

On the Morphology of *Aphelenchoides besseyi*
Christie, 1942 and *A. siddiqii* n.sp. (Nematoda,
Aphelenchoidea)

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The "Institut des Recherches Agronomiques Tropicales et des Cultures Vivrières" (I.R.A.T.), the "Office de la Recherche Scientifique et Technique d'Outre Mer" (O.R.S.T.O.M.) and the Commonwealth Bureau of Helminthology (C.B.H.) took part in a survey of the geographical distribution in Africa of *Aphelenchoides besseyi* Christie 1942, the cause of white tip disease of rice. This survey, organized by the Inter-African Phytosanitary Commission, has so far recorded the presence of *A. besseyi* on rice in Gabon, Dahomey, Madagascar, Cameroon, Congo Kinshasa, Central African Republic, Chad, Togo, Ivory Coast, Ghana, Nigeria and the Comoro Islands (Peachey *et al.*, 1966; Barat *et al.*, 1969).

The specimens of *Aphelenchoides besseyi* examined by the present author were found on varieties Iguapé Catéto, 63-83, Taichung and 1084-123 from Séfa (Senegal), on variety Dissi from Bamako (Mali) and on variety Elite I from Saria and Boulbi (Upper Volta). The records for Mali and Upper Volta are here reported as new ones for these two countries. The details of the morphology of these nematodes are considered sufficiently interesting to add to the earlier descriptions of *A. besseyi*. These nematodes were then compared with a species of *Aphelenchoides* from *Foeniculum vulgare* Mill. from Sudan. This nematode differs from *A. besseyi* in several respects and is here described as a new species, *Aphelenchoides siddiqii*, named after Dr. M. Rafiq Siddiqi under whose supervision this work was carried out.

To extract *A. besseyi*, fragments of diseased leaves and grains were placed in water for several days and the water was examined periodically with a dissection microscope. The nematodes were killed by gentle heat and were mounted on slides by the glycerol-ethanol method of Seinhorst (Goodey, 1963). Some nematodes were placed in test tubes with a nutritive solution (10g. of Maltea Moser and 20g. of Agar—Agar in one litre of distilled water) and the tubes were deliberately contaminated with the fungus *Alternaria oleracea* Milb.

*This work was done while on study leave at the Commonwealth Bureau of Helminthology, St. Albans, Herts, England.

Each tube was then inoculated with about 20 nematodes and was kept in the dark at 28 to 30°C (Huu-Hai-Vuong, 1968). The nematodes developed rapidly on the fungus in the tubes and some of them were killed and mounted by the rapid lactophenol method (Goodey, 1963).

APHELENCHOIDES BESSEYI Christie, 1942

syn. *A. ORYZAE* Yokoo, 1948

Asteroaphelenchoides besseyi (Christie, 1942) Drozdovski, 1967

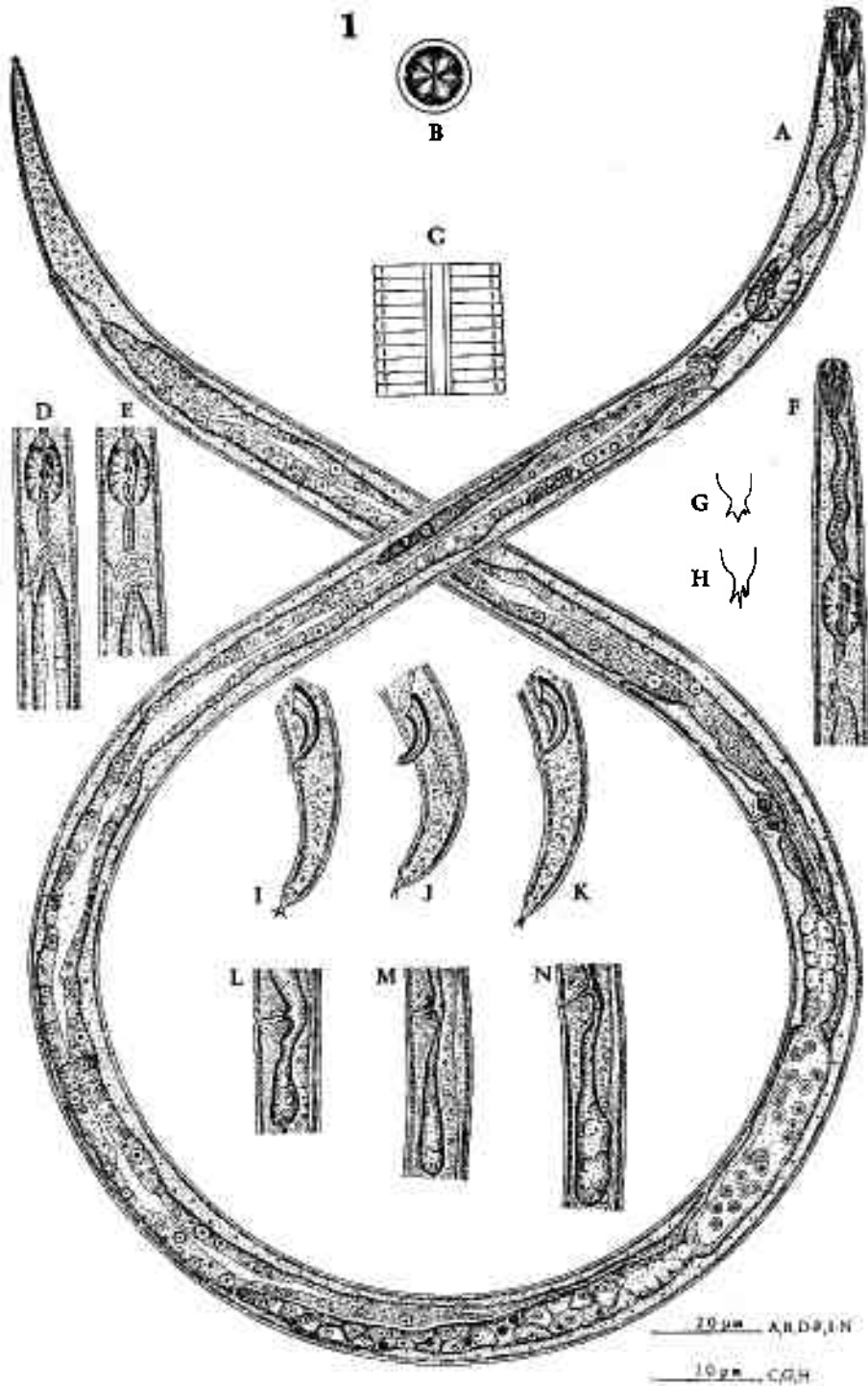
(Fig. 1, A-N)

Description

Female: Body slender, slightly arcuate ventrally when relaxed, anteriorly tapering from the level of oesophageal glands to the head which is one half of the body width. Cuticular striations 0.9 to 1.1 μm apart on midbody. Lateral field with 4 incisures, one fourth to one fifth of body width. In *en face* view, the pore like amphids are on outer margins of lateral lips; 4 papillae, one on each submedian lip (Fig. 1, B). Lip region non-striated and set off from body by a constriction as wide as or slightly wider than adjacent body; labial framework weakly developed; cheilorhabdions well sclerotized. Basal knobs of spear distinct, 2 μm across. Procorpus cylindrical; median oesophageal bulb one and a half times to twice as long as wide, with refractive valvular apparatus slightly posterior to centre. Oesophageal glands extending over intestine 5 to 8 body widths. Excretory pore at 58 to 83 μm from anterior end, level with or slightly anterior to nerve ring. Hemizonid distinct in specimens from rice seeds (but not from cultured specimens), 11 to 15 μm behind excretory pore; hemizonion 20 to 30 μm behind hemizonid, usually difficult to see. Tail straight, slender, regularly tapering to a narrowly rounded end, 3.5 to 5 anal body diameters long; mucro with 3 to 4 processes as illustrated in Fig. 1, G-H.

Ovary not extending to oesophageal glands; oocytes in 2 to 4 rows; spermatheca very conspicuous, elongate oval, full of rounded sperms showing a central nucleolus usually surrounded by a circle of black dots of unknown nature (Fig. 1, A). Postvulval uterine sac short, slender and extending up to one fourth of the distance from vulva to anus (2.5 to 3 body diameters) often found empty and collapsed but more conspicuous and rounded in nematodes from cultured specimens. Vulval lips slightly protruding.

Fig. 1, A-N.—*Aphelenchoides besseyi* Christie, 1942. A. Female. B. *En face* view, female. C. Lateral field. D & E. Variation in female oesophageal bulb and position of excretory pore. F. Anterior end, male. G & H. Tail mucro, female. I, J & K. Tails, male. L, M & N. Variations in post-vulval uterine sac.



Male: In specimens killed by gentle heat, tail end usually curved by 90° (a greater curvature has also been found); mucro of diverse shape, with 2 to 4 processes. Spicula 17 to 21 μm long when measured along dorsal limb; proximal end lacking a dorsal process but with a little developed ventral one. Caudal papillae variable in position as illustrated in Fig. 1, I-K.

The details of *A. besseyi* given above are compared with earlier ones in Table 1.

Through the courtesy of Dr. Mary T. Franklin of Rothamsted Experimental Station, Harpenden, I had the opportunity of studying specimens of *A. besseyi* from strawberry in U.S.A. and from rice in Japan. The characters based on the shape of the head, the position of the excretory pore in relation to the nerve ring and the shape and length of the postvulval uterine sac were also found to be variable in these specimens.

Nematodes extracted by Dr. A. V. Palo from the aerial portions of *Boehmeria nivea* Gaud. (Ramie), grown in the southern part of the Philippines were identified as *A. besseyi* by Dr. Franklin. The tips and apical portions of the infested plants were browned. Diseased plants soon stopped growing. *B. nivea* is here reported as a new host for *A. besseyi*.

A. siddiqii n.sp. is related to *A. besseyi* but differs from this species in several characters as shown by the following description.

APHELENCHOIDES SIDDIQII n.sp.

(Fig. 2, A-Q)

Measurements

Females ($n = 25$): Length 506 μm (370-700); $a = 32.48$ (26.66-38.88); $b = 8.28$ (7.14-9.72); $b' = 4.08$ (3.49-4.74); $c = 16.58$ (14.11-19.64); $V = 29.9869.832.72\%$ (23.57-34.3864.32-72.401.20-3.82%); spear = 11.6 μm (11.0-12.5).

Holotype female: length = 498 μm ; $a = 34.37$; $b = 8.66$; $b' = 3.98$; $c = 19.17$; $V = 32.2971.211.60\%$; spear = 11 μm .

Males ($n = 2$): length = 325-350 μm ; $a = 29.16-29.54$; $b = 6.73-6.77$; $b' = 3.57-3.84$; $c = 13.72-14.77$; $T = 43.69-45.42$; spear = 10 μm .

Fig. 2, A-Q.—*Aphelenchoides siddiqii* n.sp. A. Female. B. Anterior end, female. C. *En face* view, female. D. Transverse section of body. E. Lateral field. F, G. Post-vulval uterine sac. H & I. Male tail. J & K. Female tail. L & M. Male tail mucro. N, O & P. Female tail mucro. Q. Vulva, ventral view.

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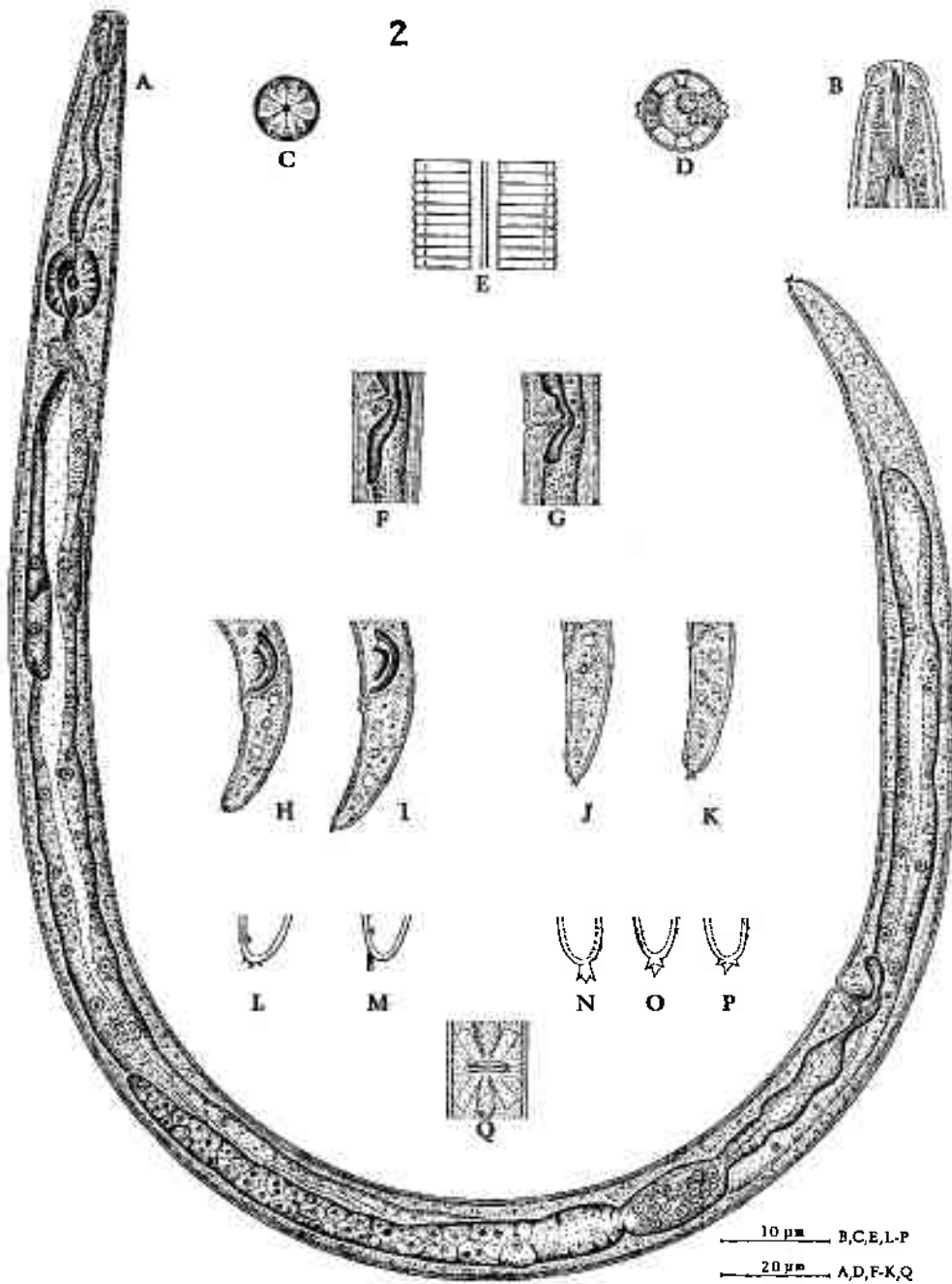


TABLE I
Measurements and characters of *A. besseyi* as previously published, compared with *A. besseyi* in the present study.

Characters	Dastur 1936	Christie 1942	Allen 1952	Timm 1955	'Ikhonova 1960	Barat <i>et al.</i> 1966	Nematodes from culture*	Nematodes from rice seeds**
♀ length (μm)	400-800	660-750	620-680	745-858	689-818	540-640	640-750 (683)	570-640 (681)
a	22-43	32-42	38-58	51-57.3	39-51	37-42	50-71-68-00 (58-58)	39-31-53-49 (47-77)
b**	5-11	10.2-11.4	9-12	10.5-11.8	7-10	9-11	9.85-13.33 (10-94)	9.21-13.19 (11-46)
b'***	—	—	—	—	—	—	4.38-6.97 (5-48)	4-06-5.77 (4-66)
c	8-20	17-20	15-20	18.1-20.9	17-19	15-20	14-88-18.37 (17-08)	13-63-20-44 (17-74)
V%	64-80	68-70	66-72	71-74.8	68-75	71-75	67-48-72.67 (70-56)	66-78-73-68 (71-21)
ovary %	—	—	33-43	29	—	—	14-84-40-69 (26-68)	19-91-39-10 (27-99)
Post vulval sac %	—	—	4-8	—	—	—	4-53-7-03 (5-45)	4-14-6-20 (4-92)
spear (μm)	10-15	—	10	11-2	9-10-6	10-12	11-13 (11-7)	10-12-5 (11-9)
♂ length (μm)	500-620	540-620	440-720	532-634	606-770	530-600	440-590 (509)	530-610 (573)
a	18-45	36-39	36-47	27-3-42	34-47	36-46	42-14-58-66 (49-16)	40-76-46-92 (44-44)
b**	3-12	8.6-8.8	9-11	9.5-9.8	7-9	9-11	7-89-9-81 (8-88)	8-87-10-70 (9-52)
b'***	—	—	—	—	—	—	3-23-4-95 (4-04)	3-57-4-91 (4-09)
c	12-7-23	15-17	14-19	15-3-18	15-19	15-19	13-90-19-25 (17-16)	16-06-20-00 (17-97)
T %	—	—	50-65	—	—	—	13-07-49-61 (36-14)	28-17-52-26 (40-59)
spear (μm)	—	—	—	—	9-9.5	—	—	10-12-5

TABLE I (continued)

	10-2-13-2	—	20	14-10-4	17-19 (18)	(11-4) 18-21 (19-2)
Spicula, μm (dorsal limb) Lip region	off set, slightly flattened	—	well off set	well off set appears wider than neck in Fig. 1, A.	appears set off, flattened not wider than neck in Fig. 1, A.	set off, sometimes wider than neck
Excretory pore	slightly post. to, or level with end of bulb	slightly antr. to nerve ring	just antr. to nerve ring	post. to bulb, appears post. to nerve ring in Fig. 1, A.	slightly antr. to, or level with nerve ring	slightly antr. to, or level with nerve ring
Median oesophageal bulb	oval, ovoid or broadly elliptical	—	almost circular	appears broadly rectangular in Fig. 1, A.	well developed	oval- elongate
Stylet knobs	2, well developed	moderately well developed	distinct, asymmetrical	distinct	moderately sized	distinct
Postvulval uterine sac	30-40 μm long	short, narrow, inconspicuous, less than 1/3 to anus, rarely with sperms	narrow, up to $\frac{1}{4}$ to anus rarely with sperms	reduced, act as a spermatheca	short, narrow, inconspicuous rounded but without sperms	short slender flattened, without sperms

*Details from 20 females and 10 males of *Aphelenchoides besseyi* examined from fungus culture of nematodes originally extracted from rice seeds from Séfa, Sénégal.

**Details from 20 females and 9 males of *A. besseyi* examined directly after extraction from rice seeds from Séfa, Sénégal.

***b = total length of nematode body divided by distance between head and posterior end of median oesophageal bulb.

b' = total length of nematode body divided by distance between head and posterior end of oesophageal glands.

Description

Female : Body cylindrical, ventrally arcuate when relaxed, tapering anteriorly from the level of median oesophageal bulb to the head which is one half to one third of midbody width. Annules about 1 μm wide, interrupted by lateral field, about one fifth of midbody width ; 4 incisures dividing it into 3 bands, outer ones being much wider than middle one (Fig. 2, D). Amphids pore like, on the very outer margins of lateral lips ; 4 papillae, one on each submedian lip (Fig. 2, C). Lip region nonstriated, offset from body by a constriction, as wide as the adjacent neck ; labial framework weakly developed ; cheilorhabdions conspicuous. Knobs of spear distinct, as illustrated in Fig. 2, B. Procorpus cylindrical, median oesophageal bulb oval with valvular apparatus in centre or slightly posterior ; oesophageal glands extending over intestine at a distance equal to 4 to 5 times the body width. Excretory pore 56 to 81 μm from anterior end, usually opposite the posterior margins of the nerve ring, sometimes reaching near its anterior margins. Posterior cephalids just behind the level of spear base ; anterior cephalids not seen ; hemizonid 10 to 15 μm posterior to excretory pore, difficult to see ; hemizonion not seen. Tail slightly convex dorsally, subcylindrical with a broadly rounded tip, 3 to 4 anal body diameters long, bearing a star shaped mucro with 3 to 4 processes (Fig. 2, N-P).

Ovary outstretched, its tip staying well short of oesophageal glands, with oocytes in 2 to 4 rows ; spermatheca oval, full of small rounded sperms ; postvulval uterine sac empty, one half to one body diameter long ; vulva a transverse slit, two fifths of body width long (Fig. 2, Q) ; vulval lips slightly protruding.

Male : Apparently rare but the spermatheca in all the females examined were full of sperms. Tail end ventrally curved through 90° when relaxed. Mucro of variable shape as illustrated (Fig. 2, L-M). Spicula 16 to 17 μm long as measured along dorsal limb ; proximal end without a dorsal process but with a little developed ventral one. Three pairs of caudal papillae : front pair adanal, middle one a little anterior to mid-tail, and the rear one subterminal (Fig. 2, H-I).

Type habitat : Soil sample collected from around roots of *Foeniculum vulgare* Mill. by Dr. El Tigani M. El Amin.

Type locality : Abu Naama, Northern Fung Area, Blue Nile Province, Sudan ; also found around roots of *F. vulgare* at Layona, in the same area.

Type material : Holotype female, a paratype male and 5 paratype females deposited with Nematology Department, Rothamsted Experimental Station, Harpenden, Herts, England ; 3 paratype females at Laboratoire de Nématologie, Route du Cap, Antibes, France, and the remaining paratypes at the Commonwealth Bureau of Helminthology, St. Albans, Herts, England.

Relationships : Among the species of *Aphelenchoides* bearing a star shaped mucro on the female tail tip, *Aphelenchoides siddiqii* n.sp. comes close to *A. asteromucronatus* Eroshenko, 1967 in having a short posterior uterine sac measuring one vulval body width or less. It differs from this species in having oocytes in multiple rows, spermatheca packed with sperms and a subcylindrical tail. According to Eroshenko (1967), the males are absent in *A. asteromucronatus*. *A. siddiqii* n.sp. has also many affinities with *A. besseyi* Christie, 1942 and *A. goodeyi* Siddiqi & Franklin, 1967 in having multiple rows of oocytes in the ovary. It differs from *A. besseyi* in having a subcylindrical tail with a broadly rounded tip, shorter postvulval uterine sac, less conspicuous spermatheca and smaller sperms. It differs from *A. goodeyi* by a much shorter postvulval uterine sac, more distinctly offset lip region and the presence of spermatheca and males. *A. ritzemabosi* (Schwartz, 1911) Steiner & Buhner, 1932, the remaining species in the genus with a star tipped tail and several rows of oocytes, differs markedly from *A. siddiqii* n.sp. in having a larger body size, much longer postvulval uterine sac and a conical tail.

The new species has the distinctive characters of the genus *Asteroaphelenchoides* Drozdovski, 1967, i.e. spicula without dorsal process and with ventral one weakly developed, and tail having a sessile star shaped mucro, *A. besseyi* (Christie, 1942) Drozdovski, 1967 being the type and only species. However, there are 10 known species of *Aphelenchoides* which have a sessile star shaped mucro on the tail, and males are known for only 4 of these. In these cases, it is very difficult to determine the size of the ventral and dorsal processes of the spicula. Hence, the present author is unable to differentiate *Asteroaphelenchoides* from *Aphelenchoides* and considers it a synonym of the latter.

The following key is given to the species of *Aphelenchoides* with a star tipped tail.

Key to *Aphelenchoides* spp.

with star tipped female tails

1. Stylet without knobs *andrassyi*
Husain & Khan, 1967
Stylet with knobs 2
2. Stylet length over 17 μm *appendurus*
Singh, 1967
Stylet length under 15 μm 3
3. Oocytes in several rows 4
Oocytes in single row 7
4. Postuterine sac longer than half
vulva-anus distance *ritzemabosi*
(Schwartz, 1911)
Steiner & Buhrer,
1932
Postuterine sac shorter than half
vulva-anus distance 5
5. Postuterine sac one body
diameter or less *siddiqii* n.sp.
Postuterine sac longer than
body diameter 6
6. Excretory pore posterior to nerve
ring, males absent, head slightly
set off, never expanded *goodeyi*
Siddiqi &
Franklin, 1967
Excretory pore at level with or
anterior to nerve ring, males
present, head distinctly set off,
sometimes expanded *besseyi*
Christie, 1942
7. Stylet knobs as slight swellings,
males present, excretory pore
slightly anterior to or level
with nerve ring *aligarhiensis*
Siddiqi, Husain
& Khan, 1967

- Stylet knobs distinct, males absent,
excretory pore posterior to or level
with posterior margin of nerve ring ...8
8. Stylet less than 10 μm , lateral
field with 4 incisures.....9
Stylet 12 μm or longer, lateral
field with 2 or 3 incisures10
9. Female 530 μm long or under.....*asteromucronatus*
Eroshenko, 1968
Female over 690 μm*coffear*
(Zimmermann, 1898)
Filipjev, 1934
10. Lateral field with 2 incisures*asterocaudatus*
Das, 1960
Lateral field with 3 incisures*nonveilleri*
Andrássy, 1959

SUMMARY

Aphelenchoides besseyi Christie, 1942 is recorded for the first time on rice in Mali and Upper Volta, the morphology is discussed and the description of the species emended. *Boehmeria nivea* Gaud. (Ramie) is reported as a new host for *A. besseyi*. *A. siddiqii* n.sp. is described from *Foeniculum vulgare* Mill. in Sudan. A key is given to the species of *Aphelenchoides* with a star tipped tail.

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