

***Trichodorus vandenbergae* n. sp.  
and *Paratrichodorus meyeri* n. sp.  
(Nematoda : Trichodoridae) from South Africa,  
with notes on *P. teres*, *P. catharinae* and *P. sacchari***

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**Summary** — Two new species of the family Trichodoridae are described from South Africa. *Trichodorus vandenbergae* n. sp. is characterized by the onchiostyle length in males (55-57  $\mu\text{m}$ ) and females (50-58  $\mu\text{m}$ ); excretory pore situated opposite the isthmus or anterior part of the pharyngeal bulb; presence of one ventromedian cervical papilla, posterior supplement situated within reach of the retracted spicules and shape of the spicules in the males; presence of two pairs of lateral body pores and shape of the vulval sclerotizations in the females. *Paratrichodorus meyeri* n. sp. is characterized by the onchiostyle length in males (44-54  $\mu\text{m}$ ) and females (45-53  $\mu\text{m}$ ); presence of both a pharyngeal gland overlap and an intestinal overlap; presence of one ventromedian cervical papilla, median and posterior supplements situated within reach of the retracted spicules and shape of the spicules in the males; presence of two to four lateral body pores on each side and shape of the vulval sclerotizations in the females. Additional morphometrics and morphological details are given for *Paratrichodorus teres* (Hooper, 1962) Siddiqi, 1974, *P. catharinae* Vermeulen & Heyns, 1983 and *P. sacchari* Vermeulen & Heyns, 1983. The occurrence of Trichodoridae in Africa is reviewed.

**Résumé** — *Trichodorus vandenbergae* n. sp. et *Paratrichodorus meyeri* n. sp. (Nematoda : Trichodoridae) provenant d'Afrique du Sud, et nouvelles données sur *P. teres*, *P. catharinae* et *P. sacchari* — Deux nouvelles espèces de la famille des Trichodoridae, provenant d'Afrique du Sud, sont décrites. *Trichodorus vandenbergae* n. sp. est caractérisé par la longueur du stylet des mâles (55-57  $\mu\text{m}$ ) et des femelles (50-58  $\mu\text{m}$ ); la position du pore excréteur; la présence d'une papille cervicale; la position du troisième supplément ventromédian au niveau des spicules et la forme des spicules, chez les mâles; la présence de deux paires de pores latéraux et la forme des sclérotisations vulvaires, chez les femelles. *Paratrichodorus meyeri* n. sp. est caractérisé par la longueur du stylet des mâles (44-54  $\mu\text{m}$ ) et des femelles (45-53  $\mu\text{m}$ ); la présence d'un recouvrement dorsal et ventral de la glande pharyngienne sur l'intestin; la présence d'une papille cervicale, la position des deuxième et troisième suppléments ventromédians au niveau des spicules et la forme des spicules chez les mâles; la présence de deux à quatre pores latéraux de chaque côté du corps et la forme des sclérotisations vulvaires, chez les femelles. Des données nouvelles sur *Paratrichodorus teres* (Hooper, 1962) Siddiqi, 1974, *P. catharinae* Vermeulen & Heyns, 1983 et *P. sacchari* Vermeulen & Heyns, 1983 sont présentées. Des données sont fournies sur la répartition des Trichodoridae en Afrique.

**Key-words** : Nematodes, *Trichodorus*, *Paratrichodorus*, South Africa.

Soil samples collected from the rhizosphere of "wit-peer" (*Apodytes dimidiata* E. Mey. ex Arn) in the indigenous forest of Tsitsikamma National Park, Cape Province, and from the rhizosphere of tobacco (*Nicotiana tabacum* L.) on a farm in Vaalwater, Transvaal, contained two new trichodorid species which are described below as *Trichodorus vandenbergae* n. sp. and *Paratrichodorus meyeri* n. sp., respectively. Soil samples collected around the roots of dune vegetation in Margate, Natal, contained *Paratrichodorus teres* (Hooper,

1962) Siddiqi, 1974. Examination of these specimens and re-examination of *Paratrichodorus catharinae* Vermeulen & Heyns, 1983 and *Paratrichodorus sacchari* Vermeulen & Heyns, 1983, also previously described from South Africa (Vermeulen & Heyns, 1983), revealed some additional information which is reported.

The nematodes were killed by gradual application of heat, fixed in TAF, dehydrated, processed into glycerin according to Thorne's slow method and mounted on permanent slides.

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*Trichodorus vandenbergae*\* n. sp.  
(Fig. 1)

## MEASUREMENTS

See Tables 1-2.

## DESCRIPTION

*Female* : General appearance typical of Trichodoridae. Posterior end straight. Lip region with distinct labial papillae. Amphidial aperture sublateral, elliptical. Cuticle not swollen after fixation, about 3-4 µm thick in mid-body region, consisting of two optically different layers : a thick outer one and a thin inner one (somewhat

less than 1 µm). Basis of inner cuticular layer with very fine striations. Excretory pore at 97-115 (107) µm, i.e. about 1.7-2.2 onchiostyle lengths, from the anterior end of the body, always situated at the level of the posterior part of the isthmus. Pharyngeal bulb occupying about one third of the neck length. Five pharyngeal gland nuclei present; the anterior ventro-sublateral nuclei small, rather indistinct, and lying in the anterior third of the bulb; the posterior ventro-sublateral nuclei large, distinct and lying in the posterior third of the bulb; the dorsal gland nucleus also large and usually lying in the middle of the pharyngeal bulb but sometimes slightly anterior or posterior to the middle of the pharyngeal bulb. No ventral pharyngeal gland overlap. No dorsal intestinal overlap in twelve out of fourteen females. In two females a very slight dorsal overlap (4-7 µm) of the

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**Table 1.** Morphometric data of females of *Trichodorus vandenbergae* n. sp., *Paratrichodorus meyeri* n. sp. and *P. teres*.

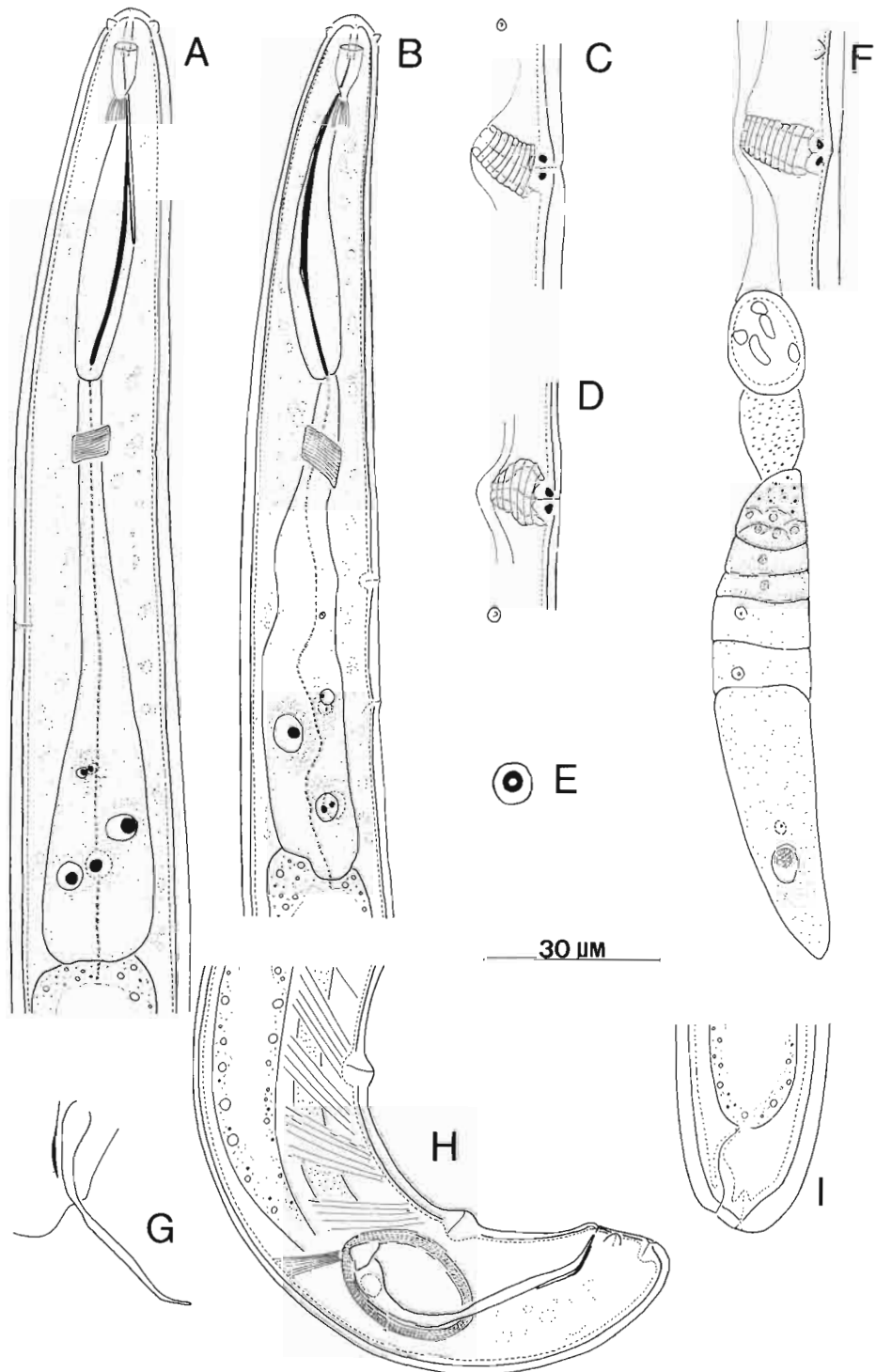
|  | <i>T. vandenbergae</i> n. sp. |                           | <i>P. meyeri</i> n. sp. |                           | <i>P. teres</i>            |
|--|-------------------------------|---------------------------|-------------------------|---------------------------|----------------------------|
|  | Holotype                      | Paratypes                 | Holotype                | Paratypes                 |                            |
| n  |                               | 13                        |                         | 7                         | 5                          |
| L  | 750                           | 681-801<br>(753 ± 32)     | 838                     | 510-896<br>(689 ± 138)    | 621-747<br>(694 ± 54)      |
| Body width   | 32                            | 30-35<br>(32 ± 2)         | 61                      | 46-60<br>(53 ± 6)         | 45-65<br>(55 ± 8)          |
| Neck length  | 162                           | 127-161<br>(153 ± 9)      | 117                     | 91-147<br>(122 ± 17)      | (92-160<br>(127 ± 26)      |
| Onchiostyle length   | 53                            | 50-58<br>(54 ± 3)         | 48                      | 45-53<br>(48 ± 3)         | 47-48<br>(47 ± 1)          |
| Ant. to excr. pore   | 107                           | 97-115<br>(107 ± 4)       | 111                     | 72-113<br>(95 ± 16)       | 66-100<br>(78 ± 13)        |
| Ant. genit. branch   | 136                           | 120-166<br>(142 ± 13)     | 155                     | 128-182<br>(157 ± 22)     | 89-160<br>(122 ± 36)       |
| Post. genit. branch  | 158                           | 134-172<br>(153 ± 21)     | 142                     | 135-174<br>(151 ± 15)     | 93-115<br>(100 ± 11)       |
| a  | 23.1                          | 21.4-25.5<br>(22.8 ± 1.1) | 13.9                    | 9.4-19.3<br>(13.2 ± 3.2)  | 10.7-16.3<br>(12.8 ± 2.3)  |
| b  | 4.6                           | 4.5-5.5<br>(4.8 ± 0.3)    | 7.2                     | 3.8-7.0<br>(5.7 ± 1.1)    | 4.4-7.2<br>(5.6 ± 1.1)     |
| V  | 55.2                          | 52.6-61.3<br>(54.6 ± 2.1) | 49.4                    | 47.9-53.2<br>(50.6 ± 2.3) | 49.3-53<br>(51.4 ± 1.5)    |
| G <sub>1</sub>   | 18.2                          | 16.4-22.8<br>(19.5 ± 2.1) | 18.5                    | 20.1-29.8<br>(22.8 ± 4)   | 12.5-244<br>(17.6 ± 6.1)   |
| G <sub>2</sub>   | 21.1                          | 18.7-24.7<br>(20.9 ± 3.3) | 16.9                    | 16.2-25<br>(21.1 ± 3.7)   | 13.1-15.7<br>(14.7 ± 1.1)  |
| $\frac{\text{Ant. to excr. pore}}{\text{Neck length}}$ (%) | 66.2                          | 61.8-80.3<br>(70 ± 4.7)   | 94.5                    | 66.1-88.5<br>(79 ± 14.1)  | 51.9-84.7<br>(62.5 ± 12.9) |
| $\frac{\text{Onchiostyle length}}{\text{Neck length}}$ (%) | 32.5                          | 31.1-37.1<br>(34 ± 2.1)   | 40.9                    | 32.9-49.4<br>(39.9 ± 5.8) | 40.9-50.8<br>(45.9 ± 7)    |

(All measurements in µm.)

**Table 2.** Morphometric data of males of *Trichodorus vandenbergae* n. sp., *Paratrichodorus meyeri* n. sp. and *P. teres*.

|  | <i>T. vandenbergae</i> n. sp.<br>(Paratypes) | <i>P. meyeri</i> n. sp.<br>(Paratypes) | <i>P. teres</i>        |
|--|--|--|------------------------|
| n  | 4  | 15                                     | 4                      |
| L  | 720-809<br>(765)                             | 510-865<br>(700 ± 101)                 | 571-666<br>(622)       |
| Body width   | 30-34<br>(32)                                | 45-56<br>(50 ± 4)                      | 32-50<br>(41)          |
| Neck length  | 145-174<br>(156)                             | 79-158<br>(113 ± 23)                   | 111-128<br>(119)       |
| Onchiostyle length   | 55-57<br>(56)                                | 44-54<br>(47 ± 3)                      | 49-50<br>(49)          |
| Ant. to excret. pore                                       | 103-120<br>(112)                             | 74-121<br>(95 ± 13)                    | 74-91<br>(85)          |
| Ant. end to CP   | 79-96<br>(91)                                | 67-109<br>(85 ± 12)                    | —<br>—                 |
| CP to EP   | 13-26<br>(21)                                | 7-14<br>(11 ± 2)                       | —<br>—                 |
| Spicule  | 43-49<br>(46)                                | 48-58<br>(53 ± 3)                      | 48-53<br>(50)          |
| Gubernaculum   | 19-22<br>(21)                                | 9-14<br>(11 ± 2)                       | 11-13<br>(12)          |
| Cloaca to SP1  | 24-25<br>(24)                                | 13-24<br>(17 ± 3)                      | 11-16<br>(14)          |
| SP1 to SP2   | 36-41<br>(38)                                | 16-25<br>(21 ± 3)                      | 17-22<br>(19)          |
| SP2 to SP3   | 38-44<br>(42)                                | 46-111<br>(74 ± 20)                    | 64-79<br>(70)          |
| a  | 21.3-26.4<br>(24.1)                          | 9.3-19.4<br>(14.2 ± 2.8)               | 11.9-208<br>(15.8)     |
| b  | 4.2-5.5<br>(5)                               | 5-77<br>(6.3 ± 0.9)                    | 4.8-5.8<br>(5.2)       |
| T  | 56.4-68.4<br>(61.9)                          | 65-76.1<br>(70.8 ± 3.3)                | 56.6-63.1<br>(59.6)    |
| $\frac{\text{Ant. end to EP}}{\text{Neck length}}$ (%)     | 61-79.3<br>(71.9)                            | 55.9-98.8<br>(83.9 ± 12.3)             | 60.6-79.6<br>(71.3)    |
| $\frac{\text{Onchiostyle length}}{\text{Neck length}}$ (%) | 31.8-39.6<br>(36.2)                          | 34.8-53.9<br>(43.3 ± 7)                | 38.1-42.2<br>(40.4)    |
| $\frac{\text{Cloaca to SP1}}{\text{Spicule length}}$ (%)   | 48.2-54.9<br>(52.5)                          | 22.7-43.1<br>(32.6 ± 5.8)              | 22.2-32.8<br>(28)      |
| $\frac{\text{Cloaca to SP2}}{\text{Spicule length}}$ (%)   | 126.3-146.8<br>(180.6)                       | 54.6-83.7<br>(72.2 ± 9.5)              | 63.0-67.9<br>(66)      |
| $\frac{\text{Cloaca to SP3}}{\text{Spicule length}}$ (%)   | 213.9-246.8<br>(226.4)                       | 156.2-298.6<br>(217.2 ± 43.9)          | 196.5-226.8<br>(205.9) |

(All measurements in µm.)



**Fig. 1.** *Trichodorus vandenbergae* n. sp. A : Female, anterior region (holotype); B : Male, anterior region; C-D : Vagina and vulval region, lateral view; E : Vulva, ventral view; F : Anterior branch of reproductive system of mature female (holotype); G : Spicule and gubernaculum, lateral view; H : Male, tail region; I : Female, tail region.

pharyngeal bulb by the intestine present. Nerve ring at the level of the anterior part of the isthmus. Female reproductive system didelphic, amphidelphic. Ovaries reflexed. Large spermatheca present at the junction of oviduct and uterus, filled with sperm. Vulval sclerotizations roundly triangular in lateral view. Vagina 11-16 (13)  $\mu\text{m}$ , extending inwards over 36-52 (44) % of the corresponding body-width. Shape of vagina usually elongated with parallel walls in lateral view. In half of the females, vagina slightly posteriorly directed. Vulva opening a pore in ventral view. Two pairs of body pores present in thirteen females : one pair situated laterally, at 55-176 (103)  $\mu\text{m}$ , i.e. 1.7-4.5 (3.2) body-widths, on the left hand side, and at 65-148 (99)  $\mu\text{m}$ , i.e. 2-4.4 (3.1) body-widths, on the right hand side of the body, anterior to the vulva; one pair situated subventrally at 16-30 (22)  $\mu\text{m}$ , i.e. within one body-width, posterior to the vulva. In one female three body pores present : two pairs situated laterally at 140-145  $\mu\text{m}$  and 72-76  $\mu\text{m}$ , i.e. 4.4-4.5 and 2.3-2.4 body-widths, anterior to the vulva, and one pair situated subventrally at 18-19  $\mu\text{m}$ , i.e. within one body-width, posterior to the vulva. Anus subterminal. One pair subventral caudal pores present.

*Male* : General appearance similar to female, but posterior end curved ventrally. One distinct ventromedian cervical papilla (CP) present, posterior to the onchiostyle region, opposite the isthmus or anterior part of the pharyngeal bulb. Excretory pore (EP) at 103-120 (112)  $\mu\text{m}$ , i.e. 1.8-2.2 onchiostyle lengths, from the anterior end of the body, situated always posterior to CP opposite anterior half of the pharyngeal bulb. One pair of lateral cervical pores present, positioned slightly anterior or posterior to the level of CP. One of the four males shows a very slight dorsal overlap (6  $\mu\text{m}$ ) of the pharyngeal bulb by the intestine. Testis single, outstretched. Three precloacal ventromedian supplements present : the posterior one (SP1) at 48-55 % of the spiculum length anterior to the cloacal aperture, i.e. within reach of the retracted spicules; the two other supplements (SP2 and SP3) out of reach of the retracted spicules. Distance between SP2 and SP3, slightly larger than between SP1 and SP2. Spicules, 43-49 (46)  $\mu\text{m}$ , proximally cephalated. Proximal half of each spicule dorsally convex; distal half straight except the tip curving ventrally. Slight constriction separating the proximal curved and straight parts of the spicule. No setae or striae observed. Gubernaculum 19-22 (21)  $\mu\text{m}$  long, keel slightly thickened. Tail with one pair of postcloacal subventral papillae and one pair of subterminal subventral pores. Tail terminus cuticle not thickened.

#### TYPE HABITAT AND LOCALITY

Soil around the roots of "witpeer" (*Apodytes dimidiata* E. Mey. ex Arn) from indigenous forest in Tsitsikamma National Park, Cape Province, South Africa. Collected by M. K. P. Meyer on 10-3-1986.

#### TYPE MATERIAL

*Holotype* female (left-hand specimen on slide 23821), eight *paratype* females and three *paratype* males (slides 23818, 23821-23823) deposited in the National Collection of Nematodes, Biosystematics Division, Plant Protection Research Institute, Pretoria, South Africa. Five *paratype* females and one *paratype* male deposited in the Nematode Collection, Instituut voor Dierkunde, Laboratorium voor Morfologie, Rijksuniversiteit Gent, Belgium.

#### DIAGNOSIS AND RELATIONSHIPS

*T. vandenbergae* n. sp. can be separated from all species in the genus by the combination of the following characters : onchiostyle length, excretory pore situated opposite the isthmus or anterior part of the pharyngeal bulb in males and females; presence of one ventromedian cervical papilla, posterior supplement situated within reach of the retracted spicules and shape of the spicules in the males; presence of two pairs of body pores and shape of the vulval sclerotizations in the females.

*T. vandenbergae* n. sp. resembles *T. philipi* De Waele, Meyer & Van Mieghem, 1990, *T. sanniae* Vermeulen & Heyns, 1985 and *T. eburneus* De Waele & Carbonell, 1982 in having males with one conspicuous ventromedian cervical papilla anterior to the excretory pore, the posterior precloacal ventromedian supplement (SP1) within reach of the retracted spicules and spicules proximally cephalated with the proximal half dorsally convex and the distal half straight except the tip which curves ventrally. Both sexes of *T. vandenbergae* n. sp. can be distinguished from these of *T. philipi*, *T. sanniae* and *T. eburneus* by the longer onchiostyle (50-58  $\mu\text{m}$  vs 26-30.5  $\mu\text{m}$  in *T. philipi*, 41-45  $\mu\text{m}$  in *T. sanniae* and 40-52  $\mu\text{m}$  in *T. eburneus*), from these of *T. philipi* and *T. sanniae* by the anterior position of the excretory pore (at 61-80 % of the pharynx length from the anterior end of the body vs 82-106 % in *T. philipi* and at level of the pharyngo-intestinal junction in *T. sanniae*) and from these of *T. sanniae* by the absence of a distinct dorsal overlap of the pharyngeal bulb by the intestine (distinct dorsal overlap always present in *T. sanniae*, see De Waele, 1988). The males of *T. vandenbergae* n. sp. also differ from the males of *T. philipi*, *T. sanniae* and *T. eburneus* by the shape of the spicules (capitulum somewhat less cephalated in *T. philipi*, spicules with distinct constriction in *T. sanniae* and without constriction in *T. eburneus*) and from the males of *T. eburneus* in the position of the posterior supplement (at 48-55 % of the spiculum length anterior to the cloaca vs 68-75 % in *T. eburneus*). The females of *T. vandenbergae* n. sp. also differ from the females of *T. philipi*, *T. sanniae* and *T. eburneus* by the characteristic shape of the vulval sclerotizations and from the females of *T. sanniae* in having two pairs of body pores (only one pair of body pores present in *T. sanniae*).

***Paratrichodorus meyeri*\* n. sp.**

(Fig. 2 A-C, H-K, P)

MEASUREMENTS

See Tables 1-2.

DESCRIPTION

*Female* : General appearance typical of Trichodoridae. Body straight after fixation. Cuticle swollen, about 4-6 µm thick in mid-body region, slightly separated from the body except at the head, vulva and tail. Lip region with distinct labial papillae. Amphidial pouch vase-shaped; amphidial aperture sublateral, elliptical. Excretory pore at 72-113 (95) µm, i.e. about 1.4-2.4 onchiostyle lengths, from the anterior end of the body. Pharyngeal bulb occupying 25-40 % of the neck length. Five pharyngeal gland nuclei present. Dorsal nucleus and posterior ventro-sublateral nuclei prominent, the former one usually lies in the middle, the latter ones in the posterior third of the pharyngeal bulb. Six females with both a ventral pharyngeal gland overlap and a dorsal intestinal overlap. Pharyngeal gland overlap 2.5-16.5 µm. Intestinal overlap 5-20 µm. One female with only a pharyngeal gland overlap (16 µm) and one female with only an intestinal overlap (2 µm). Nerve ring enveloping isthmus. Female reproductive system didelphic, amphidelphic. Ovaries reflexed. Spermatheca not observed. Vulval sclerotizations small, triangular in lateral view. Vagina 11-15 µm, extending inwards over 18-25 % of the corresponding body-width. Shape of vagina rounded in lateral view. Vulva a longitudinal slit in ventral view. Two to five lateral body pores present on each side : one to two pores situated between 71 and 197 µm anterior to the vulva and one to two pores situated between 5 and 212 µm posterior to the vulva. Pores on the left and right do not always lie opposite each other. Anus subterminal. One pair subventral subterminal caudal pores present.

*Male* : General appearance similar to female, posterior end straight. One distinct ventromedian cervical papilla (CP) present in thirteen males, posterior to the onchiostyle region, opposite the anterior or middle part of the pharyngeal bulb. CP absent in two males. Lateral cervical pores absent. Excretory pore (EP) at 74-121 (95) µm, i.e. 1.5-2.6 onchiostyle lengths, from the anterior end of the body, situated always posterior to CP. All males with both a ventral pharyngeal gland overlap and a dorsal intestinal overlap. Pharyngeal gland overlap 2-12 µm. Intestinal overlap 4-24 µm. Testis single, outstretched. Three preloocal ventromedian supplements present : the posterior one (SP1) and median one (SP2) lying at 23-43 % and 55-84 %, respectively, of the spiculum length anterior to the cloacal aperture, i.e. within reach of the retracted spicules; the anterior supplement (SP3) lying out of reach of the retracted

spicules at 90-151 µm anterior to the cloacal aperture. Spicules 48-58 (53) µm, finely striated. Gubernaculum 9-14 (11) µm, thickened at its distal half. Anterior lip of cloaca with two finger-like projections. Tail with one pair of postcloacal subventral papillae and one pair of subterminal subventral pores. Tail enveloped by a bursa.

TYPE HABITAT AND LOCALITY

Sandy soil around the roots of tobacco (*Nicotiana tabacum* L.) on the farm Uitval of Mr. W. A. Stegman, Vaalwater, Waterberg district, Transvaal, South Africa. Collected by I. du Plessis.

TYPE MATERIAL

*Holotype* female (slide 25413), 11 *paratype* females and 21 *paratype* males (slides 25411-25415, 25417) deposited in the National Collection of Nematodes, Biosystematics Division, Plant Protection Research Institute, Pretoria, South Africa. Two *paratype* females and two *paratype* males deposited in the Nematode Collection, Instituut voor Dierkunde, Laboratorium voor Morfologie, Rijksuniversiteit Gent, Belgium.

DIAGNOSIS AND RELATIONSHIPS

*P. meyeri* n. sp. can be separated from all species in the genus by the combination of the following characters : onchiostyle length and presence of both a pharyngeal gland overlap and an intestinal overlap in males and females; presence of one ventromedian cervical papilla, posterior and median supplements situated within reach of the spicules and shape of the spicules in the males; presence of two to four lateral body pores on each side and shape of the vulval sclerotizations in the females.

*P. meyeri* n. sp. resembles *P. catharinae* Vermeulen & Heyns, 1983, *P. weischeri* Sturhan, 1985 and *P. pachydermus* (Seinhorst, 1954) Siddiqi, 1974 in having females with more than one lateral body pore on each side and males with one cervical papilla, three preloocal ventromedian supplements, the posterior (SP1) and median (SP2) one situated within reach of the spicules, and the shape of the spicules. Both sexes of *P. meyeri* n. sp. can be distinguished from these of *P. catharinae*, *P. weischeri* and *P. pachydermus* by the presence of both a pharyngeal gland overlap and an intestinal overlap (only an intestinal overlap present in *P. catharinae*, *P. weischeri* and *P. pachydermus*; Decraemer and De Waele (1981) reported one specimen of *P. pachydermus* with both overlaps).

***Paratrichodorus teres* (Hooper, 1962) Siddiqi, 1974**

(Fig. 2 F, G, N, O)

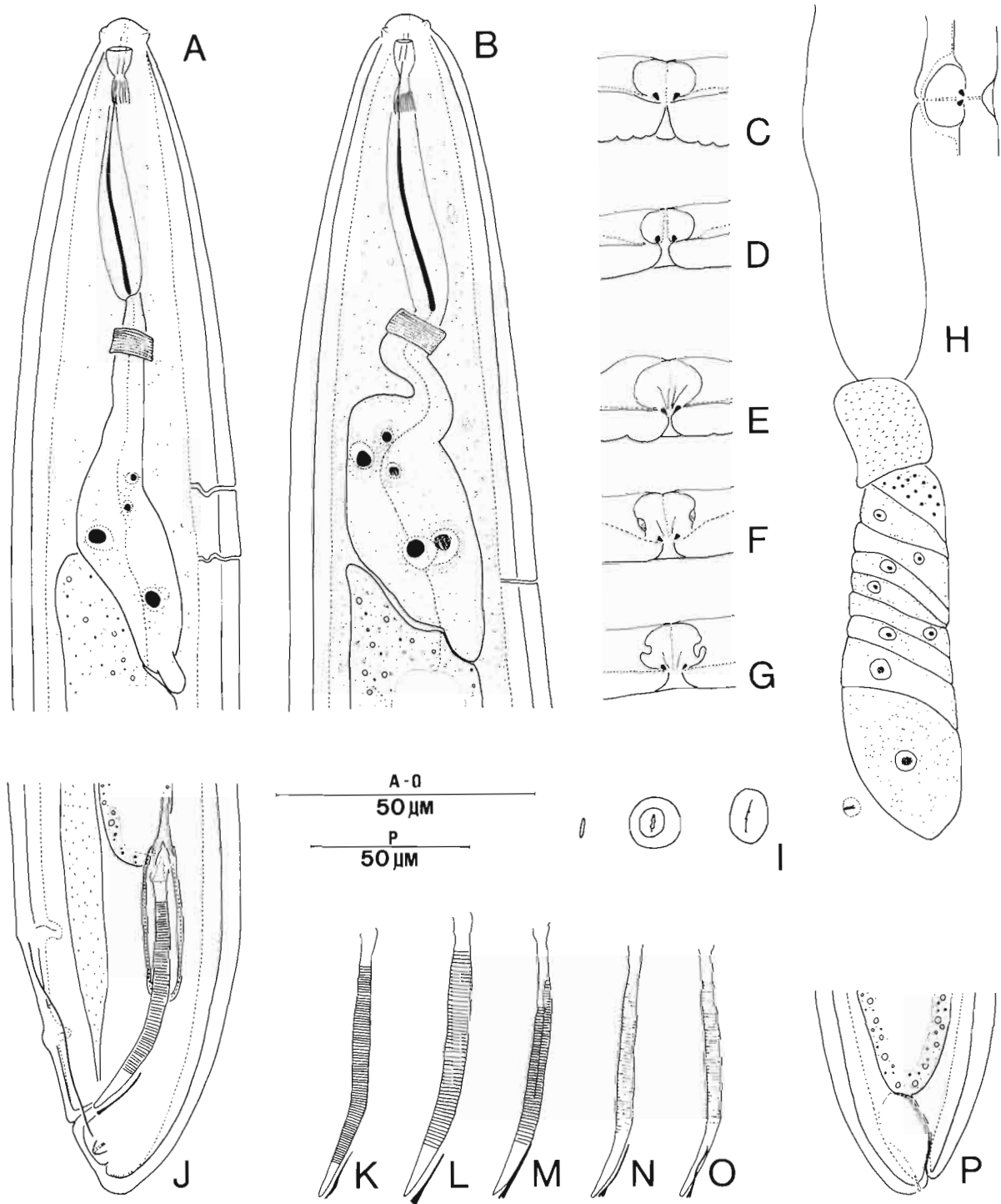
MEASUREMENTS

See Tables 1-2.

DESCRIPTION

*Female* (*n* = 5) : Excretory pore at 66-100 (78) µm, i.e. 1.4-1.6 onchiostyle lengths, from the anterior end of the

\* After Dr. A. J. Meyer, Department of Entomology and Nematology, Stellenbosch University, South Africa.



**Fig. 2.** *Paratrichodorus meyeri* n. sp. A : Male, anterior region; B : Female, anterior region (holotype); C : Vagina and vulval region, lateral view; H : Anterior branch of reproductive system of mature female (holotype); I : Surface view of vulval opening and sections through the vagina of a female; J : Mail, tail region; K : Spicule and gubernaculum, lateral view; P : Female, tail region (holotype). — *Paratrichodorus catharinae* Vermeulen & Heyns. D : Vagina and vulval region, lateral view; L : Spicule and gubernaculum, lateral view. — *Paratrichodorus sacchari* Vermeulen & Heyns. E : Vagina and vulval region, lateral view; M : Spicule and gubernaculum, lateral view (holotype). — *Paratrichodorus teres* (Hooper) Siddiqi. F : Vagina and vulval region, lateral view (Margate population); G : Vagina and vulval region, lateral view (Belgium population); N : Spicule and gubernaculum, lateral view (Margate population); O : Spicule and gubernaculum, lateral view (Belgium population).



body. One pair of lateral cervical pores at level of the excretory pore : on the left side at 73-120 (101)  $\mu\text{m}$  and on the right side at 75-97 (88)  $\mu\text{m}$  from the anterior end of the body. Two females with only a ventral overlap, 4 and 17  $\mu\text{m}$ , of the intestine by the pharynx; one female with only a dorsal overlap, 11  $\mu\text{m}$ , of the pharyngeal bulb by the intestine and one female with both a ventral and dorsal overlap, 7 and 6  $\mu\text{m}$ , respectively. Vagina 13  $\mu\text{m}$ , extending inwards over one fifth of the corresponding body-width. Six to eight lateral body pores irregularly distributed along the left or right side of the body : two (three females) to three (two females) pores situated between 112 and 191  $\mu\text{m}$  anterior to the vulva; three (one female), five (three females) or six (one female) pores situated between 26 and 245  $\mu\text{m}$  posterior to the vulva.

*Male* ( $n = 4$ ) : Excretory pore at 74-91 (85)  $\mu\text{m}$ , i.e. 1.5-1.9 onchiostyle lengths, from the anterior end of the body. No lateral cervical pores. All four males with both a ventral and dorsal overlap, 1-11 (6)  $\mu\text{m}$  and 4-13 (8)  $\mu\text{m}$ , respectively.

#### COMPARISON WITH THE TYPE AND OTHER POPULATIONS

The morphological characters and morphometrics of the *P. teres* population from Margate agree with the type population from England (Hooper, 1962) and the populations from The Netherlands (Kuiper & Loof, 1962) except that in the specimens from Margate the body length is somewhat shorter, while these females also have one pair of lateral cervical pores and six to eight lateral body pores. The shorter body length of *P. teres* specimens from South Africa was also reported by Vermeulen and Heyns (1983) for a population collected in Venda. Females of *P. teres* from The Netherlands usually have two to four lateral body pores (Kuiper & Loof, 1962). On the females from Venda, Vermeulen and Heyns (1983) observed only one pair of lateral body pores situated posterior to the vulva. In females of *Paratrichodoros*, lateral cervical pores have only been found in *P. pachydermus* (Seinhorst, 1954) Siddiqi, 1974 (De Waele *et al.*, 1985). *P. pachydermus* also has two to five lateral body pores on each side posterior to the vulva (De Waele *et al.*, 1985). Variability in the presence or absence of the ventral and dorsal overlap between specimens from the same population has been reported previously (Decraemer & De Waele, 1981).

#### *Paratrichodoros catharinae* Vermeulen & Heyns, 1983

(Fig. 2 D, L)

*Female* (four paratypes) : Excretory pore at 83-85 (84)  $\mu\text{m}$ , i.e. about 1.7-1.8 onchiostyle lengths, from the anterior end of the body. Intestine of all females with anteriorly directed dorsal overlap of pharynx. Vagina 11.5  $\mu\text{m}$ , extending inwards over 19 % of the corresponding body-width. Two pairs of lateral body pores present :

one pair situated between 129 and 172 (154)  $\mu\text{m}$ , i.e. 2.3 to 2.8 body-widths, anterior to the vulva; one pair situated between 88 and 168 (130)  $\mu\text{m}$ , i.e. 1.3 to 2.9 body-widths, posterior to the vulva.

*Male* (holotype, three paratypes) : One ventromedian cervical papilla present at 66-83 (74)  $\mu\text{m}$  from the anterior end of the body, 9-27 (17)  $\mu\text{m}$  anterior to the excretory pore. Excretory pore at 83-93 (90)  $\mu\text{m}$ , i.e. about 1.7-2 onchiostyle lengths, from the anterior end of the body. Intestine of all males with anteriorly directed dorsal overlap of pharynx. Three precloacal ventromedian supplements present : the posterior one (SP1) at 16-19 (17)  $\mu\text{m}$ , i.e. 28-33 % of the spiculum length, the median one (SP2) at 41-45 (44)  $\mu\text{m}$ , i.e. 75-78 % of the spiculum length and the anterior one at 112-139 (128)  $\mu\text{m}$ , i.e. 207-240 % of the spiculum length, anterior to the cloacal aperture.

#### *Paratrichodoros sacchari* Vermeulen & Heyns, 1983

(Fig. 2 E, M)

*Female* (two paratypes) : Excretory pore at 78-80  $\mu\text{m}$ , i.e. about 1.5-1.6 onchiostyle lengths, from the anterior end of the body. One female with anteriorly directed dorsal overlap of the pharynx (24  $\mu\text{m}$  long) but without ventral overlap of the intestine; other female with both a ventral overlap of the intestine (6  $\mu\text{m}$  long) and a dorsal overlap of the pharynx (5  $\mu\text{m}$ ). One pair of lateral body pores present situated between 89 and 105  $\mu\text{m}$ , i.e. 1.8 to 2.5 body-widths, posterior to the vulva.

*Male* (holotype, one paratype) : One ventromedian cervical papilla present at 64-75  $\mu\text{m}$ , from the anterior end of the body, 6-9  $\mu\text{m}$  anterior to the excretory pore. Excretory pore at 73-81  $\mu\text{m}$ , i.e. 1.5-1.6 onchiostyle lengths, from the anterior end of the body. Both males with both a ventral overlap of the intestine (3-5  $\mu\text{m}$  long) and a dorsal overlap of the pharynx (3-11  $\mu\text{m}$ ). Three precloacal ventromedian supplements present : posterior one (SP1) at 13-17  $\mu\text{m}$ , i.e. 25-31 % of the spiculum length, the median one (SP2) at 24-28  $\mu\text{m}$ , i.e. 46-51 % of the spiculum length, the anterior one (SP3) at 85-95  $\mu\text{m}$ , i.e. 155-183 % of the spiculum length, anterior to the cloaca.

#### Discussion

Seven *Trichodoros* species have been found in Africa : *T. vandenberga* n. sp., *T. philipi*, *T. sanniae*, *T. rinae* Vermeulen & Heyns, 1985 and *T. petrusalberti* De Waele, 1988 in South Africa (Vermeulen & Heyns, 1985; De Waele, 1988; De Waele *et al.*, 1990); *T. coomansi* De Waele & Carbonell, 1982 in Kenya; *T. eburneus* De Waele & Carbonell, 1982 in the Ivory Coast, Senegal and Burkina Faso (Baujard, 1983; De Waele, 1986). The males of these seven species have a similar spicule shape (proximal end cephalated, the cephalated part inclined



ventrally; proximal half dorsally convex, tapering towards the slender, straight or slightly curved distal half; distal tip ventrally curved). Although other morphological differences exist between the males of these species (e.g. in the number of ventromedian cervical papillae, position of the excretory pore and posterior ventromedian supplement, presence or absence of a dorsal overlap), their geographical distribution, which is restricted to Africa, strengthens the suggestion that they are closely related. Another group of closely related *Trichodorus* species based upon the similarity of the spicule shapes was reported from central to western mediterranean countries (Almeida *et al.*, 1989). In this group, consisting of *T. lusitanicus* Siddiqi, 1974, *T. beirensis* Almeida *et al.*, 1989, *T. azorensis* Almeida *et al.*, 1989 and *T. viruliferus* Hooper, 1983, the males however differ only in minor morphological characters. In both groups, the females clearly differed from the other females in the group, the most important differentiating morphological character being the shape of the vulval sclerotizations in lateral view.

Fourteen out of the 23 *Paratrichodorus* species described so far have been reported from Africa. Ten of these species occur in South Africa : *P. meyeri* n. sp., *P. catharinae*, *P. sacchari*, *P. teres*, *P. lobatus* (Colbran, 1965) Siddiqi, 1974, *P. minor* (Colbran, 1956) Siddiqi, 1974, *P. porosus* (Allen, 1957) Siddiqi, 1974, *P. tansaniensis* Siddiqi, 1974, *P. renifer* Siddiqi, 1974 and *P. acutus* (Bird, 1967) Siddiqi, 1974 (Jones, 1979; Vermeulen & Heyns, 1983, 1985; De Waele & Jordaan 1988a, 1988b; De Waele & Van den Berg, 1988; Bolton *et al.*, 1989; Van den Berg & De Waele, 1989; De Waele *et al.*, 1990; Venter *et al.*, 1992). *P. teres* was also reported from Egypt (Abou-El-Naga, 1979); *P. renifer* from Malawi (Siddiqi, 1974), *P. tansaniensis* from Tanzania (Siddiqi, 1974) and *P. minor* from Egypt, Senegal, Ivory Coast, Burkina Faso, Mauritania and the Cabo Verde Islands (Tarjan, 1964; Netscher, 1970; Netscher & Luc, 1974; Saka & Siddiqi, 1979; Baujard, 1983; Keetch & Buckley, 1984). In addition to these species, *P. tunisiensis* (Siddiqi, 1963) Siddiqi, 1974 was found in Tunisia (Siddiqi, 1963); *P. alleni* (Andrassy, 1968) Siddiqi, 1974 in Congo (Andrassy, 1968); *P. nanus* (Allen, 1957) Siddiqi, 1974 in Senegal and Burkina Faso (Baujard, 1983) and *P. rhodesiensis* Siddiqi & Brown, 1965) Siddiqi, 1974 in Zimbabwe, Senegal, Ivory Coast and the Cabo Verde Islands (Siddiqi & Brown, 1965; Baujard, 1983). Only the occurrence of *P. meyeri* n. sp., *P. catharinae*, *P. sacchari*, *P. alleni* and *P. rhodesiensis* is restricted to Africa.

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