Nematol. medit. (1993), 21: 155-159

* Département de Biologie Animale, Faculté des Sciences, Université Cheikh Anta Diop, Dakar, Sénégal,
** Laboratoire de Nématologie, Centre ORSTOM, B.P. 1386, Dakar, Sénégal

ULTRASTRUCTURAL OBSERVATIONS ON THE BODY CUTICLE OF FOUR SPECIES OF TYLENCHIDAE ÖERLEY, 1880 (NEMATA: TYLENCHIDA)

by
D. MOUNPORT*, P. BAUJARD** and B. MARTINY**

Summary. The fine structure of the body cuticle of *Cephalenchus emarginatus*, *C. lobus*, *Coslenchus franklinae* and *Filenchus* sp. is described from ultrathin sections. There are two major zones, a cortical zone and a basal zone. The cortical zone consists of external and internal layers; the external layer is trilaminate in all species except in *C. franklinae* where it appears multilayered; the internal layer is granular and consists of alternate striated and non-striated sublayers except in *C. franklinae*; longitudinal ridges in this species result from a thickening of the internal cortical layer. The basal zone consists of a striated layer never exceeding 30% of total cuticle thickness. These observations on the cuticle of Tylenchidae reveal a more simple structure than that found in previous studies of other families of the Tylenchina.

Ultrastructural studies of the body cuticle in the family Tylenchidae, mainly SEM observations, have been presented with the original species descriptions (Brzeski and Sauer, 1982; Raski and Geraert, 1986; Zeidan and Geraert, 1991). To our knowledge, TEM Studies of the cuticle in this family have not yet been published. Fine structure of the cuticle in the other families belonging to the Tylenchina showed intergeneric differences and intrageneric constancy (Johnson *et al.*, 1970; Mounport *et al.*, 1990; 1991); this paper presents observations on the cuticle of four species belonging to three genera and subfamilies in the Tylenchidae Öerley, 1880.

Materials and methods

Specimens of *Coslenchus franklinae* Siddiqi, 1981 were collected in 1987 from the rhizosphere of rice, growing along the Ziguinchor to Kolda road, Senegal; specimens of *Cephalenchus emarginatus* (Cobb, 1893) Geraert, 1968 were collected in 1990 from the rhizosphere of banana, at Bula, Guinée Bissau; specimens of *Cephalenchus lobus* Dhanachand *et* Jairajpuri, 1980 were collected in 1989 from the rhizosphere of undetermined plants, along the Diakhao to Fatick road, Senegal; specimens of *Filenchus* sp. were collected in 1989 around roots of plants in a fallow field, at Nebe, Senegal. *Coslenchus* and *Cephalenchus* species were reared on *Sorghum vulgare* L. cv 51 69 in the laboratory from the time of sampling. Females were fixed overnight in cold fixative (4 °C) containing 2.5% glutaraldehyde in 0.1M sodium cacodylate buffered at pH 7.2. They were then cut, rinsed and prepared for embedding in Spurr (1969) medium as previously described by Mounport *et al.* (1990). Ultrathin sections were made with a diamond knife on a Reichert-Jung ultramicrotome, collected on copper grids, stained with lead citrate (Reynolds, 1963) and observed in a Jeol 100 CXII transmission electron microscope operating at 80 kV.

Results

Ultrathin sections of ten specimens in each species except *Filenchus* sp. (n=6), show that the cuticle in all species consists of two zones: cortical and basal. The cortical zone consists of an external and internal layer. The basal zone is a striated layer. Measurements of the thickness of the different layers for each species are given in Table I.

Cephalenchus emarginatus and *C. lobus*
(Fig. 1, A-E)

The external cortical layer appears trilaminate (Fig. 1, D and E) consisting of two electron-dense bands separated by one that is electron-lucent. The internal cortical layer has alternate striated and non-striated sublayers parallel to the nematode surface (Fig. 1, B and C). The striated layer

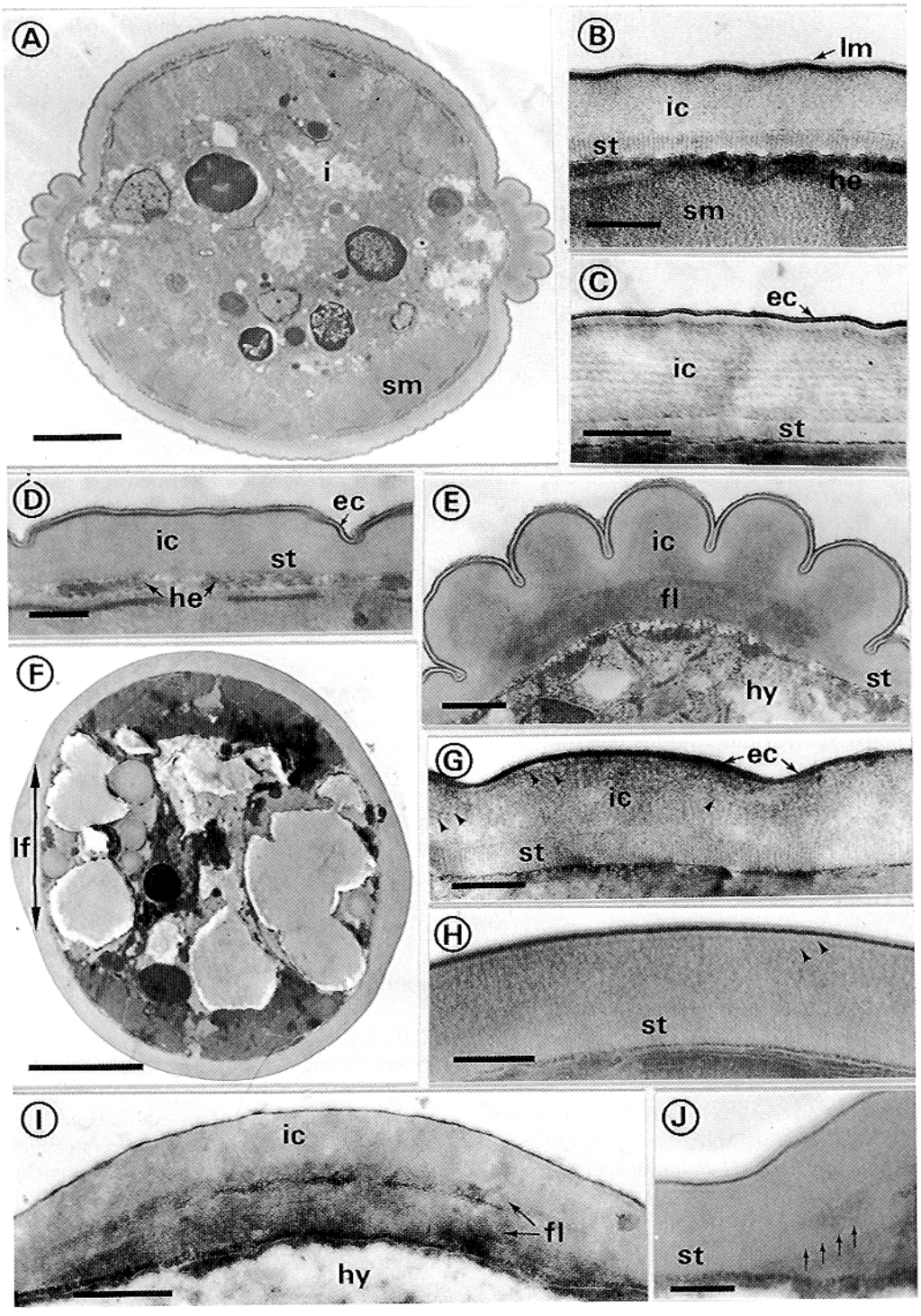

Fig. 1 - Cuticle fine structure of *Cephalenchus emarginatus* (A, D, E), *C. lobus* (B, C) and *Filenchus* sp. (F-J) females in longitudinal (LS) and cross (CS) sections. A: CS at mid-body; B, C: CS showing alternate striated and non-striated sublayers in the inner cortical layer; D: LS; E: CS of a lateral field; F: CS at mid-body; G, H: respectively LS and CS (arrowheads show alternate sublayers); I: CS of a lateral field; J: CS of a lateral field showing the striated layer tapering off. Scale bar = 2,5 µm (A, F), 0,5 µm (C-E, I) and 0,25 µm (B, G, H and J).
Abbreviations: ec: external cortical layer; fl: fibrous layers; he: hemidesmosome; hy: hypodermis; i: intestine; ic: internal cortical layer: lf: lateral field; lm: limiting membrane; sm: somatic muscles; st: striated layer.

never exceeds 30% of total cuticle thickness, and is attached to somatic muscles by hemidesmosomes (Fig. 1, B and D). Lateral fields in cross sections show six deep incisures which reduce the thickness of the inner cortical layer (Fig. 1, E); the striated layer is replaced beneath both outer incisures by two fibrous layers.

Filenchus sp.

(Fig. 1, F-J).

Cross sections at mid-body level show that lateral fields lack incisures (Fig. 1, F). The cuticle at their level is slightly thicker; the ultrastructure outside the lateral fields is identical to previous observations on *Cephalenchus* species: *i)* a trilaminate external cortical layer, *ii)* an internal cortical layer with alternate sublayers (Fig. 1, G and H) and *iii)* a basal striated layer never exceeding 25% of the cuticle thickness and replaced beneath lateral fields by two fibrous layers (Fig. 1, I and J).

Coslenchus franklinae

(Fig. 2, A-H).

Cross sections at mid-body level reveal 24 longitudinal ridges; three ridges form each lateral field, the outer ridges being larger than the median one (Fig. 2, H). The dorsal and ventral ridges are bordered on both sides by four ridges and the ventral ridge stops near the vulva (Fig. 2, A); posterior to vulva, the number of ridges decreases (Fig. 2, B). The cuticle is covered by a thin limiting membrane (Fig. 2, C and F).

The cuticle outside lateral fields consists of *i)* an external cortical layer which at high magnification (Fig. 2, C) shows alternately electron-dense and electron-lucent thin bands, *ii)* an internal cortical layer of granular appearance which is thicker beneath the ridges (Fig. 2, E and F). Electron-lucent bands occur in this layer between annulations (Fig. 2, E) and ridges (Fig. 2, D and F), *iii)* a striated layer attached to underlying somatic muscles by hemidesmosomes (Fig. 2, E and F).

In the cuticle of lateral fields, fine structure of the cortical layers remain unchanged. The striated layer beneath both outer incisures is forked in cross sections and two fibrous layers emerge from the prongs of the forks (Fig. 2, G and H).

Discussion

The ultrastructure of the cuticle of *Filenchus* sp. is quite similar to that of *Cephalenchus* species except for the morphology of the lateral fields. *C. franklinae* is distinct from these species by *i)* the multilayered external cortical layer, *ii)* the absence of alternate striated and non-striated sublayers in the internal cortical layer and *iii)* the presence of electron-lucent structures between annules and ridges in the internal cortical layer.

The ultrastructur of the cuticle in *Filenchus* and *Cephalenchus* species is similar to some previous observations on *Hemicycliophora arenaria* (Johnson *et al.*, 1970) and *Criconemella* species (De Grisse, 1972; Mounport *et al.*, 1991); the main common points are *i)* presence of alternate striated and non-striated sublayers in the internal cortical layer, *ii)* relative thickness of the basal striated layer (less than 30% of the total cuticle thickness); however, the species studies in this paper are distinct from Criconematidae in lacking a median zone (generally a vacuolar layer) in their cuticle.

The ridges in *C. franklinae* are distinct from those observed in Telotylenchinae, especially *Tylenchorhynchus germanii*, *T. sulcatus*, and *T. microphasmis* (Mounport *et al.*, 1993); in *C. franklinae*, they result from a thickening

TABLE I - *Mean thickness (µm) of the cuticle layers in females of* Cephalenchus emarginatus, Filenchus sp. *and* Coslenchus franklinae. *(numbers in brackets indicate measurements at the level of lateral fields).*

Layers	*C. emarginatus*	*Filenchus sp.*	*C. franklinae*
External cortical	0,05 (0,05)	0,025 (0,025)	0,025 (0,025)
Internal cortical	0,35 (0,20-0,75)	0,28 (0,28)	0,12-0,62 (0,20-0,93)
Striated (fibrous)	0,17 (0,35)	0,12 (0,41)	0,16 (0,25)
Total thickness	0,55 (1,20)	0,40 (0,70)	0,35-0,80 (0,30-1,25)

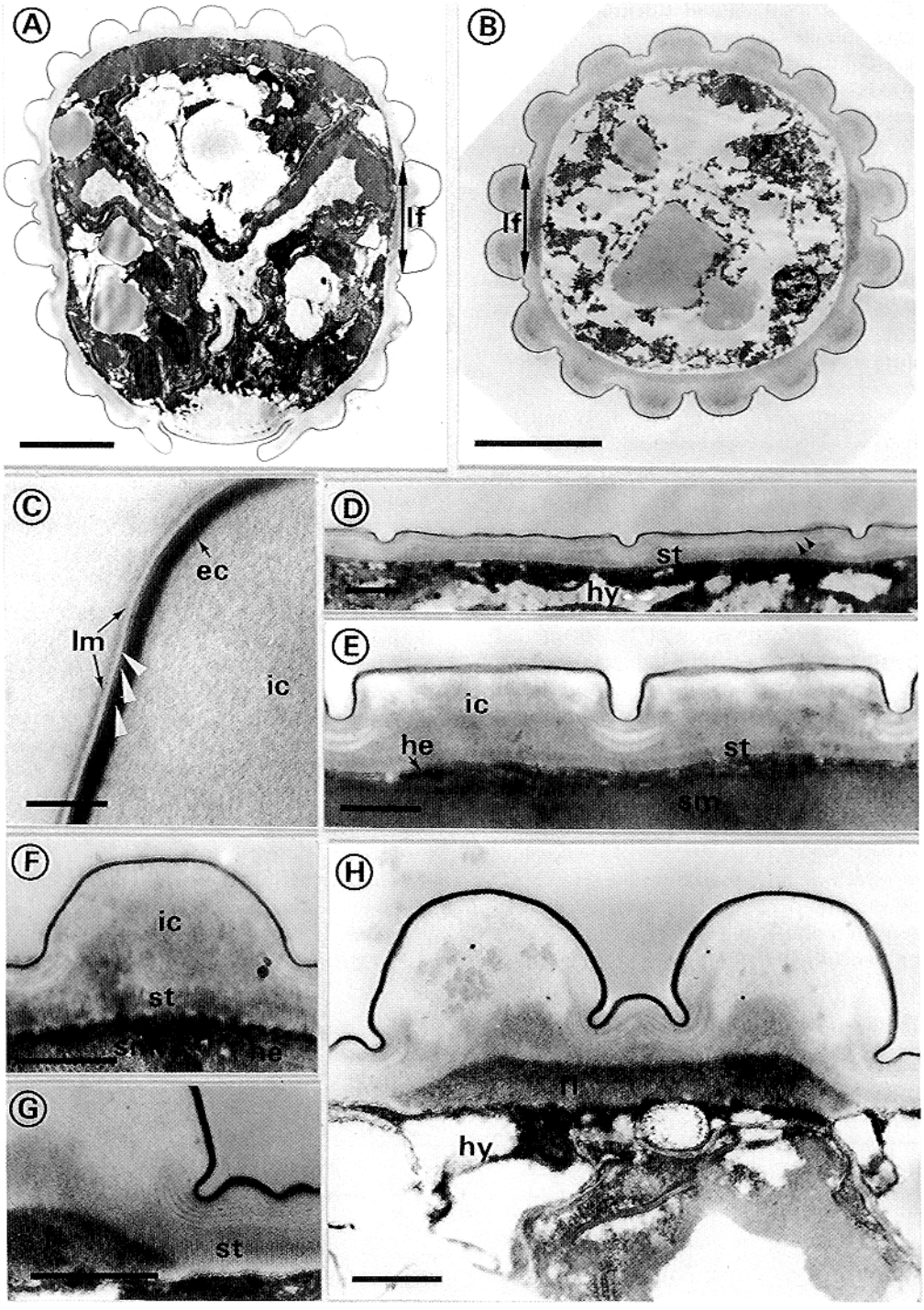

Fig. 2 - Cuticle fine structure of *Coslenchus franklinae* in longitudinal (LS) and cross (CS) sections. A: CS near vulva; B : CS of the tail; C: enlargement of the external cortical layer showing its multilayered structure (arrowheads); D: LS between two ridges showing electron-lucent bands in the inner cortical layer (arrowheads); E: LS of a ridge; F: CS of a ridge; G: CS at the level of the first incisure of a lateral field; H: CS of a lateral field. Scale bar = 2,5 µm (A, B), 0,5 µm (D-H) and 0,1 µm (C).
Abbreviations: ec: external cortical layer; fl: fibrous layers; he: hemidesmosome; hy: hypodermis; ic: internal cortical layer; lf: lateral field; lm: limiting membrane; sm: somatic muscles; st: striated layer.

of the inner cortical layer whereas in *Tylenchorhynchus* species, they consist of two thick layers of the median zone between cortical layers and the basal striated one. The cuticle ultrastructure in Tylenchidae is the simplest in the Tylenchida; at least, three zones occur in species previously studied in the families Criconematidae, Pratylenchidae, Belonolaimidae and Hoplolaimidae.

Litterature cited

BRZESKI M. W. and SAUER M. R., 1982. Scanning electron micrography of some Tylenchidae and Boleodoridae and reappraisal of the Boleodoridae. *Nematologica, 28*: 437-446.

DE GRISSE A. T., 1972. Body wall ultrastructure of *Macroposthonia xenoplax* (Nematoda). *Nematologica, 18*: 25-30.

JOHNSON P. W., VAN GUNDY S. D. and THOMSON W. W., 1970. Cuticle ultrastructure of *Hemicycliophora arenaria, Aphelenchus avenae, Hirschmanniella gracilis* and *Hirschmanniella belli*. *J. Nematol., 2*: 42-58.

MOUNPORT D., BAUJARD P. and MARTINY B., 1990. Etude ultrastructurale de la cuticule de *Pratylenchus brachyurus, P. loosi* et *P. sefaensis* (Nemata: Pratylenchidae). *Revue Nématol., 13*: 249-254.

MOUNPORT D., BAUJARD P. and MARTINY B., 1991. Cuticle ultrastructure of *Criconemella curvata* and *Criconemella sphaerocephala* (Nemata: Criconematidae). *J. Nematol., 23*: 99-103.

MOUNPORT D., BAUJARD P. and MARTINY B., 1993. Cuticle fine structure of nine species in the genus *Tylenchorhynchus* Cobb, 1913 (Nemata: Belonolaimidae). *Fund. Appl. Nematol., 16*: 137-149.

RASKI D. J. and GERAERT E., 1986. Review of the genus *Filenchus* Andrassy, 1954 and descriptions of six new species (Nemata: Tylenchidae). *Nematologica, 32*: 265-311.

REYNOLDS E. S., 1963. The use of lead citrate at high pH as an electron-opaque stain in electron microscopy. *J. Cell Biol., 17*: 208-212.

SPURR A. R., 1969. A low-viscosity epoxy resin embedding medium for electron microscopy. *J. Ultrastruc. Research, 26*: 31-43.

ZEIDAN A. B. and GERAERT E., 1991. The genera *Filenchus* Andrassy, 1954, *Sakia* Khan, 1964, *Boleodorus* Thorne, 1941 and *Basiria* Siddiqi, 1959 (Nemata: Tylenchida) from Sudan. *Nematologica, 37*: 185-212.

Accepted for publication on 7 April 1993.