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OBSERVATIONS ON SOME *XIPHINEMA* SPECIES FOUND
IN BRAZIL (NEMATODA: DORYLAIMOIDEA)

by

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Systematic studies of the genus *Xiphinema* Cobb in Brazil are still relatively few. The papers of Lordello and Carvalho (see Literature Cited) included descriptions of several species. Monteiro (1970) commented on the morphology of *Xiphinema* species found in the rhizosphere of *Coffea arabica* L. in the State of São Paulo and recently, Loof and Sharma (1979) published a taxonomic study of *Xiphinema* populations collected in the State of Bahia. The present paper reviews the biometrics and taxonomic status of *Xiphinema* populations collected in 10 Brazilian States.

Materials and methods

Nematodes collected by the author were killed by heat, fixed in TAF and processed to glycerine by the Cobb's slow method; temporary mounts in TAF were also prepared. The specimens supplied by contributors were in all cases sent in fixatives and mounted as above described.

The material studied had been collected in the States of Acre (AC), Bahia (BA), Ceará (CE), Goiás (GO), Minas Gerais (MG), Paraíba (PB), Paraná (PR), Piauí (PI), Rio de Janeiro (RJ), and São Paulo (SP) and in the Territorio of Amapá (AP).

Results and discussion

Xiphinema brasiliense Lordello, 1951 (Fig. 1: D and E)

Females (n = 10): L = 2 mm (1.8-2.2); a = 37 (31-40); b = 5.6 (5.1-5.7); c = 53 (43-62); c' = 1.2 (1-1.4); V = 28 (27-31); odontostyle = 119 μ m (111-127); odontophore = 72 μ m (71-75); spear = 191 μ m (183-200).

Occurrence: GO, PR, SP.

This species was also reported in the State of Bahia by Loof and Sharma (1979). A peculiar tail with an axial and elongated peg (10-15 μ m) at the terminus provides easy recognition of *X. brasiliense* among all the species of *Xiphinema* found in Brazil. Cohn and Sher (1972) synonymised *Xiphinema itanhaense* Carvalho, 1962 with *X. brasiliense*.

The species was found in association with *Saccharum officinarum* L. and unidentified plants collected in cerrado areas.

Xiphinema brevicolle Lordello et Da Costa, 1961 (Fig. 1-C)

Females (n = 12): L = 1.8 mm (1.6-2.2); a = 38 (32-42); b = 6.3 (5.6-7.5); c = 77 (68-88); c' = 0.85 (0.8-1); V = 53 (52-54); odontostyle = 95 μ m (86-103); odontophore = 59 μ m (56-64); spear = 154 μ m (146-166).

Occurrence: SP.

Males are known but were not reported.

Carvalho (1955) considered that the species found in association with ornamentals in São Paulo City was *Xiphinema americanum* Cobb, 1913 and gave a short description of the material. In the diagnosis of *X. brevicolle*, Lordello and Da Costa (1961) emphasized the close resemblance of the new species to Carvalho's form except for the spear length. Carvalho (1962) described specimens collected in Banana plantations from Caraguatatuba, State of São Paulo, again considering that the species involved was *X. americanum*. Lima (1965) stated that Carvalho's material was in reality *X. brevicolle*, the same opinion of Heyns (1974). Khan and Ahmad (1975) renamed *X. americanum* apud Carvalho (1955) *Xiphinema saopaolense* based on differences that this species and *X. brevicolle* showed relatively to « V » and spear

length values. Luc and Dalmasso (1975) considered *X. saopaolense* as a non valid taxon and, later, Lamberti and Loof (1977) also discussed the validity of *X. saopaolense* and concluded that it might be regarded as synonym of *X. brevicolle*. It is also my opinion that Carvalho's forms were in fact *X. brevicolle*. Regarding the 1955 description, there is evidence of error in measurements and/or drawing because contrary to the spear length of 108 μm given in the text a 134 μm long spear can be calculated from the illustration 1a, a value still abnormal for *X. brevicolle*. Other characters as body length, labial region and tail shape agreed with the type material. The second population closely resembles *X. brevicolle* in all important features. Moreover, I was able to examine Dr. Carvalho's collection (courtesy of Mrs. Arlete de Bona) and found *X. brevicolle* specimens in slides prepared several years prior to the description of this species, some of them marked « *X. americanum* ». The mounts were generally in poor condition so that an adequate study was only possible in the slide marked « *Xiphinema* - B/20/2/52 ». The following mean values were determined for five females: L = 1.9 mm; a = 41; b = 7; c = 66; c' = 1.1; V = 52; odontostyle = 101 μm ; odontophore = 55 μm ; spear = 156 μm . The specimens figured by Carvalho in both papers were not found in all slides examined and I cannot affirm that the five females above mentioned were included in the 1955 description. Anyway, more support is given to the view that Carvalho's material was *X. brevicolle*.

It should be noted that Lamberti and Loof (1977) misunderstood the term « spear » used by Carvalho in his descriptions and, although the authors' final proposition was correct, a part of the discussion regarding *X. saopaolense* was prejudiced. The term spear (= estilete) did not refer to the odontostyle alone, as is apparent from the following translation of part of Carvalho's (1955) description: « ...Spear in two parts; the anterior one (= odontostyle) is 0.070 mm long and possess a guiding ring while the posterior (= odontophore) is 0.038 mm long and presents three basal flanges ». Lamberti and Loof were also in error in thinking that Carvalho repeated his 1955 description in his 1962 publication. The specimens referred to in both papers belonged to distinct populations which had been collected from different hosts and localities. The odontostyle and spear values given in the 1962 description were 90 and 146 μm respectively, but by their oversight Lamberti and Loof included the value « 108 μm » (from the 1955 description) in their discussion with the result that some of their comments were inappropriate.

X. brevicolle was found in association with *Carica papaya* L., *C. arabica*, *S. officinarum* and unidentified plants of cerrado areas.

Xiphinema elongatum Sch. Stek. et Teun., 1938
(Fig. 1: I and J)

Females (n = 20); L = 2.2 mm (2-2.5); a = 51 (44-57); b = 6.2 (5.4-6.8); c = 37 (33-41); c' = 2.5 (2.4-2.7); V = 39.5 (38-42); odontostyle = 92 μ m (89-94); odontophore = 60 μ m (58-63); spear = 152 μ m (150-156).

Occurrence: MG, SP.

This species is very common in São Paulo and probably occurs in other parts of Brazil. No males were found even in the largest populations examined. As proposed by Luc and Tarjan (1963), *Xiphinema campinense* Lordello, 1951 and *X. elongatum* are evident synonyms.

X. elongatum was found in association with *Glycine max* (L.) Merrill, *Glycine wightii* Willd., *Phaseolus vulgaris* L., *Zea mays* L., *S. officinarum*, and some undetermined grasses.

Xiphinema georgianum Lamberti et Bleve-Zacheo, 1979
(Fig. 1-A and B)

Females (n = 10); L = 1.9 mm (1.7-2.1); a = 44 (37-48); b = 6.3 (6-6.7); c = 56 (51-60); c' = 1.4 (1.3-1.6); V = 51 (50-52); odontostyle = 98 μ m (93-105); odontophore = 54 μ m (50-57); spear = 152 μ m (146-160); tail = 30 μ m (27-32); J = 10.5 μ m (10-11).

Occurrence: PB, SP.

These values agreed with those presented by Lamberti and Bleve-Zacheo (1979). The tail shape predominant (Fig. 1 B) is identical with the type material but variations were observed (Fig. 1 A). The values of J in Brazilian females were slightly lower (10.5 viz. 12 μ m) than in paratypes, although overlapping occurred. No sperm was observed in the female gonads.

X. georgianum was found in association with *S. officinarum* in São Paulo State and in soil samples from Paraíba State.

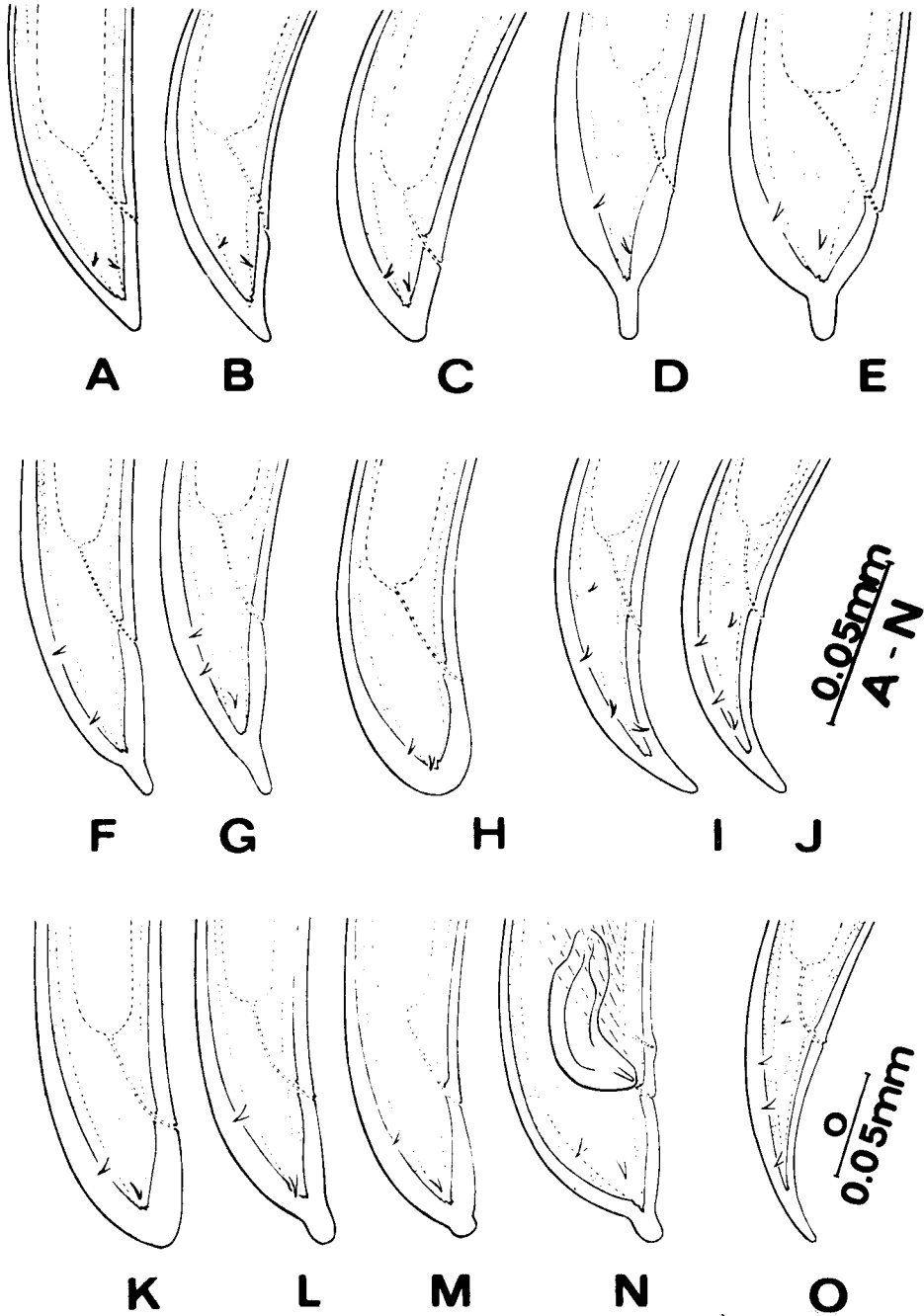


Fig. 1 - Posterior region of *Xiphinema* species found in Brazil: A and B, *X. georgianum*; C, *X. brevicolle*; D and E, *X. brasiliense*; F and G, *X. vulgare*; H, *X. surinamense*; I and J, *X. elongatum*; K, L, M and N (= male), *X. krugi*; O, *X. paritaliae*.

Xiphinema krugi Lordello, 1955 (Fig. 1: K, L, M and N)

Females (n = 51): L = 1.9 mm (1.6-2.4); a = 41 (33-53); b = 5.3 (4.2-6); c = 52 (43-66); c' = 1.2 (0.9-1.5); V = 33.5 (30-38); odontostyle = 111 μ m (97-130); odontophore = 71 μ m (62-78); spear = 182 μ m (168-200).

One male: L = 2.1 mm; a = 42; b = 6.3; c = 53; c' = 1.1; odontostyle = 107 μ m; odontophore = 66 μ m; spear = 173 μ m; T = 33; spicules = 52 μ m; J = 10 μ m.

Occurrence: AP, CE, GO, MG, PI, PR, RJ, SP.

X. krugi is widely distributed in Brazil.

The examination of more than 300 females of this pseudomonodelphic species showed a considerable variation in several characters. Frederick and Tarjan (1974) commented on the morphology of *X. krugi* based on four populations found in the United States. Later, Luc and Hunt (1978) published a very elucidative paper which dealt with the variations of the anterior genital branch and tail shape of *X. krugi* observed in thirteen populations from different geographical areas; in this study the authors confirmed the synonymy of *Xiphinema denoudenii* Loof *et* Maas, 1972 and *Xiphinema loosi* Southey *et* Luc, 1973 with *X. krugi*. My view on the subject was given in an unpublished thesis (Ferraz, 1977) and agreed fairly well with that of Luc and Hunt (1978), particularly the comments on tail shape variation. About 90% of the females displayed a more or less pronounced ventral knob in the tail (five of these specimens were also studied by Luc and Hunt, being referred to in their paper as « population 3 »). The low incidence of Brazilian females with hemispheroid tail and anterior genital branch shorter than one vulval diameter provides additional support to the idea suggested by Luc and Hunt (1978) that at least two groups may occur within *X. krugi*.

A single male was collected from the rhizosphere of *S. officinarum* in Piracicaba, São Paulo State. Males of *X. krugi* are extremely rare and, apparently, only the specimen described by Loos (1949) from Sri Lanka and illustrated by Cohn and Sher (1972) is known. The body is almost cylindrical, tapering only near the extremities. Cuticle finely striated, 2 μ m thick along body except at the extremities. Labial region 4.5 μ m high, separated by a slight depression from the rest of the body. Amphidial pouches and apertures typical of the genus. Odonto-

style 2 μm diameter along its length and guiding ring situated at 95 μm from the oral aperture. Oesophagus total length 325 μm , being approximately 1/3 occupied by the basal bulb. Oesophago-intestinal valve obscure. Body diameter at middle body and base of oesophagus are 50 and 48 μm respectively. Testes paired, being the outstretched 50 μm long and the reflexed 38 μm long. Spicules rather slender proximally, ventrally bent behind middle; lateral guiding piece of spicules 8.5 μm long. Strong diagonal copulatory muscles very evident in the region of supplements. These are three: S_1 - S_2 29 μm , S_2 - S_3 25 μm , and S_3 - cloacal aperture 147 μm . The adanal pair lies 21 μm from the cloacal aperture but 19 μm in the specimen from Sri Lanka. Tail shape and distribution of caudal papillae are figured (Fig. 1 - N). Differences in « c » and « c' » ratios determined for the males are related to the more elongated tail of the Brazilian specimen. The male specimen is in the author's collection.

X. krugi was found in association with *Anacardium occidentale* L., *G. max*, *P. vulgaris*, *S. officinarum*, *Z. mays*, *Citrus* sp., *Musa* sp., and several weeds such as *Malva parviflora* L., *Cassia occidentalis* L., *Phytolacca thyrsoflora* L., *Alternanthera brasiliensis* (L.) Kuntze, and *Solanum* sp..

Xiphinema pachtaicum (Tulaganov, 1938) Kirjanova, 1951

Females (n = 8): L = 1.9 mm (1.8-2.1); a = 65 (61-73); b = 6 (5.6-7.2); c = 59 (54-65); c' = 1.7 (1.6-1.9); V = 56 (54-59); odontostyle = 90 μm (87-91); odontophore = 51 μm (47-53); spear = 141 μm (137-143); tail = 31 μm (28-33); J = 11 μm (9.5-12).

Occurrence: SP.

This is the first report of the species in Brazil.

Measurements obtained from 8 females agreed with those presented by Lamberti and Martelli (1971), Lamberti and Bleve-Zacheo (1979) and, particularly by Heyns (1977) for South African populations. It should be noticed that in Brazilian females the tail is conical, clearly pointed in the extremity and with a very slight dorsal indentation (see Fig. 18 and 22 in Heyns, 1977). Only one pair of caudal papillae was observed in all specimens.

X. pachtaicum was found in association with *Citrus reshni* Hort. ex. Tan..

Xiphinema paritaliae Loof et Sharma, 1979 (Fig. 1: 0)

Females (n = 18): L = 3.6 mm (3.2-3.9); a = 70 (59-78); b = 9.2 (8.5-11); c = 42 (37-48); c' = 2.9 (2.6-3.3); V = 41 (37-44); odontostyle = 115 μ m (106-122); odontophore = 67 μ m (64-74); spear = 182 μ m (170-192); tail = 78-98 μ m; oesophagus total length = 370-437 μ m; J = 22-28.5 μ m.

One male: L = 3.8 mm; a = 80; b = 10.8; c = 47; c' = 2.6; odontostyle = 121 μ m; odontophore = 64 μ m; spear = 185 μ m; oral aperture to guiding ring = 98 μ m; oesophageal basal bulb = 91 x 17 μ m; tail = 81 μ m; spicules = 49 μ m; T = 57; J = 24 μ m; body diameter at middle body = 47 μ m; body diameter at anus = 31 μ m.

Occurrence: AP, RJ, SP.

X. paritaliae was described with basis on 3 females and some juveniles from Bahia State, Brazil.

A comparison of the available biometrical data showed that the odontostyle is clearly longer (130-136 viz. 106-122 μ m) in the females from Bahia than in all specimens examined during this study. On the other hand, a wider range of values was obtained for the oesophagus total length, « V », tail length and « c' » in the population here considered. It should be noticed that in about 40% of the females the inner surface of the cuticle of the tail tip forms a thin and short « blind canal » (7-8 x 1.5 μ m), which slightly resembles that of *Xiphinema ifacolum* Luc, 1961.

A single male was collected from the rhizosphere of *Eucalyptus saligna* Sm. in Santa Lucia, São Paulo State, which is in the author's collection. Males of *X. paritaliae* were still unknown. It is morphologically and biometrically similar to the female but more coiled in the posterior region. Testes paired, being the outstretched 322 μ m long and the reflexed 254 μ m long. Spicules dorylaimid, lateral guiding pieces 10 μ m long. Apart from the adanal pair (distance = 14 μ m) there are 4 supplements: S₁-S₂ 30 μ m, S₂-S₃ 29 μ m, S₃-S₄ 29 μ m, S₄ to cloacal aperture 173 μ m. Strong diagonal copulatory muscles very evident in the region of the supplements. Tail shape and caudal papillae as in the female. The fine caudal canal present in several females was not observed in the male specimen.

X. paritaliae was found in association with *Citrus limonia* Osbeck, *Piper nigrum* L., *Ananas comosus* (L.) Merr., *E. saligna*, *G. wightii*, and *S. officinarum*.

Xiphinema surinamense Loof *et* Maas, 1972 (Fig. 1: H)

Females (n = 14): L = 2.2 mm (2-2.5); a = 43 (40-48); b = 5.4 (5.1-5.7); c = 81 (76-87); c' = 0.85 (0.8-0.9); V = 37.5 (36-39); odontostyle = 116 μ m (113-122); odontophore = 75 μ m (73-79); spear = 191 μ m (186-200).

Occurrence: SP.

Unfortunately no males were found in São Paulo to compare with specimens obtained by Loof and Sharma (1979) from Bahia.

In the diagnosis of the species, Loof and Maas (1972) suggested that *Xiphinema ensiculiferum* *apud* Carvalho (1955) might be identical to *X. surinamense*. This possibility is now confirmed. When examining Dr. Carvalho's collection I found the female illustrated in the mentioned paper in the slide marked « B-13/2/54 ». The following biometrical data were determined for the specimen: L = 2.2 mm; a = 39; b = 5.2; c = 68; c' = 0.8; V = 39; odontostyle = 126 μ m; odontophore = 85 μ m; spear = 211 μ m; one egg = 218 x 50 μ m. The specimen was slightly depressed thus accounting for some differences in the measurements. The anterior branch is reduced to an elongated uterus and the ovary is clearly lacking.

X. surinamense was found in association with *Pinus elliottii* Englem., *Pinus taeda* L., and *S. officinarum*.

Xiphinema vulgare Tarjan, 1964 (Fig. 1: F and G)

Females (n = 23): L = 2.4 mm (2.2-2.9); a = 50 (48-60); b = 6.6 (5.5-8.4); c = 51 (41-65); c' = 1.6 (1.5-1.7); V = 39 (37-40); odontostyle = 113 μ m (109-119); odontophore = 70 μ m (67-76); spear = 183 μ m (178-192); J = 18 μ m (14-20).

Occurrence: AC, BA, MG, SP.

Two female specimens from Bahia were kindly supplied by Dr. R. D. Sharma. This species is close to *Xiphinema setariae* Luc, 1958 and according to Luc and Dalmasso (1975) they can be separated by examination of the hyaline part of the tail which is smaller in *X. vulgare* (13-20 *viz.* 23-29 μ m).

X. vulgare was found in association with *Solanum melongena* L.,

Crotalaria lanceolata Mey., *S. officinarum*, and several weeds such as *Bidens pilosa* L., *Indigofera truxillensis* HBK., and *Solanum* sp.

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S U M M A R Y

The following species of the genus *Xiphinema* Cobb were identified from soil and root samples collected in ten Brazilian States: *X. brasiliense* Lordello, *X. brevicolle* Lordello et Da Costa, *X. elongatum* Sch. Stek. et Teun., *X. georgianum* Lamberti et Bleve-Zacheo, *X. krugi* Lordello, *X. pachtaicum* (Tulaganov) Kirjanova, *X. paritaliae* Loof et Sharma, *X. surinamense* Loof et Maas, and *X. vulgare* Tarjan. *X. ensiculiferum* apud Carvalho (1955) was confirmed as *X. surinamense*. The validity of *X. saopaolense* Khan et Ahmad is also discussed. The male of *X. paritaliae* is described.

R I A S S U N T O

Osservazioni sulle specie di Xiphinema trovate in Brasile.

Esaminando campioni di terra e radici provenienti da dieci stati del Brasile è stata osservata la presenza delle seguenti specie appartenenti al genere *Xiphinema* Cobb: *X. brasiliense* Lordello, *X. brevicolle* Lordello et Da Costa, *X. elongatum* Sch. Stek. et Teun., *X. georgianum* Lamberti et Bleve-Zacheo, *X. krugi* Lordello, *X. pachtaicum* (Tulaganov) Kirjanova, *X. paritaliae* Loof et Sharma, *X. surinamense* Loof et Maas e *X. vulgare* Tarjan. *X. ensiculiferum* apud Carvalho (1955) è in realtà *X. surinamense*. Vengono inoltre fatti commenti sulla validità di *X. saopaolense* Khan et Ahmad ed è descritto il maschio di *X. paritaliae*.

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