Belg. J. Zool., 130 (1): 47-57 January 2000

Nematode species of the order Tylenchida, new to the Belgian Nematofauna with additional morphological data

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ABSTRACT. Ten nematode species belonging to the order Tylenchida were recorded for the first time in Belgium: *Tylenchus arcuatus*, *Coslenchus polonicus*, *Basiria graminophila*, *Cephalenchus leptus*, *Pratylenchus flakkensis*, *Hirschmanniella loofi*, *Hirschmanniella gracilis*, *Helicotylenchus varicaudatus*, *Paratylenchus similis* and *Gracilacus aculenta*. The genera *Cephalenchus* and *Hirschmanniella* are first genera records. For each species, morphometrical and morphological information is presented. Special attention has been given to the female reproductive system. The nematofauna review of the Nematofauna of Belgium (COOMANS, 1989) has been updated: records from our study as well as from others were added.

KEY WORDS: Belgium, female reproductive system, morphology, nematofauna, SEM, Tylenchida.

INTRODUCTION

As Belgium has a long "nematological tradition", the Belgian nematofauna has been relatively well studied. Within the terrestrial nematodes, the economically important plant parasitic nematodes belonging to the order Tylenchida have been profoundly examined. However, recently, greater attention has been paid to the more natural habitats and non-conventional crops such as orchards. As a result, ten species were found that had not yet been recorded for the Belgian fauna. The morphometrical dimensions of these species are given and compared with the original descriptions. Also, some remarkable morphological aspects are discussed. Special attention is given to cellular structure of the female reproductive system. GERAERT (1972, 1976) and GERAERT *et al*. (1980a, 1980b) provided detailed descriptions of the cellular structure of the female reproductive system of different nematode orders, and pointed out the importance of the morphology of female reproductive systems in nematode systematics (GERAERT, 1981, 1983). In this paper we provide some results on the female reproductive system of the nematodes listed in this study. More conclusions, including considerations of relationships and phylogenetic implications, will be discussed in following papers.

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In the second part of this paper, we update the review of the nematofauna of Belgium (COOMANS, 1989). This review discussed the nematological history in Belgium and provided a species listing up to 1989. In addition to the species discussed in our study, we add some species belonging to the order Tylenchida, which have not yet been mentioned in this listing, and species recorded after 1989.

MATERIAL AND METHODS

Soil samples were collected from several localities in Belgium. Extraction of the nematodes was performed by a simple substitute for the Baermann funnel (SCHLINDER, 1961) or centrifugal-flotation method (CAVENESS & JENSEN, 1955). They were then killed and fixed using hot formalin (4% with 1% glycerol), processed into anhydrous glycerol (SEINHORST, 1959), mounted on aluminium slides with double cover slips, and examined by lightmicroscope (LM). For scanning electron microscope (SEM) observations, glycerine-embedded nematodes were first transferred into a drop of glycerine, then distilled water was added gradually (over a period of four hours) until the nematodes were almost in pure water. Ultrasonic treatment was used for about 8-10 minutes in order to remove adhering particles as much as possible. The nematodes then were initially dehydrated by passing them gradually through ethanol concentrations of 25, 50 75, 95, and 100% at two hourly intervals,

followed by an overnight dehydratation in 100 % ethanol. After critical-point drying with carbon dioxide, dried specimens were sputter coated with a layer of gold and examined with a JEOL JSM-840 at 15 kV.

In order to study the female reproductive structure, gonads were first extruded: the living females were cut with an eye-knife in the region of the vulva. After extrusion of the gonads, a drop of acetic orcein or acid fuchsin stain was added, the gonads covered by a coverslip, and studied immediately with LM. A similar method was also used by GERAERT (1972).

To update the list of nematodes recorded in Belgium (COOMANS, 1989) according to recent nomenclatorial changes, the reappraisal of Tylenchina (FORTUNER, 1987; GERAERT & RASKI, 1987; LUC, 1987; MAGGENTI *et al*., 1987; LUC *et al*., 1988 & MAGGENTI *et al*., 1988) was mainly used for the superfamily Tylenchoidea, HUNT (1993) was used as a reference for the suborder Aphelenchina, and SIDDIQI (1986) was consulted for the suborder Hexatylina. BRZESKI (1998) and BONGERS (1988) were the major works consulted for the geographical distribution in Europe of the species we found in this study.

ABBREVIATIONS USED IN TEXT AND TABLES

L: total length
L': distance from anterior end to anus
a: L divided by body width
b: L divided by neck length
c: L divided by length of the tail
c': tail length divided by width at anus level
V: distance from anterior end to vulva as percentage of total length
V': distance from anterior end to vulva as percentage of L'
MB: distance from anterior body end to centre of valves as percentage of neck length
E. pore: distance of excretory pore from anterior end
Deirid: distance of deirid from anterior end
DGO: distance from dorsal pharyngeal gland orifice to stylet base
O: DGO as percentage of stylet length
V-a: distance from the vulva to the anus
PUS: length of postvulval uterine sac
Spicule: spicule length
Guber.: gubernaculum length
Annul.: mean width of annuli at mid-body

All the measurements presented in Tables are in µm. The dimensions and ratios of the specimens are presented as "mean ± standard deviation (range)".

RESULTS AND DISCUSSION

Tylenchus arcuatus Siddiqi, 1963

Two populations of *T. arcuatus* were found: in an apple orchard at Vliermaal and in the vicinity of a willow tree (*Salix matsudana* Koidz) at the botanical garden of the University of Gent. These locations both have a sandy loam soil. The Vliermaal population has a more slender body and a slightly longer tail, which results in a high c' value (7.4) compared with a c' value of 5 in the original description. In this aspect the specimens from the Vliermaal population come close to *Tylenchus davainei* Bastian, 1865. The latter species, however, has a longer body size and a hooked tail instead of a ventral arcuate tail. Both populations had a slightly longer stylet compared with the original description (a mean value of 16.7 µm for the specimens from Gent and 16.1 µm for the Vliermaal population compared with 15µm in the original description). The bend of the tail is also more pronounced (Fig. 2G) compared with the figures of the original description, although this can be due to the influence of fixation. Distribution in Europe: France, the Netherlands, Poland and Hungary.

Female reproductive system: the oviduct contains two rows of four cells (Fig 3A), the non-offset spermatheca

TABLE 1

Morphometrical data of *Tylenchus arcuatus* from Gent and Vliermaal (measurements in µm)

	Gent	Vliermaal
n	**3** EE	**5** EE
L	748±33 (707-774)	682±10 (671-696)
L'	655±23 (626-674)	580±7 (565-587)
a	25.7±0.9 (25.6-26.8)	30.2±1.2 (28.5-31.4)
b	6.6±0.4 (6.2-6.9)	6.6±0.2 (6.3-6.9)
c	8.1±0.5 (7.7-8.8)	6.8±0.7 (6-7.9)
c'	4.7±0.1 (4.6-4.7)	7.4±0.8 (5.9-8.4)
V	69±0.9 (68.8-70.6)	65.6±2.8 (62.8-69.3)
V'	79.3±0.3 (79-79.7)	77.1±2.1 (74.9-80.3)
Stylet	16.7±0.5 (15.9-16.8)	16.1±1 (14.2-17.2)
Pharynx	112.9±1.7 (111.6-115)	103.3±3.6 (97.2-107.3)
MB	44.4±1 (44-46)	47.3±1.8 (45.1-50.5)
E. pore	111.3±3.1 (106.3-112.6)	92.7±2.1 (89.9-95.2)
Deirid	113.5±1.7 (112.6-115.9)	94.4±2.9 (90.4-99.1)
V-a	135.6±7 (127.5-141.4)	133.1±11.9 (114.5-147.7)
Tail	93.5±9.6 (80.8-100)	101.7±11 (85.1-113.5)
Annul	1.6±0.1 (1.5-1.6)	1.5±0 (1.4-1.5)
n	**4** DD	**5** DD
L	697±25 (660-728)	629±23 (596-662)
L'	600±22 (578-631)	595±16 (574-615)
a	26.4±1.3 (25.3-28.2)	28.5±0.5 (28.2-29.3)
b	6±0.2 (5.7-6.3)	6±0.1 (5.8-6)
c	7.5±0.4 (7-8.1)	7.6±0.1 (7.6-7.7)
c'	5.6±0.3 (5.2-6)	6.4±0.2 (6.2-6.8)
Stylet	15.8±0.5 (15-16.4)	15.2±0.7 (14.1-16)
Pharynx	116±4.3 (110-120)	104±3.3 (101.5-109.4)
MB	46±0.8 (45-47)	46.3±0.9 (45-47.3)
E. pore	102±2.2 (100-105)	91±3.9 (88-96.4)
Deirid	104±2.1 (101-107)	89.2±0.2 (89-89.5)
Spicule	24.5±1.5 (22.6-26)	23.2±2.5 (19.7-26)
Guber.	6.6±0.5 (5.8-7.2)	6.1±0.4 (5.8-6.7)
Annul	1.4±0.2 (1.3-1.6)	1.5±0 (1.5-1.5)

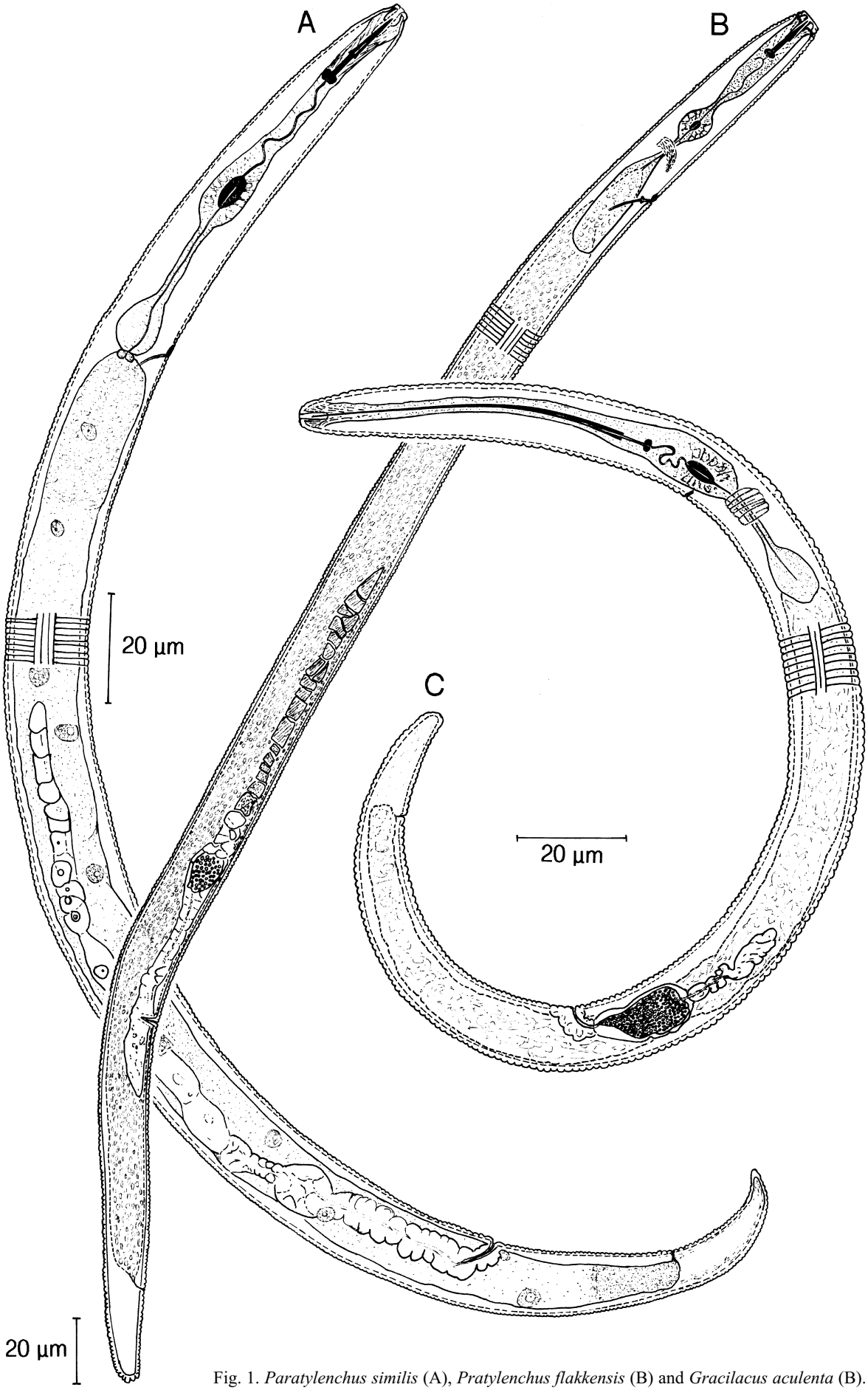

Fig. 1. *Paratylenchus similis* (A), *Pratylenchus flakkensis* (B) and *Gracilacus aculenta* (B).

consists of two parts: - twelve cells, of which the last two cells close to the uterus are remarkably bigger, and - two large cells, which form a structure that could be homologous to what is called "fertilisation room" for species with offset spermatheca. Although *Tylenchus arcuatus* has a non-offset spermatheca, the basic structure is comparable to the *Tylenchus* species with an offset spermatheca, as described by GERAERT (1972). In the excised gonads only twelve large cells were counted in the uterus, and they were more or less arranged in four rows. In the specimens preserved in glycerine a quadricolumella with twenty cells was found.

Basiria graminophila Siddiqi, 1959

= *Tylenchus* (*Filenchus*) *gramminophila* (Siddiqi, 1959) Goodey, 1963
= *B. incita* Szczygiel, 1969 = *B. nasikensis* Darekar & Khan, 1979 = *B. asaraensis* Khan, 1982
= *B. Pakhi* Hashim, 1985 =*B. elegans* Patil & Khan, 1983 = *B. patil* Fortuner, 1985
= *B. bajorensis* Khan & Bilqees, 1993

B. graminophila was found in a small potato field in Schorisse (Flemish Ardennes). The main difference from the original description lies in the position of the dorsal pharyngeal gland orifice: it was situated further back (9-12 µm) in the original description, compared with our population (7-8 µm). However, BRZESKI (1998) mentioned a DGO range from 2.5 to 10 µm for *B. graminophila*. Our morphometrical data (Table 2) correspond with the data for *B. graminophila* presented by KAREGAR & GERAERT (1997). In their paper a wide range of morphometrical variation is presented, which has led to five new synonymies retained for *B. graminophila*. Distribution in Europe: the Netherlands & Poland.

TABLE 2

Morphometrical data of *Basiria graminophila*

n	**5** ♀♀	**1** ♂
L	673±21 (643-704)	593
L'	574±23 (546-610)	493
a	39.2±1.2 (37.6-40.6)	36.26
b	6.2±0.2 (5.9-6.5)	5.7
c	6.8±0.4 (6.4-7.5)	6
c'	8±0.8 (7-9.2)	7.2
V	67.5±1.2 (65.9-68.9)	
V'	79.2±1.3 (77.6-81.2)	
Stylet	11.4±0.1 (11.3-11.5)	10.1
Pharynx	108.9±2.8 (105.3-112.6)	104.4
MB	51.8±0.3 (51.4-52.2)	50.2
E. pore	91.2±1.9 (88.5-92.8)	84.7
Deirid	90.2±0.5 (89.5-90.7)	52.4
V-a	119.2±6.7 (107.7-125.1)	
Tail	99.4±3.7 (94.3-105.3)	99.6
Annul	1.4±0 (1.3-1.4)	1.4
Spicule		15.4
Guber.		4.3

Within the female reproductive system (Fig 3C) the oviduct consists of two slightly coiled rows of five cells. A long axial sac of sixteen cells forms the spermatheca, which begins and ends with two cells, in the rest of the spermatheca the cells are grouped in fours, two by two at the same level. The oviduct and the spermatheca of *B. graminophila* are similar to those of *Ditylenchus* spp. (WU, 1958; 1967). *Psilenchus hilarulus* de Man, 1921 a member of the same subfamily as *Basiria* (Boleodorinae) also has a long axial spermatheca with sixteen cells; in the oviduct however, only eight cells were counted (GERAERT, 1981).

Coslenchus polonicus Brzeski, 1982

C. polonicus was collected in a wet habitat (sandy loam soil with a high peat content) situated in the nature reserve Bourgoyen-Ossemeersen near Gent. Our population closely corresponds to the original description (for morphometrical dimensions see Table 3). However, no males were found. In Europe *C. polonicus* has only been found in Poland.

The female reproductive system (Fig 3B) was characterised by an oviduct with two rows of four cells; a filled spermatheca with a clear offset part (twelve cells) followed by four big cells in line with the uterus; the uterus cells themselves arranged in four rows.

TABLE 3

Morphometrical data of *Coslenchus polonicus*

n	**7** ♀♀
L	721±71 (605-810)
L'	602±63 (505-687)
a	45.2±2.5 (41.9-48.9)
b	6.7±1 (5-8.1)
c	6.1±0.3 (5.7-6.6)
c'	11±1.1 (8.7-12.7)
V	65.9±0.9 (64.3-66.8)
V'	79.1±0.8 (77.8-79.8)
Stylet	14±0.8 (13-14.9)
Pharynx	109.7±8.6 (96.2-121.2)
MB	48.5±0.3 (48.2-49)
E. pore	88±2.5 (83.7-90.9)
Deirid	92±3.9 (86.6-97.2)
V-a	124.6±16.5 (102.5-146.2)
Tail	119.1±9.6 (100-133.7)
Annul	2.3±0.1 (2.2-2.5)

Cephalenchus leptus Siddiqi, 1963

= *C. limichus* Nesterov, 1973.

C. leptus was found in sandy loam soil of an apple orchard at Vliermaal. This population closely corresponds with the original description (Table 4). However, the body annuli are smaller and the smallest value overlaps with the value for body annuli of *Cephalenchus limichus* Nesterov, 1973. RASKI & GERAERT (1986a) proposed *C. limichus* as

a junior synonym of *C. leptus*, all differences were bridged by overlapping dimensions, except for the width of the body annuli. Consequently the overlapping body annuli values found in this study support the synonymisation of *C. limichus* and *C. leptus*. European distribution: The Netherlands & Poland.

The oviduct of the female reproductive system (Fig 3D) contained two coiled rows of five, six or seven cells. This is remarkable as two rows of four cells is most common within the Tylenchina. Within this suborder, an oviduct containing such a high number of cells has not been found so far. The non-offset elongated spermatheca contains four rows of three cells, followed by a uterus with also four rows of cells. In the specimens preserved in glycerine the crustaformeria-part of the uterus, containing about seven or eight cells in each of the four rows, was followed by a transition zone of several cells before the uterine sac. This rather high number of uterus cells was used as one of the characteristics of the subfamily Tylodorinae (to which *Cephalenchus* belongs) (GERAERT & RASKI, 1987).

TABLE 4

Morphometrical data of *Cephalenchus leptus*

n	**6** ♀♀
L	655±37 (617-706)
L'	451±34 (407-498)
a	41.1±7.1 (33.4-49.3)
b	7.1±0.6 (6.5-8.2)
c	3.1±0.2 (2.8-3.4)
c'	21.4±4 (16.7-25.6)
V	56.5±1.5 (54.8-59)
V'	83.4±0.4 (82.9-83.9)
Stylet	17.6±0.8 (16.2-18.8)
Pharynx	93.8±6.2 (85.1-101)
MB	41.6±0.6 (41-42.6)
E. pore	68.6±5.9 (60.7-74.9)
Deirid	70.2±0.9 (69.2-71.3)
V-a	74.9±5.4 (69.3-80.8)
Tail	212.6±8.8 (201.5-227.5)
Annul	1.8±0.2 (1.5-2.1)
Pus	15.6±0.6 (14.4-15.9)

Pratylenchus flakkensis Seinhorst, 1968

P. flakkensis was found together with *Helicotylenchus varicaudatus*, *Paratylenchus similis* and *Gracilacus aculenta* (see below) in the light sandy loam soil along the watercourse of the Moervaart-canal (Eksaarde, Lokeren). The vegetation was dominated by *Arrhenatherion elatius* and *Holcus lanatus.*

A total body drawing from a glycerine mounted specimen is illustrated in Fig. 1B. The female and male tail are illustrated with SEM photographs (Figs 2,E & F). The morphometrical data are given in Table 5. The stylet length (a mean of 16.3 µm for the female, 14.8 µm for the male) of our population is shorter compared with the original description (17 µm for the female, 16 µm for the male). FREDERICK AND TARJAN (1989), however, mentioned a female stylet variation for *P. flakkensis* ranging from 14 to 17 µm, and BRZESKI (1998) a stylet range from 15 to 18µm. Along with a smaller stylet, the total body length of the male is shorter (0.32-0.38 versus 0.42-0.49 in the original description); other aspects are similar to the original description. European distribution: The Netherlands, Germany, Denmark and Poland.

The spermatheca outlook as seen from glycerine mounted specimens (Fig. 1B) is similar to the one drawn and described by SEINHORST (1968).

TABLE 5

Morphometrical data of *Pratylenchus flakkensis*

n	**7** ♀♀	**4** ♂♂
L	465±26 (421-484)	351±24 (324-383)
a	28.3±2 (24.9-30.3)	23.8±1 (22.8-24.9)
b	6.4±0.4 (5.7-6.8)	4.8±0.3 (4.4-5)
b'	5.7±2.6 (3.9-10.1)	3.6±0.2 (3.2-3.8)
c	17.5±1.1 (16.6-19.3)	17.4±0.7 (16.4-18.1)
c'	2.3±0.2 (2-2.6)	2.1±0.2 (1.9-2.4)
V	77.4±1.5 (76-79.9)	
Stylet	16.1±0.3 (15.7-16.6)	14.8±0.2 (14.4-14.9)
Pharynx	72.3±1.8 (69.7-74.1)	73.9±2.4 (71.2-77)
MB	66.1±2.9 (61.7-69.8)	61.4±1.6 (59.5-63.4)
E. pore	76±3.1 (71.2-79.4)	66.1±0.8 (64.9-66.9)
DGO	4.2±0.6 (3.6-4.8)	2.9±0.1 (2.9-3)
V-a	78±4.5 (71.7-85.6)	
Tail	26.1±2.1 (23.6-28.9)	20.2±1 (19.2-21.6)
Annul	1.2±0 (1.2-1.2)	
Spicule		14.9±0.8 (13.9-15.9)
Guber.		4.9±0.3 (4.5-5.3)

TABLE 6

Morphometrical data of *Hirschmanniella loofi*

n	**5** ♀♀	**5** ♂♂
L	2506±231 (2221-2862)	2098±96 (2010-2231)
a	60.4±4.4 (53.1-64.5)	55.8±6.9 (47.8-64.6)
b	4.6±0.4 (4.2-5.4)	4.9±0.1 (4.7-5.1)
b'	15.8±1.4 (14.8-18.2)	13±0.8 (11.9-14)
c	18.9±0.9 (17.8-19.8)	17.8±0.4 (17.3-18.1)
c'	4.3±0.1 (4.1-4.4)	5.6±0.3 (5.2-6)
V	53.8±0.5 (52.8-54.2)	
Stylet	35.9±1.5 (33.6-38.3)	32.7±1.4 (31.3-34.5)
Pharynx	544±353 (494-591)	442±28 (404-473)
MB	19.2±1.2 (18.2-21.1)	25.3±1.7 (23.6-27)
E. pore	172±5 (164-178)	153±9 (143-166)
DGO	5±1.9 (3.4-8.2)	4.2±0.2 (3.9-4.5)
V-a	1248±132 (1048-1407)	
Tail	128.5±11.3 (113-144.3)	119±4.2 (113.5-123.6)
Annul	2±0 (2-2)	1.7±0 (1.6-1.7)
Spicule		38.7±1.4 (37-40.5)
Guber.		12.6±0.9 (11.5-13.8)

***Hirschmanniella loofi* Sher, 1968 & *H. gracilis* (de Man, 1880) Luc & Goodey, 1962**

H. loofi and *H. gracilis* were collected at Bourgoyen-Ossemeersen (Gent) near the sampling site of *Coslenchus polonicus* but closer to a stand of *Phragmites australis*. The morphometrical data (Table 6) for *H. loofi* is similar to the original description. No details are given for *H. gracilis*. According to SHER (1968) *H. loofi* and *H. gracilis* are frequently found together and our results confirm this, but the latter species could only be found out of the winter season. European distribution: Germany, The Netherlands & Poland.

***Helicotylenchus varicaudatus* Yuen, 1964**

H. varicaudatus, from the Moervaart sampling site, had a more hemispherical lip region than that of the original description. In this respect our population is closer to the Dutch population (LOOF, 1984). Consequently we agree with LOOF (1984) who stressed that the interspecific variation in the lip region is too high to separate species within *Helicotylenchus*. SEM end-on view showed six longitudinal incisures on the first annuli (Fig. 2A). According to SHER & BELL (1975) such incisures were absent in the genus *Helicotylenchus*. Subdivisions in the anterior lip annuli are typical of *Rotylenchus*, *Scutellonema*, *Hoplolaimus* and *Rotylenchulus* (GERAERT, 1997). Six incisures were also found by LOOF (1984) for the same species and by VOVLAS (1984) for *H. multicinctus*. The variation of the tail is presented by SEM photographs (Figs 2, B-D). Fig. 2B presents the most common tail type for *H. varicaudatus*.

Morphometrical data are represented in Table 7. The dorsal pharyngeal gland orifice is closer to the stylet base (6-8 µm) in comparison with the original description (8-10 µm). This gives O values of (20-27), which are remarkably low for the genus. European distribution: The Netherlands, Poland, Turkey, Bulgaria, the Czech Republic, Britain and Italy.

TABLE 7

Morphometrical data of *Helicotylenchus varicaudatus*

n	**10 EE**
L	633±68 (572-780)
a	25.8±0.9 (24.3-27.0)
b	5.3±0.5 (4.8-6.2)
b'	4.4±0.4 (4.0-5.0)
c	45.3±7.0 (36.5-57.3)
c'	0.9±0.1 (0.8-1.0)
V	61.9±2.2 (56.9-64.2)
Stylet	30.5±1.1 (29.4-33.6)
Pharynx	120.2±9.2 (109.2-133.3)
E. pore	102.1±21.7 (72.6-124.1)
DGO	7.0±0.9 (5.8-8.4)
V-a	233.9±19.6 (214.5-260.7)
Tail	14.3±2.3 (10.6-18.6)
Annul	1.4±0.2 (1.3-1.9)

The female reproductive system is presented in Fig. 3B. At the end of the ovary eight cells form a sphincter-like structure. The oviduct contains two rows of four cells followed by an offset spermatheca (twelve cells) and a tricollumelled uterus.

***Paratylenchus similis* Khan, Prasad & Mathur, 1967**

= *P. tatea* Wu & Townshend, 1973 = *P. italiensis* Raski, 1975a

= *P. labiosus* Anderson & Kimpinski, 1977.

P. similis (Moervaart sampling site) morphometrically (Table 8) bears a resemblance to the original description of *P. similis* but also to *P. microdorus* Andrássy 1959, which was previously found in Belgium. According to BRZESKI (1995) *Paratylenchus similis*, *P. tatae*, *P.italiensis* and *P. labiosus* are synonyms because of overlapping morphometrical characters. Following this idea *P. microdorus* belongs to this group. There is, however, a difference in the head morphology. *P. similis* has a squarish head with well developed submedian lobes, while *P. microdorus* has a conical head with a rounded or flat end without projecting lips. GERAERT (1965) suggested the morphology of the head could be influenced by fixation. Different fixation methods, however, (hot formalin, cold formalin, ethanol and no fixation), showed us the same squarish head appearance. Consequently this can be used to distinguish *P. similis* from *P. microdorus*. However, the influence of fixation on the head morphology of *P.microdorus* could not yet be demonstrated. A total body drawing is shown in Fig. 3A. European distribution: Spain and Poland.

TABLE 8

Morphometrical data of *Paratylenchus similis*

n	**10 EE**
L	333±23 (303-375)
a	23.1±1.6 (20.8-25.8)
b	4.2±0.2 (3.7-4.4)
c	13.5±1.1 (11.5-15)
c'	2.9±0.2 (2.6-3.3)
V	77.3±6.8 (68.6-85.1)
Stylet	17.4±0.8 (16.4-19.2)
Pharynx	81±2.7 (76-87.1)
MB	55.1±3 (51.2-58.4)
E. pore	76.2±0.7 (75.5-77)
V-a	35.2±5.2 (26.5-44.3)
Tail	25.1±2.7 (20.7-29.4)
Annul	1.2±0 (1.1-1.2)

Within the female reproductive system (Fig. 3F), the oviduct was formed by two rows of four cells as in most of the members of the suborder Tylenchina. A twelve-celled spermatheca forms the ventral corner of the spermatheca-uterus complex. GERAERT (1972) described a similar arrangement of the spermatheca for *Criconemella* sp. The uterus cells following the spermatheca are arranged in four rows. Closer to the vulva, this pattern

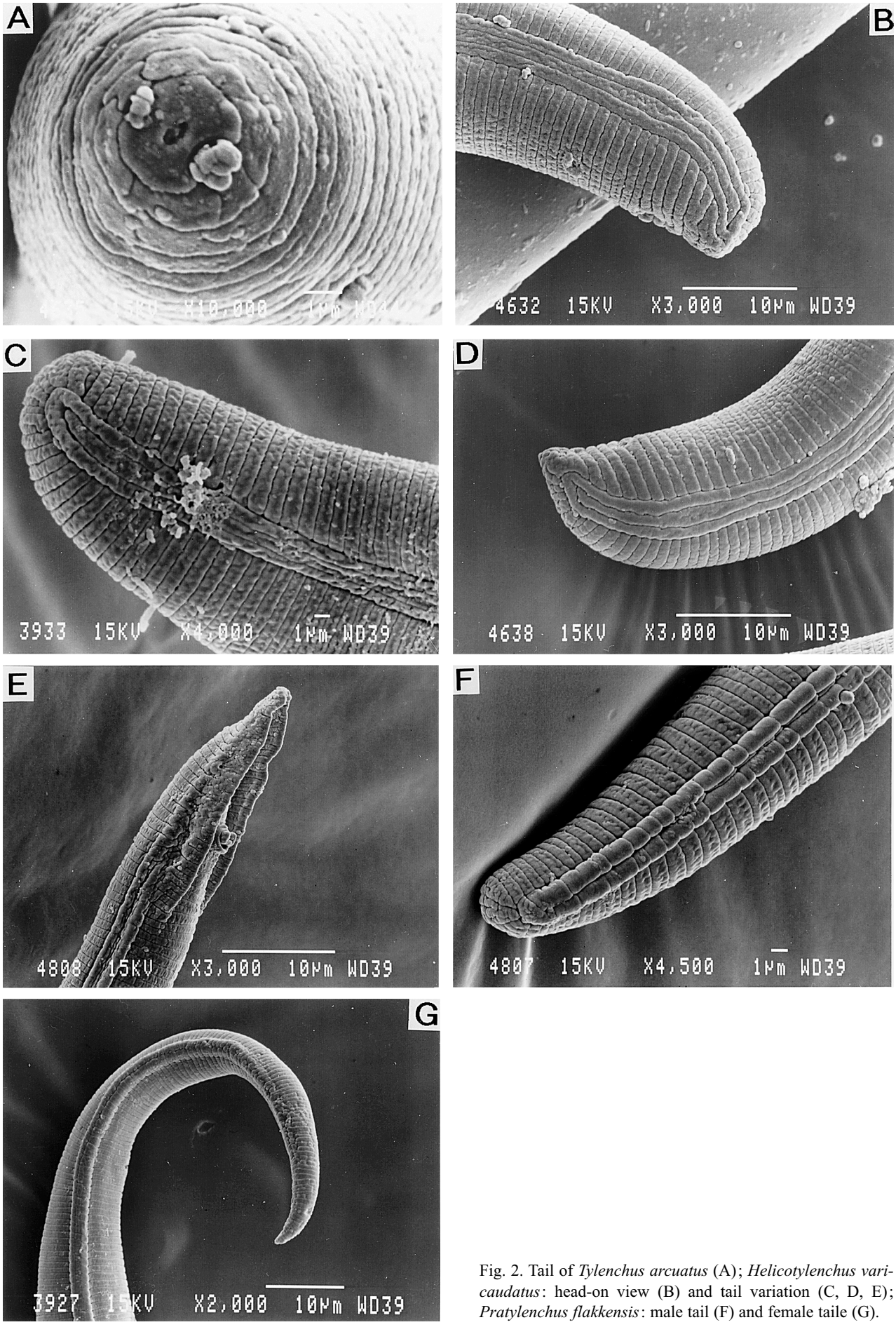

Fig. 2. Tail of *Tylenchus arcuatus* (A); *Helicotylenchus varicaudatus*: head-on view (B) and tail variation (C, D, E); *Pratylenchus flakkensis*: male tail (F) and female taile (G).

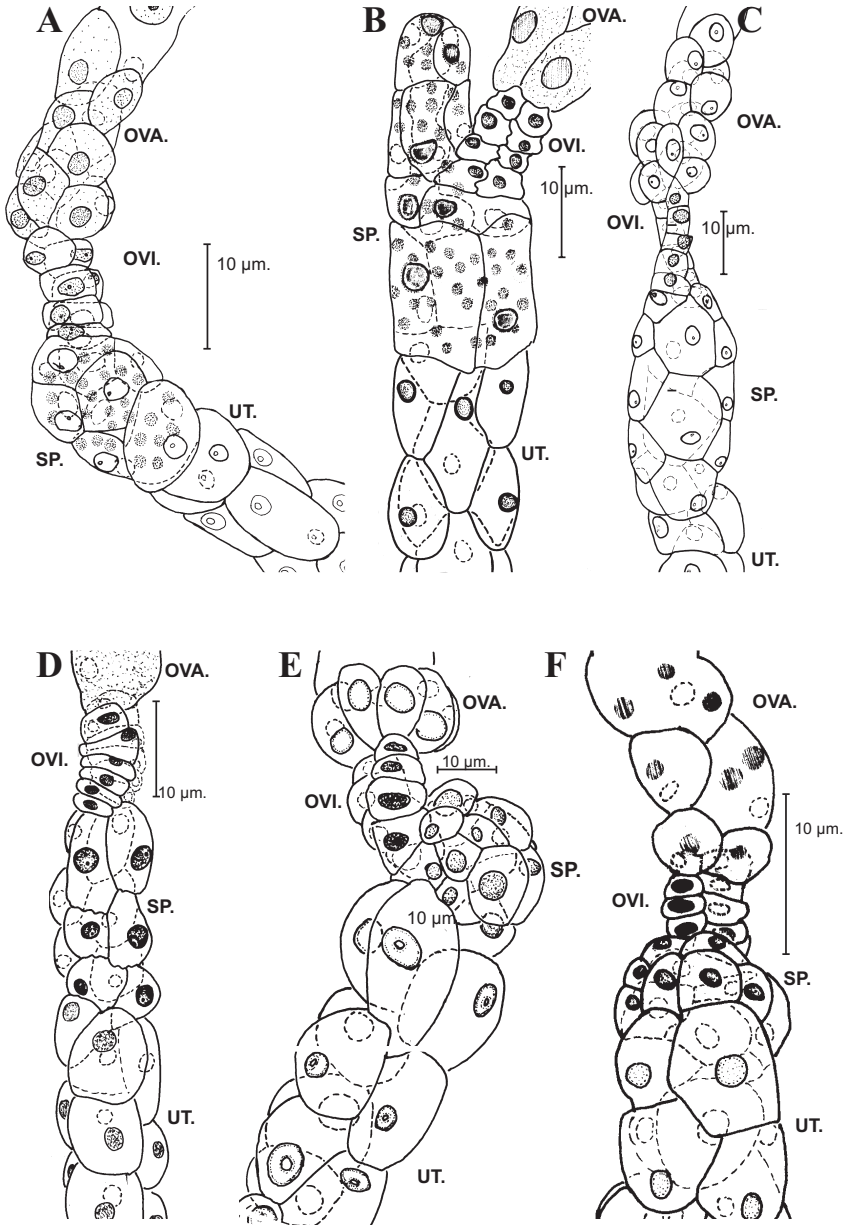

Fig. 3. Female reproductive system: end of ovary (OVA), oviduct (OVI), spermatheca (SP) and beginning of uterus (UT) of *Tylenchus arcuatus* (A), *Coslenchus polonicus* (B), *Basiria graminophila* (C), *Cephalenchus leptus* (D), *Helicotylenchus varicaudatus* (E) and *Paratylenchus similis* (F).

becomes diffuse and unclear. Similar (unpublished) results have been obtained for *Hemicycliophora conida* Thorne 1955, *Criconemella xenoplax* (Raski, 1952) Luc & Raski, 1981 and *Criconemella rustica* (Micoletzky, 1915) Luc & Raski, 1981. Apparently all Criconematidea have a comparable cellular structure of the female reproductive system. This fact together with an arrangement of four cell rows in the uterus, could be an indication that the Criconematoidea were diverged from a hypothetical common ancestor, close to the Tylenchidae.

Gracilacus aculenta (Brown, 1959) Raski, 1962

The morphometrical dimensions (Table 9) of *G. aculenta* from the Moervaart sampling site correspond with the original description, except for a longer stylet length (59-68 µm. compared with 54-62 µm in the original description). Raski (1976), however, mentioned a stylet

TABLE 9

Morphometrical data of *Gracilacus aculenta*

n	**10** EE	**1** D
L	291±11 (270-313)	302.5
a	22.1±1.3 (20-24)	24.2
b	2.7±0.1 (2.5-2.9)	
c	14.3±1.1 (13-16.2)	13.4
c'	2.8±0.2 (2.7-3.1)	2.5
V	72±0,8 (70,2-72,8)	
Stylet	63.1±2.9 (59.2-68.3)	
Pharynx	108.4±5.2 (97.2-114)	
MB	68±1.4 (66.5-70.2)	
E. pore	74±2.6 (70.7-78.4)	63.2
V-a	61.1±3.8 (54.8-69.7)	
Tail	20.6±1.9 (17.8-23.6)	22.6
Annul	1.2±0.1 (1-1.3)	
Spicule		15.4
Guber.		3.8

variation of 48-68 µm for *G. aculenta.* Only one male was found. A total body drawing from a glycerine mounted specimen is shown in Fig. 1C. In Europe *G. aculenta* is only known from Poland.

Tylenchida recorded from Belgium: an updated list

The following Tylenchida species are recorded in Belgium, but not mentioned in the review of the nematofauna of Belgium (COOMANS, 1989):

Amplimerlinius icarus (Wallace & Greet, 1964) Siddiqi, 1976 is present in the collection of Wageningen (The Netherlands) and originated from St. Truiden. More information of these specimens was destroyed by a fire in 1973. *A. icarus* was found in our study at an apple orchard in Vliermaal.

Coslenchus rhombus Andrássy, 1982 was found in Mendonk (GERAERT, pers. comm.). However, BRZESKI (1998) considered *C. rhombus* as a junior synonym of *C. alacinatus* Siddiqi, 1981

Criconema demani Micoletzky, 1925 obtained at Drongen and Landskouter, was mentioned by DE GRISSE (1968).

Criconemella kirjanovae (Andrássy, 1962) Luc & Raski, 1981 was mentioned by DE GRISSE (1968) from Drongen and Landskouter.

Filenchus vulgaris **(**Brzeski, 1963) Lownsbery & Lownsbery, 1985 is a common species in Belgium (RASKI & GERAERT, 1986b).

Helicotylenchus exallus Sher, 1966 was mentioned as being recorded in Belgium (Bongers, 1988).

Hemicycliophora triangulum Loof, 1968 was found by A. De Grisse in Aalter, Merendree and Huise (LOOF, 1968).

Malenchus acarayensis Andrássy, 1968 was mentioned from Belgium (Geraert & Raski, 1986).

Meloidogyne chitwoodi (Golden *et al*., 1980) O' Bannon, Santo & Finley, 1980 was found in different locations in the provinces Antwerpen, Limburg and West-Flanders on sandy soils (WAEYENBERGE & MOENS, 1997).

Meloidogyne duytsi Karssen, Van Aelst & Van Der Putten, 1998 was detected along the North Sea coastal foredunes, also in Belgium. (KARSSEN & VAN HOENSELAAR, 1998).

Meloidogyne fallax Karssen, 1996 was detected in the provinces Antwerpen and Limburg, on similar locations to those where *Meloidogyne chitwoodi* was found (WAEYENBERGE & MOENS, 1997).

Meloidogyne maritima (Jepson, 1987) Karssen, van Aelst & Cook, 1998 was found in the coastal dunes of Belgium (KARSSEN & VAN HOENSELAAR, 1998).

Nagelus alpensis Doucet & Luc, 1981 is present in the collection of Wageningen (The Netherlands) and originated from a sample taken in a castle pond (Gent) by M. de Pelsmaker. We found *N. alpensis* in the Bourgoyen (Gent). BRZESKI (1997) considered *N. alpensis* as a junior synonym of *N. obscurus* (Allen, 1955).

The following species have to be removed from the Belgian nematofauna list, because they have been synonymised with other species from this list:

Meloidogyne deconincki Elmiligy, 1968 (with, as type location, a garden from the University of Gent) is, based on KARSSEN & VAN HOENSELAAR (1998), considered as a junior synonym of *M. ardenensis* Santos, 1968.

Pratylenchus irregularis Loof, 1960 is considered according to LOOF (1978) as a junior synonym of *Pratylenchus pratensis* (de Man, 1880) Filipjev, 1936.

CONCLUDING REMARK

After the addition of ten new records and fourteen recent amendments, the Belgian tylenchid nematofauna now consists of 142 species. This list is far from complete: more sampling on natural and semi-natural habitats will result in a better knowledge of the Belgian nematofauna.

ACKNOWLEDGEMENTS

R. Van Driessche is acknowledged for the preparation of the scanning photographs. We thank everyone who helped to complete the Belgian tylenchid nematofauna list, especially P.A.A. Loof and we are grateful to G. Karssen for reading this manuscript critically.

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Received: 11 June, 1999
Accepted: 21 October, 1999