Fundam. appl. Nematol., 1995, **18** (4), 355-360

Ecology and pathogenicity of the Hoplolaimidae (Nemata) from the sahelian zone of West Africa. 4. The genus *Aphasmatylenchus* Sher, 1965

Pierre BAUJARD* and Bernard MARTINY

ORSTOM, Laboratoire de Nématologie, B.P. 1386, Dakar, Sénégal.

Accepted for publication 2 August 1994.

Summary – Soil temperature, soil moisture and host plant significantly affected the multiplication rate of *Aphasmatylenchus straturatus* and *A. variabilis*. These two nematodes appeared unable to enter anhydrobiosis and to survive in dry soil during the dry season. *A. straturatus* is pathogenic to cowpea and peanut at inoculum levels above 1000 and 2000 nematodes per plant respectively.; *A. variabilis* is non pathogenic to millet at the inoculum levels tested. The distribution of the three known species of the genus *Aphasmatylenchus* in West Africa is discussed.

Résumé. ***Écologie et nocuité des Hoplolaimidae (Nemata) de la zone sahélienne de l'Afrique de l'Ouest. 4. Le genre* Aphasmatylenchus *Sher, 1965.*** – La température du sol, le taux d'humidité du sol et la plante-hôte influent sur les taux de multiplication d'*Aphasmatylenchus straturatus* et *A. variabilis;* ces deux nématodes apparaissent incapables d'entrer en anhydrobiose et de survivre au dessèchement du sol pendant la saison sèche. *A. straturatus* apparaît pathogène pour l'arachide et le niébé; *A. variabilis* n'apparaît pas pathogène pour le mil aux taux d'inoculum testés. La répartition des trois espèces du genre *Aphasmatylenchus* en Afrique de l'Ouest est discutée.

Key-words : *Aphasmatylenchus straturatus, Aphasmatylenchus variabilis,* nematode, West Africa, distribution, soil temperature, soil moisture, host plant, multiplication rate, pathogenicity.

This is part 4 of an extensive study on the ecology of Hoplolaimidae from the sahelian zone of West Africa (Baujard & Martiny, 1995 *b, c, d*). In this section, *A. straturatus* and *A. variabilis* were studied under varying climatic conditions.

Species in the genus *Aphasmatylenchus* Sher, 1965 are uncommon, found mainly in West Africa (Fig. 1). *Aphasmatylenchus nigeriensis* Sher, 1965 has been identified around the roots of cocoa and hevea in the South West of Nigeria (Sher, 1965) and also collected in tropical rain forests in Ivory Coast (Fortuner & Couturier, 1983) and « natural habitat » in Liberia (Vovlas *et al.*, 1991). Van den Berg and Cadet (1991) reported the presence of *A. nigeriensis* from the tropical rain forests of French Guyana. Germani (1970) described *Aphasmatylenchus straturatus* from the South West of Burkina Faso, a species inducing chlorosis of peanut (Germani, 1972). Germani and Luc (1984) described *Aphasmatylenchus variabilis* from Senegal associated with the roots of peanut and from Mali with cotton.

Materials and methods

GEOGRAPHICAL DISTRIBUTION

Data originated from surveys conducted by the first author in Mali and Senegal (Baujard & Martiny, 1994, 1995 *a*), from slides deposited in the collection of the Muséum National d'Histoire Naturelle, Paris, France and from published data.

LABORATORY EXPERIMENTS

Unless otherwise stated, nematode extractions, nematode cultures and laboratory experiments were conducted as previously indicated (Baujard, 1995). The same host plants and cultivars (peanut [*Arachis hypogea* L. cv. 55 437], millet [*Pennisetum typhoides* Rich. cv. Souna III], sorghum [*Sorghum vulgare* L. cv. 51 69] and cowpea [*Vigna unguiculata* (L.) Walp. cv. N 58 57]) were used in all experiments.

ORIGIN OF NEMATODES AND STOCK CULTURES

A. straturatus : soil samples originating from Niangoloko, Burkina Faso (type locality) were sent to the laboratory in September 1988 by Dr. P. Cattan. Nematodes were cultured in the laboratory on peanut at constant soil temperature (32 °C) and soil moisture (10 %) in a growth chamber until June 1992.

A. variabilis originates from soil samples taken from 100 cm deep during the dry season in the rhizosphere

* *Present address : Muséum National d'Histoire Naturelle, Laboratoire de Biologie Parasitaire, Protistologie, Helminthologie, 61, rue Buffon, 75005 Paris, France.*

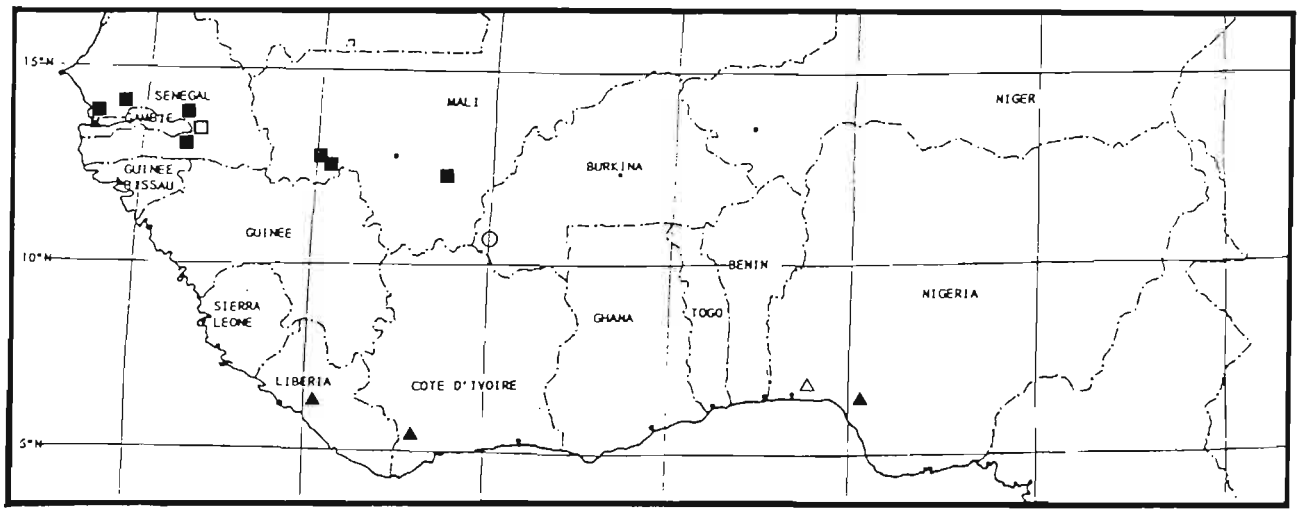

Fig. 1. *Known geographical distribution of* Aphasmatylenchus nigeriensis, A. straturatus *and* A. variabilis *in West Africa (*A. nigeriensis : *triangles;* A. straturatus : *circles;* A. variabilis : *squares; white symbols : type locality; black symbols : other localities).*

of *Icacina senegalensis* A. Juss. in the West of Senegal in November 1988. Nematodes were cultured in the laboratory on millet at constant soil temperature (30 °C) and soil moisture (10 %) in a growth chamber until February 1991.

Soil temperature

50 hand picked *A. straturatus* and 51 ± 7 *A. variabilis* (mixtures of all stages) originating from laboratory stock cultures were inoculated on peanut and millet respectively, maintained at four constant soil temperature levels (30, 32, 34 or 36 °C), at 13 % and 10 % respectively constant soil moisture, for 60 days in a growth chamber with artificial lighting (16 h-photoperiod).

Soil moisture

78 ± 12 *A. straturatus* and 50 hand picked *A. variabilis* (mixtures of all stages) originating from laboratory stock cultures were inoculated on peanut and millet respectively, and maintained at constant soil temperature (32 °C for *A. straturatus,* 30 °C for *A. variabilis*) and at four (5, 7, 9 or 11 %) constant soil moisture levels for 60 days in a growth chamber.

Host plants and soil drying

106 ± 10 *A. straturatus* and 94 ± 9 *A. variabilis* (mixtures of all stages) originating from laboratory stock cultures were inoculated on peanut, millet, sorghum or cowpea under constant soil temperature (32 and 30 °C, respectively) and soil moisture (10 %) with 20 replicates per treatment for 60 days in the greenhouse. At the end of the experiment, ten replicates were extracted for nematode counting and watering was stopped for the ten other replicates. Sixty days later, the nematodes in these replicates were extracted for evaluation of the survival rate.

In a second experiment on soil drying, seven tubes, each with millet plants, were inoculated with 94 ± 9 *A. variabilis* (mixture of all stages) and kept at 30 °C constant soil temperature and 10 % constant soil moisture in the growth chamber. Nematodes were extracted from one tube 60 days later while the six other tubes were allowed to dry an additional 60 days. The soil in each tube was thoroughly mixed and the nematodes were extracted from 50 g of soil from each tube. The rest of the soil was composited and equally distributed in six new tubes, and topped-up with sterilized soil to a volume of 250 cm^3. The tubes were re-planted with the same host plant and kept at the same constant soil temperature and moisture conditions in a growth chamber. Nematodes were extracted again 60 days after the second planting.

Pathogenicity of *A. straturatus* on peanut and cowpea

In four experiments with peanut, the multiplication rate and the effects on plants growth of *i)* 270 ± 18 or 510 ± 19, *ii)* 600 ± 30 or 1200 ± 60, *iii)* 800 ± 40 or 1600 ± 80, *iv)* 2000 ± 70 or 4000 ± 140 nematodes originating from laboratory stock cultures were compared to control plants without nematodes at constant soil temperature (32 °C) and moisture (10 %) for 40 days in a greenhouse.

In one experiment with cowpea, the multiplication rate and the effects on the plant of 1350 ± 120 or 2700 ± 240 nematodes originating from laboratory stock cultures were compared to control plants without

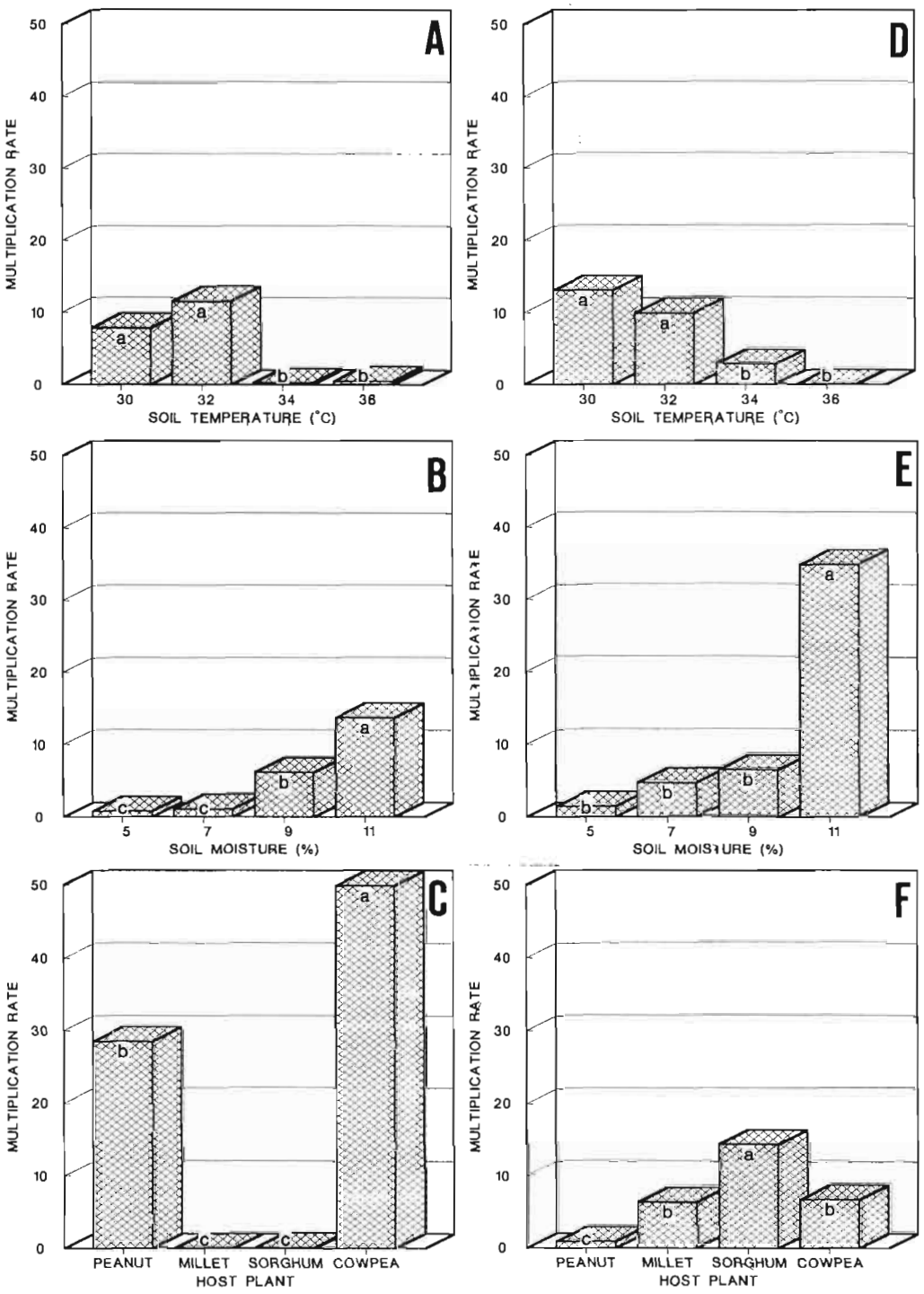

Fig. 2. *Effects of soil temperature (A, D), soil moisture (B, E) and host plants (C, F) on multiplication rate of* Aphasmatylenchus straturatus *(A-C) and* A. variabilis *(D-F).* (Data followed by the same letter are not significantly different at $P < 0.05$).

nematodes at constant soil temperature (32 °C) and moisture (10 %) for 40 days in the greenhouse.

No *Rhizobium* were inoculated on leguminous plants during these experiments.

Pathogenicity of *A. variabilis* on millet

In two experiments, the multiplication rate and the effects on millet of *i)* 200 ± 11 or 400 ± 22, *ii)* 450 ± 30 or 900 ± 60 nematodes originating from laboratory stock cultures were compared to control plants without nematodes at constant soil temperature (30 °C) and moisture (10 %) for 40 days in the greenhouse.

Results

Geographical distribution and miscellaneous observations

The three species of the genus *Aphasmatylenchus* showed different distribution patterns according to the latitude (Fig. 1). *A. nigeriensis* occurs from Nigeria to Liberia, between the latitudes 5 and 8° N in biotopes where no soil drying occurs during the two dry seasons. *A. straturatus* is characterized by a very limited distribution in the south of Burkina Faso at a latitude of 11° N, where the climate is characterized by a long rainy season of more than 6 months). *A. variabilis* occurs more to the north, between latitudes 12 and 14° N, where the rainy season is 4 to 6 months shorter.

In the sahelian zone of West Africa, *A. variabilis* was found only in 3 % of the samples (n = 101) in Mali at the beginning of the rainy season in fields previously cropped with millet, sorghum or cowpea and in less than 1 % of the samples (n = 237) during the dry and rainy seasons, at depth (more than 50 cm deep) around the roots of a non-identified plant and of *Icacina senegalensis*.

Multiplication rate

Soil temperature, soil moisture and host plants had a significant effect on the multiplication rate (Fig. 2) of both species. *A. straturatus* and *A. variabilis* reacted similarly to soil temperature and soil moisture, the multiplication rate being higher at the lower soil temperature combined with high soil moisture level. The host range differed for the two species : *A. straturatus* reproduced only on leguminous hosts whereas *A. variabilis* appeared more polyphagous, reproducing on sorghum, millet and cowpea.

Population densities of both species in the roots were low, and were often less than 10 % of the total population in the different experiments (Table 1).

Survival rate after soil drying

The cessation of watering induced a decrease of soil moisture down to 0.2 % in 15 days. Nematode extraction 60 days later did not reveal the presence of nematodes. In the second experiment conducted with *A. variabilis*, nematodes were not recovered even after soil rehydration and cropping with the same host.

Table 1. *Percentages of the population of* Aphasmatylenchus straturatus *and* Aphasmatylenchus variabilis *in the roots at the end of the different experiments (ND = not determined).*

Experiment and treatments	Root population as a % of total tube population	
	A. straturatus	*A. variabilis*
Soil temperature		
30 °C	0.04	0.01
32 °C	0.03	0.05
34 °C	0.05	1.0
36 °C	0.01	0
Soil moisture	ND	ND
Host plants		
peanut	0.51	7.5
millet	0	3.6
sorghum	0	2.3
cowpea	1.51	10.2
Pathogenicity		
peanut		
* 270 nematodes	ND	
* 500 nematodes	ND	
* 822 nematodes	1.2	
* 1644 nematodes	0.9	
*1982 nematodes	ND	
* 3964 nematodes	ND	
cowpea	ND	
millet		ND

* Inoculum per tube.

Pathogenicity

A. straturatus significantly reduced peanut growth only at the highest inoculum levels of 2000 and 4000 nematodes per plant. It appeared to be slightly pathogenic to cowpea at an inoculum of 1350 nematodes per plant (Table 2). The effects on growth differed slightly according to the plant : on peanut, the nematode reduced both the root and shoot weights whereas on cowpea, only the shoot weight was reduced (Table 2). Symptoms of chlorosis were observed on both plants. *A. variabilis* did not have any significant effects on millet at the inoculum levels tested (Table 3).

Discussion

These studies showed that the two species reacted similarly to environmental factors such soil temperature and moisture and host plants. In addition, the results confirmed observations made in previous studies on the ecology and pathogenicity of *A. straturatus* (Germani & Luc, 1982 *a, b*). These two species did not appear to be

Table 2. *Multiplication rate and effects of* Aphasmatylenchus straturatus *on peanut and cowpea.* (Numbers followed by the same letter are not significantly different at $P < 0.05$).

Plant	Inoculum	Multiplication rate	Fresh weight (g)		Dry weight (g)	
			Roots	Shoots	Roots	Shoots
Peanut	0	–	1.54 *a*	6.42 *a*	0.14 *a*	0.91 *a*
	270	3.91	1.81 *a*	7.08 *a*	0.14 *a*	1.05 *a*
	500	4.35	1.83 *a*	7.38 *a*	0.19 *a*	1.11 *a*
	0	–	1.68 *a*	5.79 *a*	–	0.84 *a*
	600	7.78	1.62 *a*	6.13 *a*	–	0.81 *a*
	1200	5.79	1.78 *a*	6.34 *a*	–	0.85 *a*
	0	–	2.09 *a*	7.11 *a*	–	1.20 *a*
	800	9.98	2.27 *a*	7.57 *a*	–	1.16 *a*
	1600	7.87	2.34 *a*	7.47 *a*	–	1.13 *a*
	0	–	3.20 *a*	6.63 *a*	0.37 *a*	1.38 *a*
	2000	6.25	2.84 *b*	6.02 *b*	0.21 *b*	0.87 *b*
	4000	3.35	2.11 *c*	5.12 *c*	0.16 *c*	0.83 *b*
Cowpea	0	–	2.72 *a*	6.13 *a*	–	1.24 *a*
	1350	12.14	2.62 *a*	4.40 *b*	–	0.63 *b*
	2700	7.56	2.80 *a*	4.49 *b*	–	0.59 *b*

Table 3. *Multiplication rate and effects of* Aphasmatylenchus variabilis *on millet.* (Numbers followed by the same letter are not significantly different at $P < 0.05$).

Plant	Inoculum	Multiplication rate	Fresh weight (g)		Dry weight (g)	
			Roots	Shoots	Roots	Shoots
Millet	0	–	1.23 *a*	3.63 *a*	0.12 *a*	0.42 *a*
	200	3.19	1.61 *a*	3.89 *a*	0.17 *a*	0.49 *a*
	400	3.02	1.30 *a*	3.88 *a*	0.18 *a*	0.47 *a*
	0	–	1.16 *a*	2.87 *a*	0.12 *a*	0.33 *a*
	850	5.70	1.13 *a*	3.07 *a*	0.14 *a*	0.35 *a*
	1700	4.09	1.06 *a*	3.03 *a*	0.12 *a*	0.31 *a*

effective migratory endoparasites, since the root population never exceeds 10 % of the total population.

In contrast to the species of the genus *Scutellonema* previously studied (Baujard & Martiny, 1995 *b, c, d*), the two species of *Aphasmatylenchus* did not appear well adapted to the climatic conditions of the semi-arid tropics of West Africa (Baujard & Martiny, 1995 *a*). Their multiplication rates were higher at lower soil temperature levels and high soil moisture levels. They are not as polyphagous as the species of *Scutellonema* and seemed to be unable to enter anhydrobiosis or to survive in the egg stage during the dry season. These characteristics and the location of the two species at greater depth in the soil profile during the dry season may explain the relatively low frequences of occurrence in these countries.

The differential distribution of the three species of the genus *Aphasmatylenchus* in relation to latitude might be related to the influence of the abiotic factors of the soil environment (temperature and moisture) in conjunction with the host plants. Experiments with *A. nigeriensis* would be necessary to test this hypothesis.

Acknowledgements

The authors thank Dr. P. Cattan, I. R. H. O., Ouagadougou, Burkina Faso, for the sending of soil samples with *Aphasmatylenchus straturatus*.

References

BAUJARD, P. (1995). Laboratory methods used for the study of the ecology and pathogenicity of Tylenchida, Longidoridae and Trichodoridae from rainy and semi-arid tropics of West Africa. *Fundam. appl. Nematol.,* 18 : 63-66.

BAUJARD, P. & MARTINY, B. (1994). Études nématologiques au Mali, Afrique de l'Ouest. I. Prospections de deux zones arachidières. *J. afr. Zool.,* 108 : 217-222.

BAUJARD, P. & MARTINY, B. (1995 *a*). Characteristics of the soil nematode populations from the peanut cropping area of Senegal, West Africa. *J. afr. Zool.,* 109 : 51-69.

BAUJARD, P. & MARTINY, B. (1995 *b*). Ecology and pathogenicity of the Hoplolaimidae from the sahelian zone of West Africa. 1. Field studies on *Scutellonema cavenessi* Sher, 1964. *Fundam. appl. Nematol.,* 18 : 261-269.

BAUJARD, P. & MARTINY, B. (1995 *c*). Ecology and pathogenicity of the Hoplolaimidae from the sahelian zone of West Africa. 2. Laboratory studies on *Scutellonema cavenessi* Sher, 1964. *Fundam. appl. Nematol.,* 18 : 235-245.

BAUJARD, P. & MARTINY, B. (1995 *d*). Ecology and pathogenicity of the Hoplolaimidae (Nemata) from the sahelian zone of West Africa. 3. *Scutellonema clathricaudatum* Whitehead, 1959. *Fundam. appl. Nematol.,* 18 : 247-253.

FORTUNER, R. & COUTURIER, G. (1983). Les nématodes parasites de plantes de la forêt de Taï (Côte-d'Ivoire). *Revue Nématol.,* 6 : 3-10.

GERMANI, G. (1972). Une chlorose des légumineuses de Haute-Volta liée à la présence d'un nématode. *C. R. hebd. Séanc. Acad. Agric. France,* 58 : 202-204.

GERMANI, G. & LUC, M. (1982 *a*). Études sur la « chlorose voltaïque » des légumineuses due au nématode *Aphasmatylenchus straturatus* Germani. I. *Revue Nématol.,* 5 : 139-146.

GERMANI, G. & LUC, M. (1982 *b*). Études sur la « chlorose voltaïque » des légumineuses due au nématode *Aphasmatylenchus straturatus* Germani. II. *Revue Nématol.,* 5 : 195-199.

GERMANI, G. & LUC, M. (1984). Description de *Dolichorhynchus elegans* n. sp. et *Aphasmatylenchus variabilis* n. sp. (Nematoda : Tylenchida). *Revue Nématol.,* 7 : 81-86.

SHER, S. A. (1965). *Aphasmatylenchus nigeriensis* n. gen., n. sp. (Aphasmatylenchinae n. subfam. : Tylenchoidea : Nematoda) from Nigerian Soil. *Proc. helminth Soc. Wash.,* 32 : 172-176.

VAN DEN BERG & CADET, P. (1991). One new and some known plant parasitic nematode species from the French Caribbean (Nemata : Tylenchina). *Fundam. appl. Nematol.,* 14 : 389-405.

VOVLAS, N., TROCCOLI, A. & LAMBERTI, F. (1991). Morpho-anatomical observations on *Aphasmatylenchus nigeriensis* and *Scutellonema clathricaudatum* from West-Africa. *Nematol. medit.,* 19 : 259-264.