens agree with the amended descriptions of Fortuner (1991) and Marais (2001). Vovlas (1983) reported a *H. multicinctus* population from Italy with a divided first lip annulus. This character was not seen in the population from Rwanda or any other *H. multicinctus* populations (Marais & Buckley 1992; Marais & Quénéhervé 1999; Orion et al. 1999; Marais et al. 1999).

Helicotylenchus variocaudatus (Luc, 1960) Fortuner, 1984, Fig. 1

Rotylenchoides variocaudatus Luc, 1960: 12.
Helicotylenchus affinis (Luc, 1960) Fortuner, 1984: 258. **Syn.n.**
Rotylenchoides affinis Luc, 1960: 14.

H. variocaudatus was described from the rhizosphere of black pepper (*Piper nigrum* L.), Côte d'Ivoire, and also reported from banana plants in São Tomè (Luc 1960; Vovlas et al. 1995).

Measurements

Females (*n* = 22). L = 480 ± 49.5 (386–549) µm; a = 26.1 ± 3.2 (21.4–32.2); c = 33.0 ± 5.4 (23.4–47.4); c' = 1.3 ± 0.2 (0.8–1.6); DGO = 8 ± 0.9 (7–10) µm; stylet length = 28 ± 1.1 (26–31) µm; m = 50 ± 1.7(44–53); V = 88 ± 1.2 (85–90). excretory pore/oesophagus length (%) = 85 ± 2.1 (82–87).

Males (*n* = 2). L = 503–515 µm; a = 30.8–33.7; c = 32.9–40.2; c' = 1.3–1.4; stylet length = 20–21 µm; m = 43–49; spicule length = 17 µm; excretory pore/oesophagus length (%) = 78.

Description

Females. Habitus straight (76 %) to C-shaped (24 %), body tapering to posterior end. Lip region 4 ± 0.5 (3–5) µm high and 9 ± 0.5 (8–10) µm wide, anteriorly rounded, not set off, with 3–4 annuli. Labial disc in the form of an eight in en face view. Outer margins of labial framework extend 3 ± 0.3 (3–4) µm backward from basal plate. Cephalids not seen. Stylet robust, stylet knobs 3 ± 0.4 (2–4) µm high and 6 ± 0.9 (4–9) µm wide, anteriorly indented. Median bulb oval, 11 ± 1.0 (9–13) µm long and 9 ± 1.4 (6–12) µm wide, valve 2 ± 0.6 (2–4) µm long and 3 ± 0.4 (2–4) wide. Length of oesophagus 90 ± 6.2 (87–97) µm, with length to end of glands 115 ± 7.1 (101–123) µm. Oesophagus with 26 ± 1.8 (25–27) µm long ventral or dorsal overlap. Excretory pore 95 ± 6.2 (87–97) µm from anterior end, i.e. at 20 ± 1.4 (17–22) % of body length. Hemizonid two annuli long, located 1–2 annuli anterior to excretory pore (*n* = 2). Hemizonion not seen. Fasciculi not seen. Width of annuli at midbody 1.5 ± 0.2 (1.1–2.0) µm. Body width at excretory pore 21 ± 1.7 (18–24) µm, at midbody 19 ± 2.0 (15–22) µm and at anus 11 ± 1.3 (10–14) µm. Posterior reproductive branch non-functional, reduced to a postvulval uterine sac, length of posterior branch 14 ± 5.9 (7–27) % of the corresponding anterior branch length; anterior branch 112 ± 28.0 (78–167) µm and posterior branch 15 ± 4.1 (7–21) µm long. Spermatheca axial, rounded, filled with sperm. Epiptygma folded into vagina. Lateral field 5 ± 0.7 (3–5) µm wide; inner two lines end on tail in a U- (12%), Y- (42 %) or M-shaped (46 %) pattern. Phasmids located one annulus anterior to three annuli posterior to anus. Tail 15 ± 2.1 (10–17) µm long, conical, with 7–12

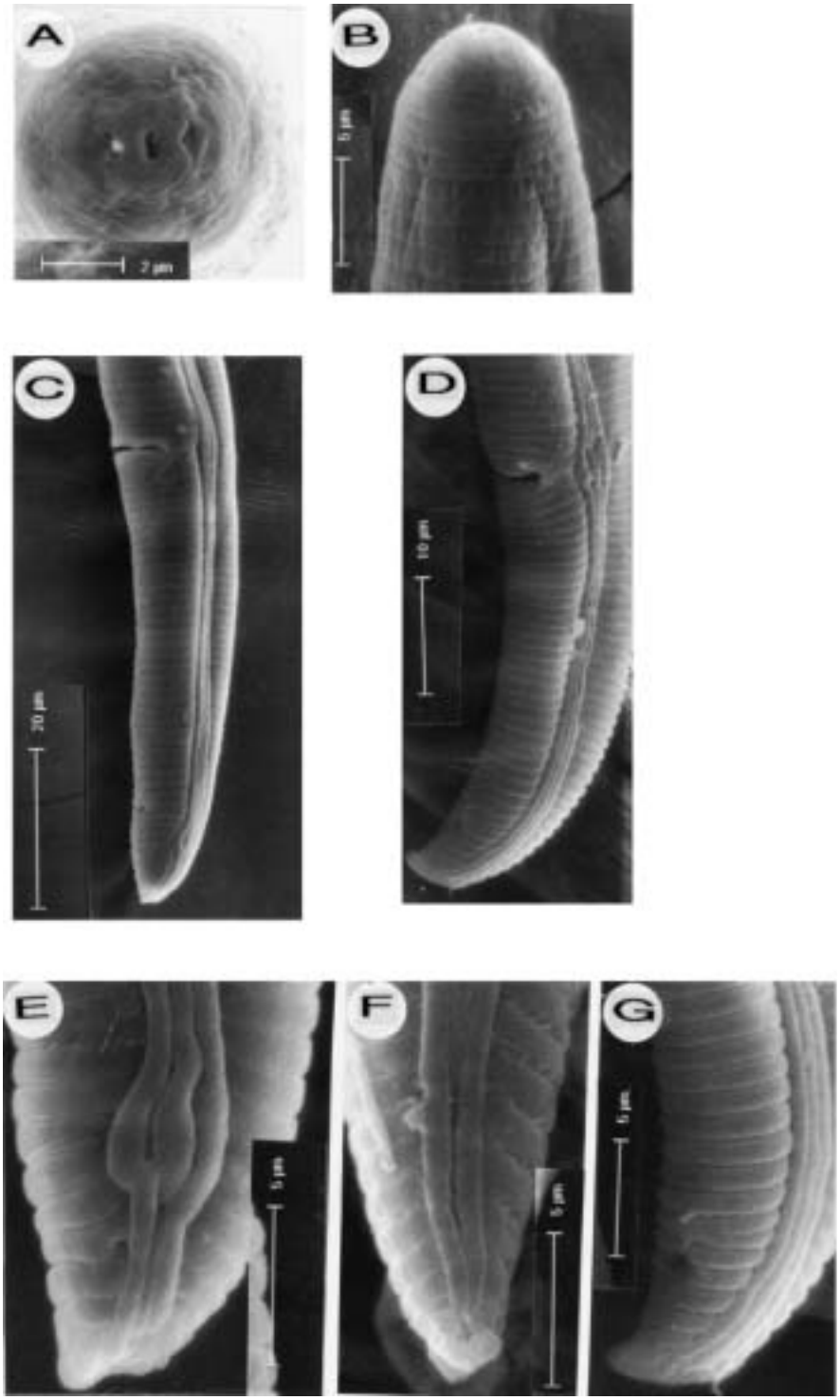

Fig. 1. *Helicotylenchus variocaudatus,* female. **A**: lip region, en face view; **B**: anterior part of body, lateral view **C–D**: posterior part of body with vulva; **E–G**: variation in posterior part of body.

Table 1. Comparison of characters used by Luc (1960) to distinguish between *Helicotylenchus affinis* and *H. variocaudatus.*

Character	*H. affinis* acc. to Luc (1960)	*H. variocaudatus* acc. to Luc (1960)	*H. variocaudatus* acc. to Vovlas et al. (1995)	*H. variocaudatus* from São Tomè[a]	*H. variocaudatus* from Rwanda
Stylet length (µm)	25 (25–26.5)	28 (26–31)	25 (24–27)	28–29	28 (26–31)
Tail length (µm)	11.5–16	14–24	17(15–22)	18–20	15 (10–17)
Ending of inner two lines of lateral field	y-shaped	u- and y-shaped	u- and y-shaped	u- and y-shaped	u-, y- and m-shaped
Distance between vulva and anus divided by tail length.	3.1 (2.4–4.4)	2 (1.6–2.2)	–	2.3–2.5	2.7 (1.7–3.7)
Position of phasmid	1–2 annuli posterior to anus[b]	3–5 annuli posterior to anus[b]	3–4 annuli posterior to anus	3–4 annuli posterior to anus	One annulus anterior to four annuli posterior to anus

[a]Measurements calculated from specimens on loan.
[b]Figures calculated from illustrations in relevant literature.

ventral annuli.

Males (n = 2). Habitus straight, tapering to tail. Lip region 3–5 µm high and 8–10 µm wide, anteriorly slightly flattened with four annuli. Outer margins of labial framework extend 1–3 µm backward from basal plate. Stylet knobs 1 µm high and 4 µm wide, anteriorly indented. Median bulb oval, 10 µm long and 7 µm wide, valve 2 µm long and 1 µm wide. Oesophagus length to end of glands 104 µm. Excretory pore 82–83 µm from anterior end, i.e. at 16 % of body length. Body width at excretory pore 15 µm, at midbody 15–16 µm and at cloaca 10–11 µm. Hemizonid 2 annuli long, located directly anterior to excretory pore (n = 1). Width of annulus at midbody 1.4–1.8 µm. Lateral field 3 µm wide, areolated in the region of the oesophagus and opposite bursa. Tail 13–15 µm long, conical, with finger-like projection. Bursa surrounds tail tip.

Remarks

The specimens were identified as *H. variocaudatus* because of posterior position of vulva, presence of a postvulval uterine sac, stylet length and tail shape. Paratype specimens of *H. variocaudatus* and *H. affinis* were not available for study. Luc (1960) differentiated *H. affinis* from *H. variocaudatus* by the following characters (Table 1): stylet length, tail length, position of phasmids, ending of inner lines of lateral field on tail and the distance between vulva and anus divided by tail length. The characters used by Luc (1960) to separate the two species were observed in all the Rwandan populations. Features such as 'shape of tail annuli', 'fusion of inner lines of lateral field on tail' and 'position of phasmids' have no specific value or are extremely variable (Fortuner 1984; Marais 2001) and the two species can no longer be distinguished from each other. *H. affinis* is therefore here proposed as a junior synonym of *H. variocaudatus.*

Whitehead (1958) erected the genus *Rotylenchoides* to accommodate the type and only species, *Rotylenchoides brevis,* and differentiated it from *Helicotylenchus* by the presence of a postvulval uterine sac only. Luc (1960) added *R. variocaudatus, R. affinis* and *R. intermedius* to the genus. *R. intermedius* has a greatly reduced posterior reproductive branch. Siddiqi & Husain (1964) described *Helicotylenchus neoformis,* a species similar to *R. intermedius,* stating that the reduction of the posterior reproductive branch had

no generic value. Sher (1966) considered this character as of generic value and transferred *H. neoformis* to the genus *Rotylenchoides.* Because *Rotylenchoides* differs from *Helicotylenchus* only in the regression of the posterior reproductive branch, and because of the existence of intermediate forms, Fortuner (1984) synonymised *Rotylenchoides* with *Helicotylenchus,* recognising the regression as a valid specific character with three states within the genus *Helicotylenchus*: two branches functional, equally or almost equally developed; posterior branch non-functional as a row of degenerated cells and posterior branch reduced to a postuterine vulval sac. Siddiqi (1986) again reinstated *Rotylenchoides* as a valid genus. Both Ebsary (1991) and Firoza & Maqbool (1994) accepted the diagnosis for the genus *Helicotylenchus* as proposed by Fortuner (1984). With the description of two new species of *Rotylenchoides* from Cameroon, Siddiqi (1995) suggested that *Rotylenchoides* could be considered a subgenus of *Helicotylenchus.* Marais (1998), in turn, described *Helicotylenchus delanus* with a reduced posterior reproductive branch and thereby recognised the synonymisation proposed by Fortuner (1984). Siddiqi (2000) considered *Rotylenchoides* as a valid genus in the subfamily Rotylenchoidinae Whitehead, 1958. In an extensive study of the systematics of the genus *Helicotylenchus* in South Africa, French Guiana and the French Caribbean, Marais (2001) found that the position of the vulva (V value) was very consistent, but the value 'posterior reproductive branch length/anterior reproductive branch length × 100' showed variability. The intra- and interspecies variation of this character illustrated the existence of intermediate stages in the regression of the posterior reproductive branch and therefore supports the synonymisation of *Rotylenchoides* with *Helicotylenchus.* Four states of regression was suggested for *Helicotylenchus* by Marais (2001): two branches both functional, equally or almost equally developed, vulva at 60 % of body length; two branches both functional, almost equally developed with the vulva in a more posterior position, at 70 %; posterior branch non-functional, appearing as a row of degenerated cells and posterior branch reduced to a postvulval uterine sac. The following species are hereby transferred to the genus *Helicotylenchus*:

Helicotylenchus attenuatus (Siddiqi, 1995) **comb.n.**
Rotylenchoides attenuatus Siddiqi, 1995: 196.
Helicotylenchus (Rotylenchoides) attenuatus Siddiqi, 1995: 196.

Helicotylenchus brevis (Whitehead, 1958) Fortuner, 1984: 257.
Rotylenchoides brevis Whitehead, 1958: 327.

Helicotylenchus delanus Marais, 1998: 327.
Rotylenchoides delanus (Marais, 1998) Siddiqi, 2000: 300.

Helicotylenchus khani Fortuner, 1984: 259.
Rotylenchoides impar Khan, Saha & Chawla, 1980: 118.

Helicotylenchus intermedius (Luc, 1960) Siddiqi & Husain, 1964: 214.
Rotylenchoides intermedius Luc, 1960: 9.

Helicotylenchus neoformis Siddiqi & Husain, 1964: 212.
Rotylenchoides neoformis (Siddiqi & Husain, 1964) Sher, 1966: 54.

Helicotylenchus subterminalis (Siddiqi, 1995) **comb.n.**
Rotylenchoides subterminalis Siddiqi, 1995: 195.
Helicotylenchus (Rotylenchoides) subterminalis Siddiqi, 1995: 195.

Helicotylenchus valdeclarus (Orton Williams, 1983) Ebsary, 1991: 36.
Rotylenchoides valdeclarus Orton Williams, 1983: 30.

Helicotylenchus variocaudatus (Luc, 1960) Fortuner, 1984: 257.
Rotylenchoides variocaudatus Luc, 1960: 12.
Helicotylenchus affinis (Luc, 1960) Fortuner, 1984: 258.
Rotylenchoides affinis Luc, 1960: 14.

Helicotylenchus whiteheadi (Ganguly & Khan, 1987) Firoza & Maqbool, 1994: 20.
Rotylenchus whiteheadi (Ganguly & Khan, 1987) Castillo, Vovlas, Gómez-Barcina & Lamberti, 1993: 39.
Rotylenchoides whiteheadi Ganguly & Khan, 1987: 18.

Rotylenchulus borealis Loof & Oostenbrink, 1962, Figs 2, 3
Rotylenchulus borealis Loof & Oostenbrink, 1962: 83.

This species is widespread in the banana-producing areas of Rwanda, being present at 29 localities in 10 districts of the five provinces. It has also been found in several European countries as well as in West Africa, Cameroon, Kenya and South Africa. This is the first report of this species from Rwanda.

Measurements

Females (n = 8). L = 426 ± 18.8 (406–457) µm; a = 25.5 ± 2.5 (20.5–28.9); b = 3 ± 0.2 (2.8–3.3); c = 13.2 ± 1 (11.6–14.5); c' = 3.4 ± 0.4 (2.7–3.7); o =

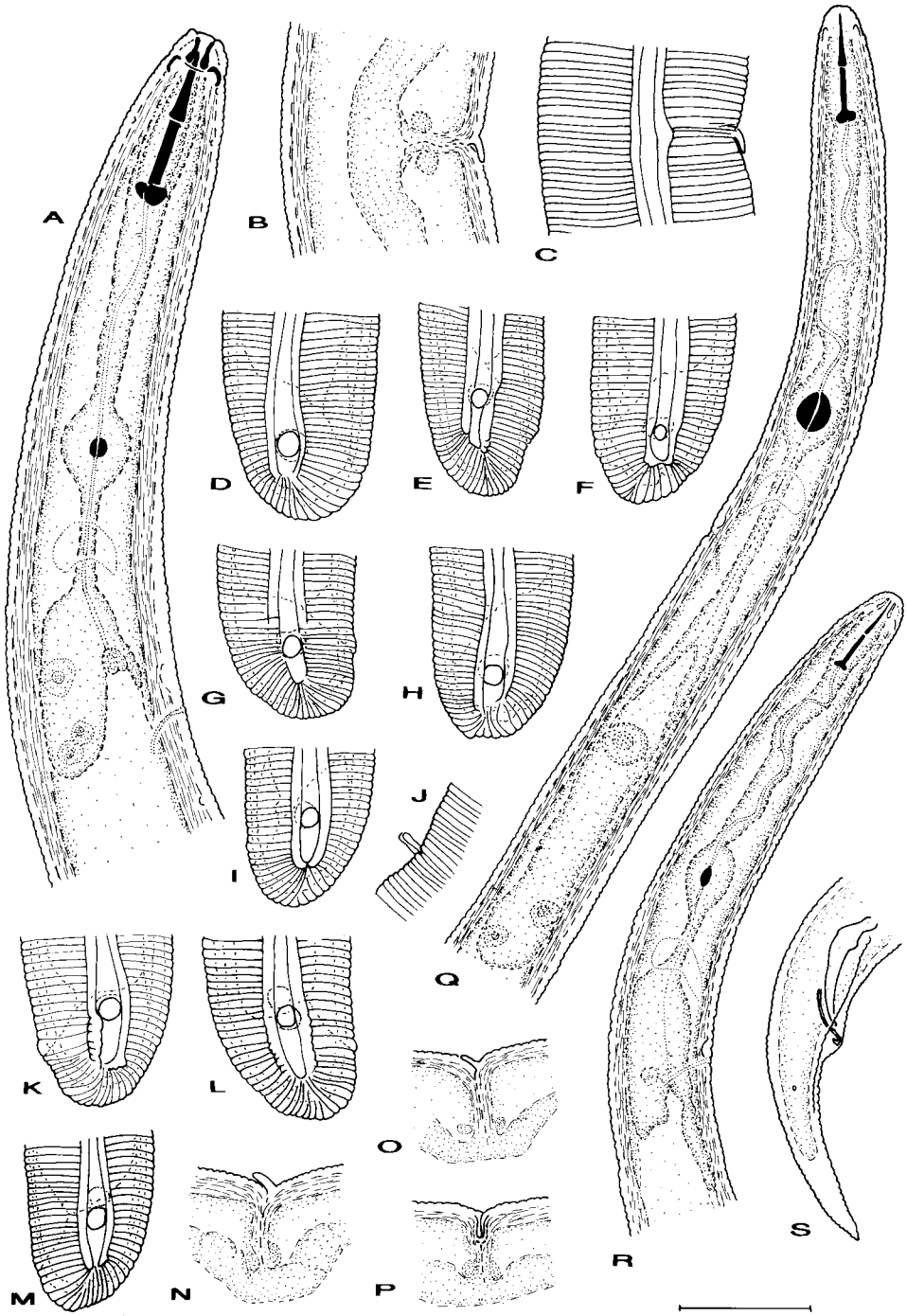

Fig. 2. *Scutellonema paralabiatum.* Rwandan population, female; **A**: anterior part of body; **B**: vulval area, internal view; **C**: vulval area, external view; **D–I**: posterior part of body with variation in lateral field endings; **J**: projecting epiptygma. Ugandan paratypes; **K–M**: posterior part of body with variation in lateral field endings; **N–P**: vulval area with epiptygma. *Rotylenchus borealis*; **Q**: anterior part of female body; **R**: anterior part of male body; **S**: male tail. Scale bar = 20 µm.

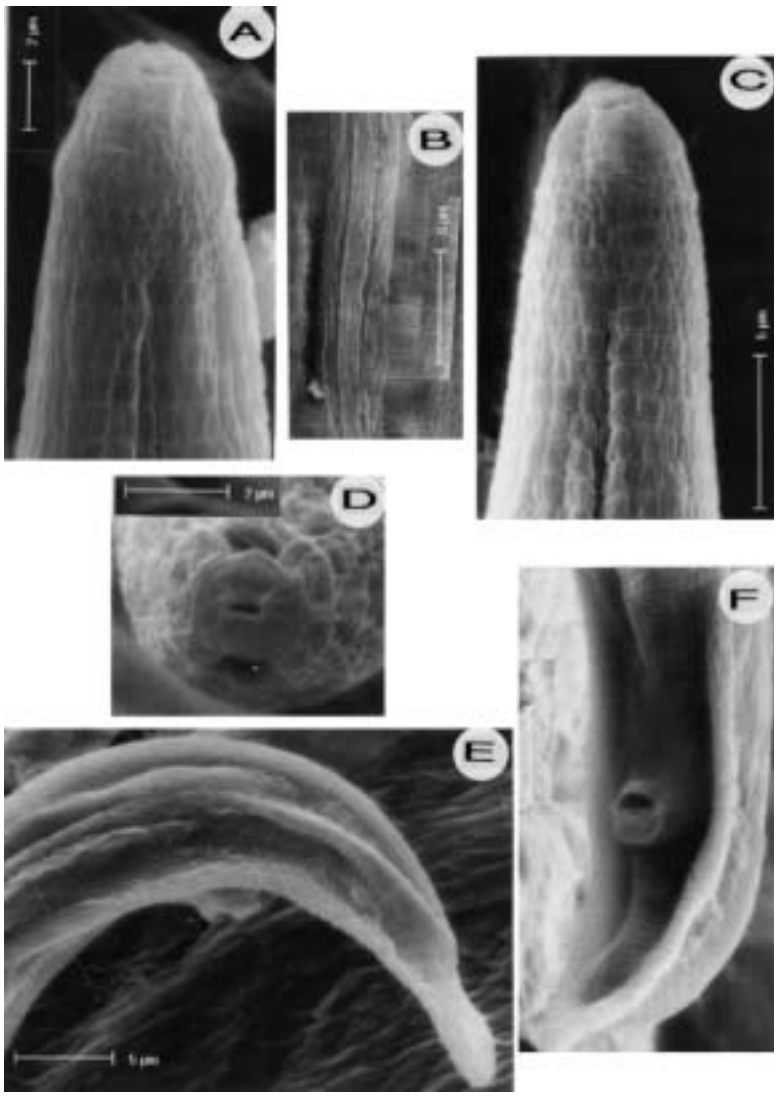

Fig. 3. *Rotylenchulus borealis.* Female; **A**: anterior part of body, lateral view. Male; **B**: lateral field at midbody; **C**: anterior part of body, lateral view; **D**: lip region, en face view; **E–F**: posterior part of body.

142.1 ± 21.7 (124.5–160); DOG = 23 ± 2.1(20.5–26.5) µm; V = 64 ± 1.9 (61–67); OV_1 = 10 ± 0.6 (9–11); OV_2 = 10 ± 1 (8–11); stylet = 16 ± 0.5 (15–16.5) µm; metenchium = 7.5 ± 0.6 (6.5–8.5) µm; telenchium = 8.5 ± 0.3 (8–9) µm; stylet knob height = 1.8 ± 0.3 (1.5–2) µm; stylet knob width = 3 ± 0.3 (2.5–3) µm; oesophagus length = 144 ± 5.5 (135.5–153) µm; excretory pore from anterior end = 87 ± 4.5 (82–95) µm; lip region width = 7.5 ± 0.4 (6.5–8) µm; lip region height = 4 ± 0.15 (3.7–4) µm; width at midbody = 17 ± 1.6 (15.5–20) µm; annuli width at midbody = 1.4 ± 0.2 (1.1–1.5) µm; lateral field width = 3 ± 0.3 (3–4) µm; tail length = 32.5 ± 3.1 (28–37) µm; h = 12 ± 1.4 (10–14) µm.

Males (*n* = 5). L = 478 ± 25.1 (448–513) µm; a = 28.4 ± 3.1 (25–33); b = 4.3 ± 0.3 (3.8–4.5); c = 14 ± 0.7 (12.7–14.6); c' = 2.9 ± 0.4 (2.6–3.5); o = 155.5 ± 30.2 (129.4–193.8); DOG = 19.5 ± 3.1 (16–23) µm; stylet = 12 ± 0.8 (11.5–13) µm; stylet knob height = 0.7 ± 0.1 (0.4–0.7) µm; stylet knob width = 1.5 ± 0.2 (1.1–1.8) µm; oesophagus length = 112.5 ± 6.5 (103–120) µm; excretory pore from anterior end = 87 ± 4.6 (81–93) µm; lip region

width = 7 ± 0.6 (6–7) µm; lip region height = 4 ± 0.4 (3.7–4.4) µm; width at midbody = 17 ± 1.9 (15–19.5) µm.

Remarks

The morphology and morphometrics compare very well with the specimens from West and South Africa (Germani & Luc 1978; Sakwe & Geraert 1992; Van den Berg 1998) except for the following: female stylet slightly longer (15–16.5 vs 12–15 µm), hyaline part of male tail longer (12–18.5 vs 3–11 µm), male oesophagus degenerate with median bulb valve and lumen distinct vs absent (Sakwe & Geraert 1992), males with a very distinct hook-like distal end were also reported by Sakwe & Geraert (1992) but not mentioned by Germani & Luc (1978), or observed in the South African specimens (Van den Berg 1998).

Scutellonema paralabiatum Siddiqi & Sharma, 1994, Figs 2, 4

Scutellonema paralabiatum Siddiqi & Sharma 1994: 35.

Measurements

Rwandan females (*n* = 27). L = 728 ± 42.9 (640–813) µm; a = 23.1 ± 1.5 (20.8–26.3); b = 6.8 ± 0.5 (6–7.9); b' = 5.8 ± 0.6 (5–7.2); c = 99.5 ± 22.5 (72.5–158); c' = 0.4 ± 0.08 (0.29–0.6); o = 24 ± 3.4 (18.5–31.9); V = 59 ± 1.3 (56–61); OV_1 = 21 ± 3.1 (15–29); OV_2 = 20 ± 1.8 (16–22.5); stylet = 25.5 ± 1.3 (22.5–27) µm.

Paratypes (Uganda) (*n* = 4). L = 671 ± 69 (578–729) µm; a = 24.8 ± 1.4 (23.1–26.1); b = 6.9 ± 0.6 (6.3–7.4); b' = 5.6 ± 0.4 (5–6); c = 85.5 ± 18.7 (59.1–99.4); c' = 0.47 ± 0.1 (0.38–0.61); o = 16.3 ± 3.2 (14–19.4); V = 59 ± 0.5 (59–60); OV_1 = 23 ± (20–24.5); OV_2 = 20; stylet = 25 ± 0.8 (24–26) µm.

Description

Females. Body form an open or closed 6 or complete circle. Lip region broad, high, flattened, not set off, 10 ± 0.5 (9–11) µm wide and 5.5 ± 0.5 (4.5–6.5) µm high; five or six lip annuli present, occasionally seven, with about 14–20 areolations on basal lip annulus, not discernible under light microscope; scanning electron microscope shows them to be very irregular; lip region with irregular blocks present on all annuli. En face view shows a round, non-raised oval labial disc surrounded by a six-sector first lip annulus; subdorsal and subventral sectors distinct, seen laterally when viewed under the light microscope. Labial framework strongly developed, reaching backward 2–3 annuli from basal plate. Anterior and posterior cephalids distinct in most specimens situated three or four and nine to thirteen annuli, respectively, from basal plate. Stylet well developed with stylet knobs indented anteriorly, 3 ± 0.3 (2–4) µm high and 5 ± 0.4 (4–6) µm wide. Metenchium shorter than telenchium (m = 38.5–49.4 %). Dorsal oesophageal gland opening 6 ± 0.9 (4.5–8) µm posterior to base of stylet. Oesophagus 127 ± 9.5 (108–145) µm long with a 20 ± 6.1 (9.5–32) µm intestinal overlap. Excretory pore situated opposite the oesophageal lobe from level of oesophagointestinal junction to base of oesophagus, 115.5 ± 8 (100–135) µm from anterior end of body. Hemizonid distinct, 2–4 annuli long, situated from opposite five annuli anterior to excretory pore. Hemizonion three quarters of an annulus to one annulus long situated 13–20 annuli posterior to hemizonid. Annuli width at midbody 1.3 ± 0.2 (1–1.5) µm. Width at midbody 31.5 ± 2.9 (26–38) µm. Spermatheca small, round and empty in all specimens; both genital tracts equally developed. Two distinct, rounded vulval glands present. Epiptygma double, 4.5 ± 0.6 (2.5–5) µm long, one flap, mainly posterior one, is folded into the vulva and one, mainly the anterior one, is folded over the vulval opening; in only four specimens the double epiptygma projected straight outwards. No intestinal overlap over rectum. Scutellum situated from just posterior to two annuli anterior to anus, 2.7 ± 0.6 (1.8–3.7) µm wide, with internal pouch 4 ± 0.3 (3.3–4.5) µm wide. Lateral field 6 ± 0.8 (5–7.5) µm wide, areolated opposite oesophageal area, not opposite scutellum, ending on tail very variable (Fig. 2D–I). Caudalid not seen. Tail 7.5 ± 1.6 (4.5–10) µm long, evenly rounded to more rounded on dorsal side with 8–14 ventral annuli mostly irregular and/or smaller than on rest of body.

Material examined. Forty-three females, of which 27 were measured, from banana fields in the Bugarama, Gishoma, Karengera, Rubava and Nyamvumba districts of the Gyangugu and Gisenyi provinces of Rwanda.

Discussion

Twenty-three of the 60 samples contained *S. paralabiatum.* This species was originally described from pigeon pea (*Cajanus cajan* (L.) Millsp.) from Kenya and has also been found on sweet potato (*Ipomoea batatas* (L.) Lam.) in Uganda. This is the first report of this species from Rwanda. The present specimens compare well

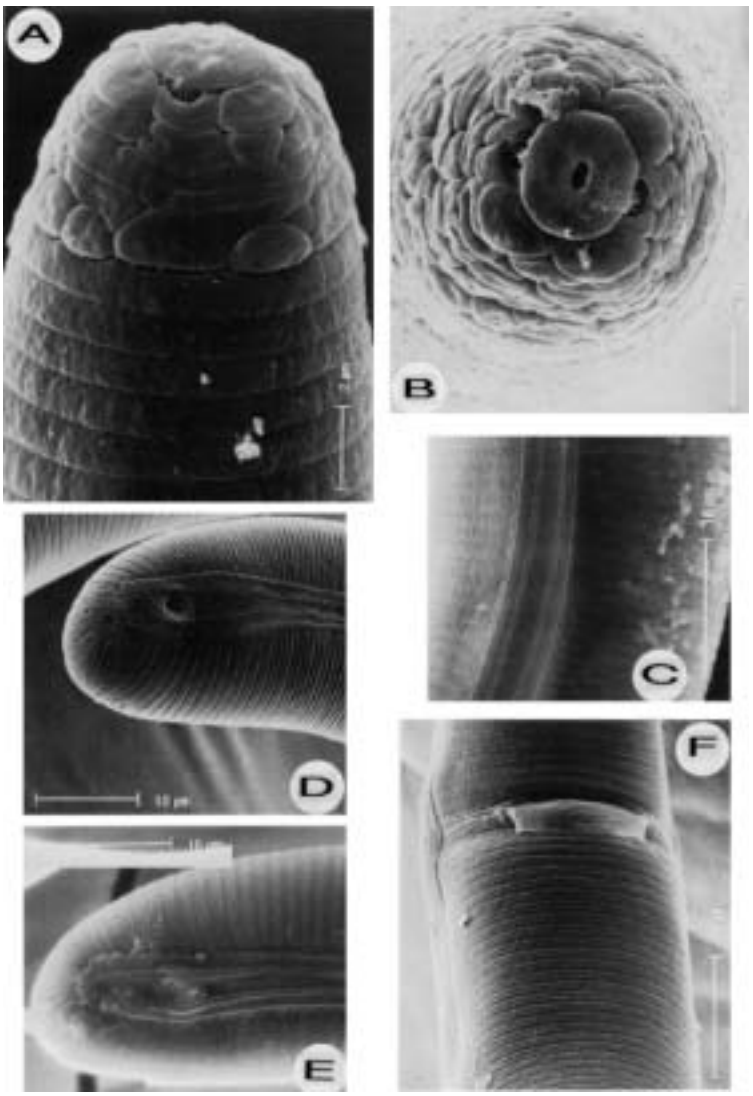

Fig. 4. *Scutellonema paralabiatum,* female. **A**: lip region, lateral view; **B**: lip region, en face view; **C**: lateral field at midbody **D–E**: posterior part of body; **F**: vulva with overlying epiptygma.

with those described by Siddiqi & Sharma (1994) except for a shorter tail 7.5 (4.5–10) µm vs 10 (8–13) µm, larger c value [99.5 (72.5–158) vs 62 (49–77)], smaller c' value [0.4 (0.29–0.6) vs 0.64 (0.58–0.72)]; epiptygma projecting from body surface in only four females, while one flap is folded into the vulva and one flap folded over the vulval opening in the other specimens; tail annuli more irregular and smaller than noted by Siddiqi & Sharma (1994).

These specimens also compare well with *Scutellonema labiatum* Siddiqi, 1972 but differ mainly in the absence of males vs males present, lip region not offset vs slightly offset, stylet well developed with 2–4 µm high and 4–6 µm wide, anteriorly indented knobs vs weakly developed anteriorly flattened knobs, 2 µm high and 3.2–4.3 µm wide, epiptygma 2.5–5 vs 5–7 µm long, intestine not overlapping vs slightly overlapping; tail annuli frequently smaller or irregular vs coarser and regular.

Four paratypes from Uganda were studied. Their measurements compare well with those given by Siddiqi & Sharma (1994), but contrary to the

original description none of the specimens had a projecting epiptygma.

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