The male of *Xiphinema index* Thorne & Allen, 1950 (Nematoda : Longidoridae)

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Summary

The authors give a detailed description of the male of *Xiphinema index* Thorne & Allen, 1950 based on 29 specimens from the vicinity of roots of fig-trees in Israel. The "innervated organ anterior to the supplement series" recorded in the original description is actually an atrophied anterior supplement. Some spermatozoa were observed in the uterus of one female.

Résumé

Le mâle de Xiphinema index *Thorne & Allen, 1950 (Nematoda : Longidoridae)*

Les auteurs donnent une description détaillée du mâle de *Xiphinema index* Thorne & Allen, 1950 fondée sur l'étude de 29 spécimens provenant de la rhizosphère de figuier, en Israel. « L'organe innervé antérieur à la série de suppléments ventraux » signalé dans la description originale n'est en fait qu'un supplément ventral antérieur atrophié. Quelques spermatozoïdes ont été observés dans l'utérus d'une femelle.

Xiphinema index Thorne & Allen, 1950 is probably the best known species of the genus. This is due to its worldwide distribution and to its economic importance as the vector of the fan-leaf virus, which causes a serious disease of the grapevine. It was with this species that transmission of a plant virus by a nematode was demonstrated for the first time (Hewitt, Raski & Goheen, 1958). Thus, there is considerable information concerning its anatomy, ultrastructure, ovogenesis, embryology, life-history, host range, host reactions, distribution in soil, seasonal fluctuations of populations, etc (see Siddiqi, 1974).

Since the original description several authors have added information on morphology and biometrics of females and juveniles from various sources (Martelli & Lamberti, 1967 ; Heyns, 1971 ; Prota *et al.*, 1971 ; Southey, 1973 ; Siddiqi, 1974 ; Garau & Prota, 1977 ; Kankina, 1978). Siddiqi (1974) redescribed the species on the basis of six syntype females and designated a lectotype. Males however are generally considered as extremely rare, and it has been proven that reproduction is of the meiotic parthenogenetic type (Dalmasso, 1970). The males studied until now are the two recorded, « among hundreds of females », and described by Thorne and Allen (1950) ; nine males, from Sardinia, of which Prota *et al.* (1971) gave a brief description, main dimensions, and drawing of the tail and spicules ; a male «slightly pressed », from California, of which the tail and spicules are illustrated by Siddiqi (1974) ; and one male, from vineyards in Tadzhikistan, measured and illustrated by Kankina (1978). This last specimen generally fits the original description, but Kankina (1978) underlines the presence of only two single ventral supplements instead of four as in the male paratype. The males recorded by Thorne and Allen (1950) have probably not been preserved as they were not studied by Siddiqi (1974) together with the syntype females. Harris (1977) recorded males in populations from vineyards in north-eastern Victoria (Australia), but did not give details

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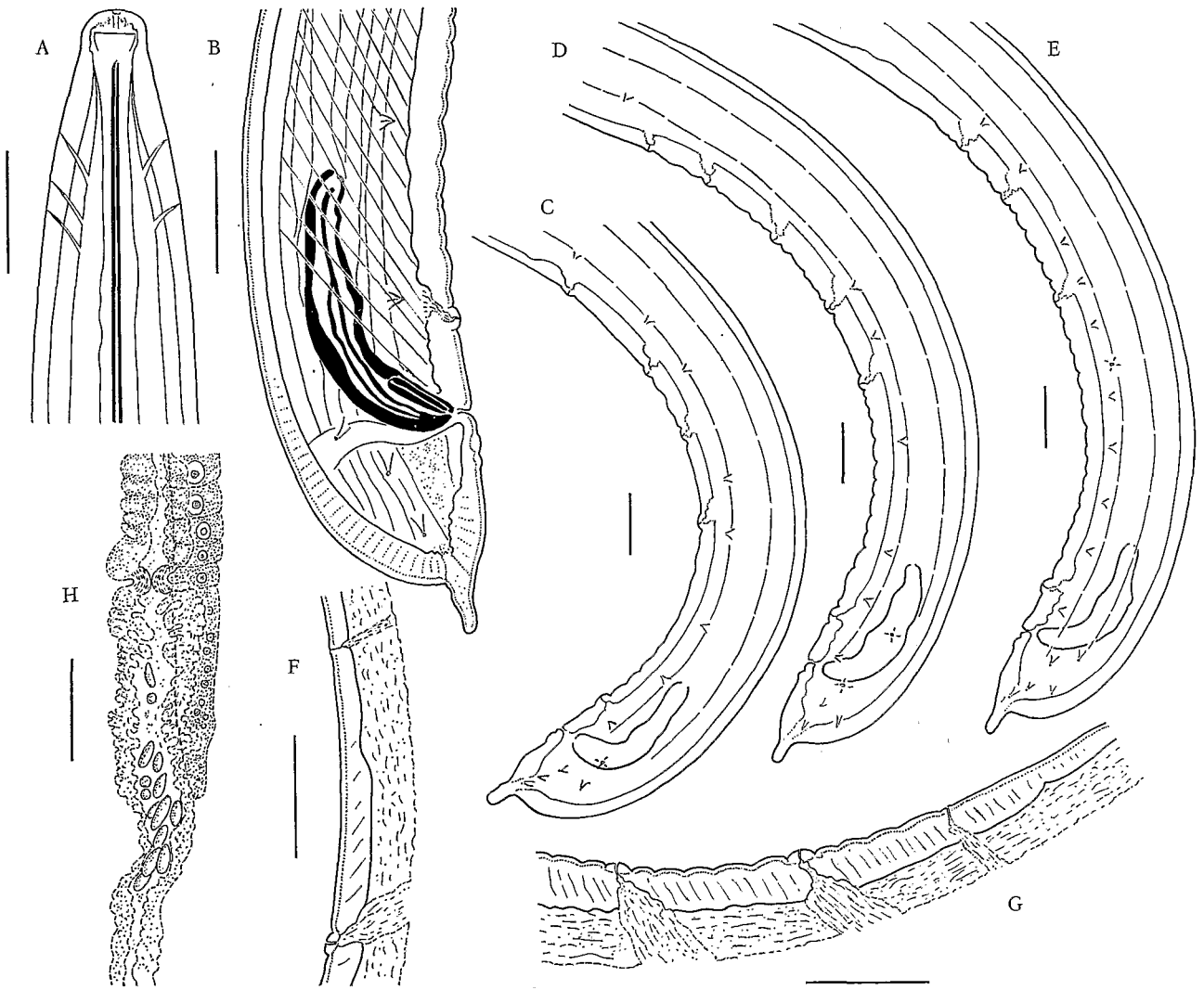

Fig. 1. *Xiphinema index* Thorne & Allen, 1950. Male. A : anterior end. B : tail and spicules. C, D, E : posterior part of body showing position of ventral supplements and of ventromedian papillae. F : ventral pore (above) and most anterior ventral supplement (below). G : two normal ventral supplements and an anterior atrophied supplement (above). Female. H : portion of the genital tractus showing spermatozoa in the uterus. *(Bars are equivalent to 25 µm).*

other than : « measurements of males and females ... were similar to those given for the species » ; and a photomicrograph of the posterior part of a male with protruding spicula. These Australian males are rare : 1-2% in one population, one in 76 000 specimens in another.

In Israel, *X. index* is widely distributed on grapevine and citrus on both of which it has been shown to be pathogenic (Cohn & Orion, 1970). Twenty-nine males were collected from a population a reared on fig-trees in a glasshouse at Bet-Dagan. The proportion of males in the adult population was 2.65% (mean of five samples). Study of these males has enabled us to collect more precise morphometric data, and to clarify the question of the enigmatic « innervated organ anterior to the supplement

series » and the « ventro-submedian series of seven papillae » reported in the original description (Thorne & Allen, 1950).

Xiphinema index Thorne & Allen, 1950

FEMALES

Biometrics of fifteen females are given in Table 1. No supplementary data need be added to the original or other descriptions published. The only point to be recorded is that in one of the 28 females observed, spermatozoa were present in the uterus, more precisely in the proximal part of the cylindrical portion and in the distal part of the uterine pouch (Fig. 1, H). These spermatozoa were few in number, and not clustered in the uterine pouch as is frequently observed in various amphimictic species of the genus. This observation proves at least that males are functional and that copulation can occur. Nothing more can be said about the role of these spermatozoa, but parthenogenesis of meiotic type does permit amphimixy. Curiously this female was the only one in the population studied with a rounded tail devoid of the characteristic terminal peg. No spermatozoa could be detected in seven other rounded tailed females from other samplings. The mean percentage of these females, in five samples, was 2.23% of total females.

TABLE 1

Xiphinema index (Population fig-tree, Bet-Dagan, Israel) Biometrics of males and females

	Females	*Males*
n	15	29
L	2.84-3.50	2.39-3.35
(mm)	3.08	2.95
a	52.6-65.9	43.4-71.4
	58.5	57.9
b	6.5-7.3	5.4-8.1
	6.8	6.7
Tail	37-45 *	38-47 *
(µm)	38.5	42
c	72.8-85.7 *	53.1-79.8 *
	79.1	69.8
c'	0.9-1.1 *	0.9-1.2 *
	1.0	1.0
V	38.7-42.7	—
	40.7	
Od. style	129-141	128-143
(µm)	135	134
Od. phore	66-76	69-77
(µm)	72	73
Stylet	200-215	197-218
(µm)	207	207
Spicules	—	59-70
(µm)		64
	* n = 13	* n = 28

MALES

A complete redescription is given below.

When heat-relaxed, body forms a more or less closed C or open spiral ; curvature more pronounced in the posterior part. Body elongated, tapering only for a short distance at the fore-part, and ending abruptly. Cuticle apparently composed of two layers, 3-4.5 µm thick at mid-body, 4-5.5 µm at neck, and 7-10 µm on dorsal side of the tail. Cervical pores in four rows, beginning close to the fore-end ; 2-3 dorsal cervical pores, 3-4 closely-situated ventral cervical pores followed by more widely spaced and irregularly disposed ventral pores all along the body, ending at variable distance from the most anterior ventral sexual supplement ; lateral pores in a single line in the anterior part, then divided into two lines, the pores being more numerous on the latero-subventral line than on the latero-subdorsal one. Lateral chord 10-15 µm (12) wide at mid-body, or 21-27% (25) of the corresponding diameter. Labial area 13-15 µm wide, somewhat flattened with rounded edge, almost continuous with the rest of body which enlarges progressively (the shape of the anterior part is very characteristic of the species). Opening of the amphids a straight line, approximately 75% of the corresponding diameter, at 5-6 µm from the fore-end. Stylet typical of the genus ; flanges well developed, 12-13 µm wide, with reinforced margin. Base of the « tubular » guide at 112-126 µm (117) from fore-end when stylet is retracted, at 113-115 µm when exserted ; length of guide : 10-19 µm (14) for retracted stylets and 21-32 µm (26) for exserted stylets. Basal oesophageal bulb measuring 93-114 × 20-25 µm (102 × 23) ; position of oesophageal gland nuclei and their ducts normal for genus. (Thorne and Allen (1950) recorded and figured a posterior pair of subventral nuclei « frequently ... very obscure » in addition to the three normal oesophageal gland nuclei ; this additional pair of nuclei could not be seen in any of the male or female specimens examined). « Mucro » in the oesophageal wall, 4-5 µm long, at 22-45 µm from base of

TABLE 2
Xiphinema index (Population fig-tree, Bet-Dagan, Israel), Position of the ventral supplements in 29 males (in µm) (Numbers between brackets indicate an atrophied supplement)

N°	*Cloaca-double pap.*	*Double pap.-S_1*	S_1-S_2	S_2-S_3	S_3-S_4	S_4-S_5	S_5-S_6
1	20	122	46	27			
2	21	103	42	40			
3	23	101	30	32	(48)		
4	22	98	38	37	28		
5	21	89	29	41	25		
6	20	88	38	31	25		
7	20	134	38	29	39		
8	22	115	45	32	26		
9	21	90	43	48	35		
10	20	102	34	18	44		
11	19	91	31	38	37		
12	19	84	38	39	24		
13	20	97	31	23	25		
14	21	94	23	36	30		
15	20	110	40	19	39		
16	20	84	38	36	33		
17	20	89	39	37	25		
18	18	108	20	22	36		
19	22	101	42	42	28		
20	22	95	35	46	42		
21	22	97	29	34	23		
22	22	93	37	26	26		
23	23	96	26	43	33		
24	22	72	39	38	35	(30)	
25	21	98	33	36	37	28	
26	22	67	35	44	29	37	
27	21	96	31	32	17	24	
28	21	112	29	23	22	42	
29	22	71	23	33	35	34	(26)

stylet. Hemizonid flat, 6-8 µm (6.5) at 179-211 µm (198) from fore-end ; hemizonion lentiform, 2-3 µm, at 241-281 µm (261) from fore-end. Nerve ring 10-20 µm wide, at 10-23 µm from base of stylet ; no posterior second nerve ring observed. Genital tract : two testes, one straight, the other reflexed. Spicules massive, curved, not cephalated, with a more or less pronounced ventral protuberance in the middle part ; accessory piece straight, 15-17 µm (16) long. Double ventral papilla in front of the cloaca and three to five (exceptionally six) single ventral supplements, the most common number (21/29 males) being four. (The position of the double papilla and of the supplements is given for each of the males in Table 2). On some specimens (3/29) the most anterior supplement is atrophied (Fig. 1, G).. In the original description, the presence of an « innervated organ anterior to the supplement series » (given as four) is noted ; this « organ » is almost certainly a fifth, atrophied, ventral supplement, as suggested by Sturhan (1963) ; more doubtfully, it could be the most posterior ventral pore. Thorne and Allen (1950) recorded too « a ventro-median series of seven pairs or innervated papillae » ; these papillae (pores?) were observed in each of the males examined ; their number varies from six to ten ; the most posterior is situated slightly posterior or anterior to the double papilla and the most anterior at the approximate level of the most anterior single supplement ; these ventro-median papillae appear distinct from the normal latero-subventral pores, because in some rare cases (Fig. I, E) one of these pores can be observed together with the ventro-median papillae. Tail short, dorsally rounded, with a terminal peg situated ventrally and 8-12 µm (10.5) long. One male lacking peg with a rounded tail. Internal blind canal large, but its limits often obscure. Four to five caudal pores. Ventrally, about 5 µm posterior to the cloaca, the cuticle shows a slight bulge corresponding to a thickening of the external layer(s) ; no innervation could be observed in this structure which is present in all males examined and has not yet been recorded in any other species of the genus.

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