

# Description of *Xiphinema karachiense* sp. n. and morphometric data on *Enchodelus macrodorus* (de Man, 1880), Thorne, 1939 (Nematoda : Dorylaimida) from Pakistan

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**Summary** — Specimens collected from citrus soil and identified as *Xiphinema karachiense* sp. n. are related to the group 5 of the polytomous key proposed by Loof and Luc (1990) having two equally developed female genital branches and a pseudo-Z-organ in uterus. *X. karachiense* sp. n. can be separated from all the other species of the genus by a combination of following characteristics : total body length, odontostyle length, c' value, female tail convex conoid with broadly rounded terminus and males with digitate tail. Morphometric data on *Enchodelus macrodorus* (de Man, 1880) Thorne, 1939 are also presented.

**Résumé** — Description de *Xiphinema karachiense* sp. n. et données morphométriques sur *Enchodelus macrodorus* (de Man, 1880) Thorne, 1939 (Nematoda : Dorylaimida) — Des spécimens collectés dans la rhizosphère de Citrus spp. et identifiés comme *Xiphinema karachiense* sp. n. sont attribués au groupe 5 de la clé polytomique proposée par Loof et Luc (1990) en raison des deux branches génitales femelles également développées et de la présence d'un pseudo-organe Z. *X. karachiense* sp. n. peut être séparé de toutes les autres espèces du genre par la combinaison suivante de caractères : longueur du corps, longueur de l'odontostyle, valeur de c', queue de la femelle convexe-conoïde à terminus largement arrondi, queue du mâle digitée. Des données morphométriques concernant *Enchodelus macrodorus* (de Man, 1880) Thorne, 1939 sont également fournies.

**Key-words** : Nematodes. *Xiphinema*, *Enchodelus*.

So far ten species belonging to the genus *Xiphinema* Cobb, 1913 have been reported from Pakistan viz. *X. americanum* Cobb, 1913, *X. basiri* Siddiqi, 1959, *X. brevicolle* Lordello & Dacosta, 1961, *X. elongatum* Schuurmans Stekhoven & Teunissen, 1938, *X. index* Thorne & Allen, 1950, *X. insigne* Loos, 1949, *X. intermedium* Lamberti & Bleve-Zacheo, 1979, *X. pachtaicum* (Tulaganov, 1938) Kirjanova, 1951, and *X. radiculola* Goodey, 1936 (Maqbool, 1986; Lamberti *et al.*, 1987). During a recent survey specimens belonging to an undescribed species were recovered from soil around the roots of citrus (*Citrus* spp.) and named *X. karachiense* n. sp. Morphometric data, description and illustrations of this species are presented herein. *Enchodelus macrodorus* collected from the high altitude of Saifulmuluk from grassy field is recorded for the first time in Pakistan and redescribed.

## Materials and methods

Soil samples were collected from citrus orchards. Nematodes were extracted by wet sieving, heat relaxed by pouring hot water (about 90 °C) over nematodes held in a very small quantity of tap water, fixed and stored in a 3 % formaldehyde solution. The fixed nematodes were transferred to warm lactophenol and were left in the

same medium overnight at room temperature. They were then transferred to warm 75 % glycerine and 25 % lactophenol solution. After two hours, they were transferred to pure dehydrated glycerine. Specimens were mounted on slides in glycerine. All measurements were taken from glycerine mounted specimens. Specimens were measured with the aid of camera lucida. Identification of the *Xiphinema* specimens has been made with the help of the polytomous key given by Loof and Luc (1990).

## *Xiphinema karachiense* sp. n.

(Fig. 1)

### DIMENSIONS

*Female, male and juveniles* : see Table 1.

*Holotype* (female) : L = 2.6 mm; a = 69; b = 6.9; c = 75; c' = 1.3; V = 50; odontostyle = 120 µm; odontophore = 60 µm; total stylet = 180 µm; stylet guiding ring = 105.6 from anterior end.

### DESCRIPTION

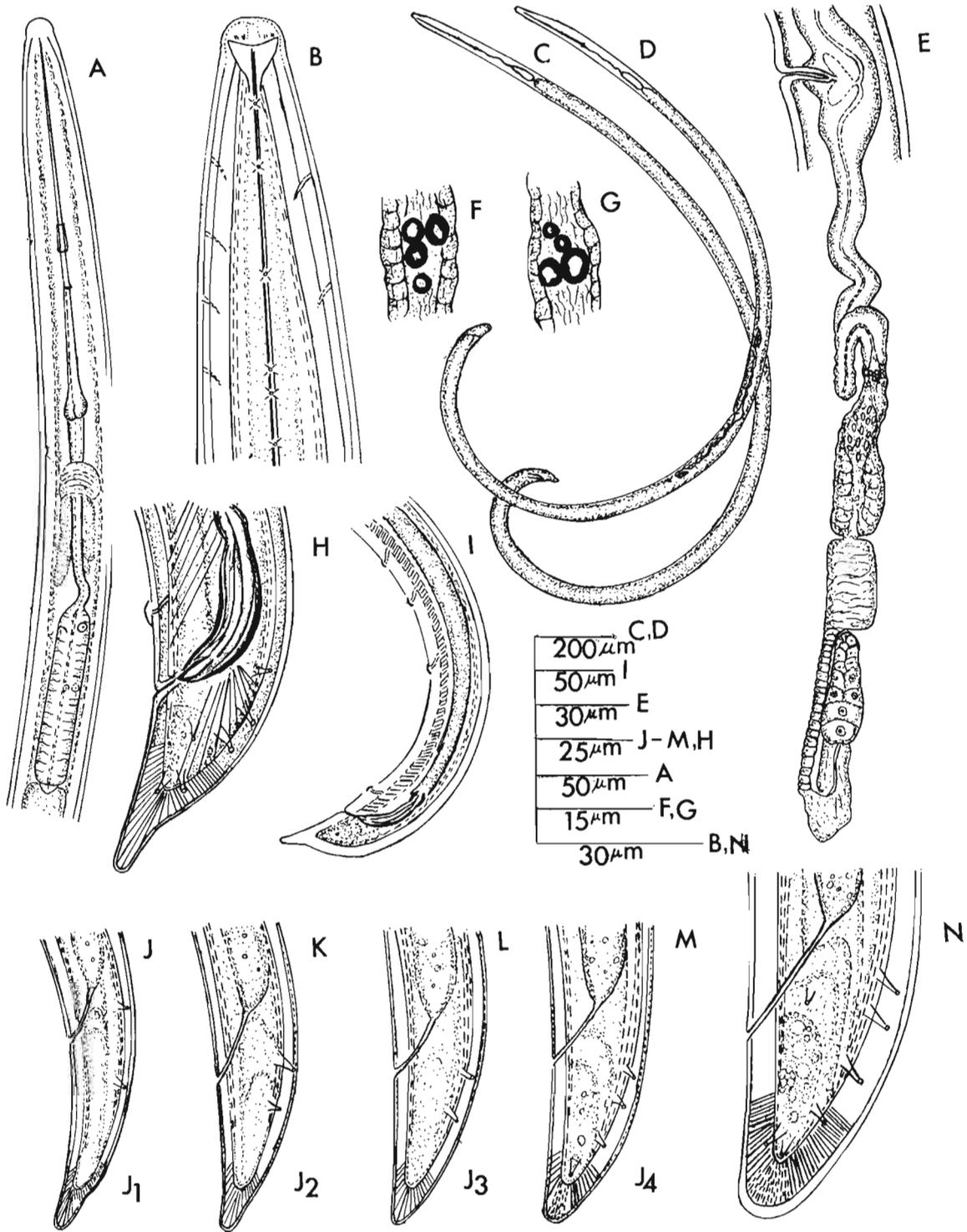
*Female* : Body when relaxed assumes a loose spiral shape; body robust, cylindrical, tapering very gradually towards the anterior extremity. Cuticle with very fine transverse striae; 3.2 µm thick ventrally and dorsally at

**Table 1.** Morphometrical characters of *Xiphinema karachiense* n. sp. (all measurements in  $\mu\text{m}$ , except L)

	<i>j1</i>	<i>j2</i>	<i>j3</i>	<i>j4</i>	Females	Males
n	1	1	2	1	6	2
L (mm)	1.5	1.7	2.0, 2.0	2.3	2.4-3.2 (2.83 $\pm$ 0.33)	2.9, 3.3
a	51.9	54.9	70.1, 61.5	59.5	63.4-72.0 (67.9 $\pm$ 3.51)	75.0, 86.2
b	5.8	7.2	5.2, 4.5	6.8	6.6-8.2 (7.1 $\pm$ 0.62)	7.6, 11.0
c	30.0	43.7	51.8, 55.0	56.0	66.2-111.0 (85.7 $\pm$ 16.3)	60.0, 69.0
c'	2.8	1.6	1.7, 1.5	1.5	1.0-1.4 (1.1 $\pm$ 0.15)	1.5, 1.4
V					48.0-52.0 (50.0 $\pm$ 1.91)	
Odontostyle	81.1	92.8	102.4, 100.0	98.9	113.0-123.3 (119 $\pm$ 3.8)	117.6, 116
Odontophore	39.8	48.0	52.0, 52.0	53.2	58.5-63.3 (60.7 $\pm$ 1.96)	64.0, 60.0
Total stylet	120.9	140.0	154.0, 152.0	152.1	173.6-184.3 (180.1 $\pm$ 4.1)	181.0, 176.0
Repl. odontostyle	96.0	112.0	118.0, 120.8	120.0	—	—
Ant. to guid. ring	68.6	80.0	86.4, 86.4	87.8	104.0-112.0 (107.5 $\pm$ 3.56)	104.0, 122.4
Tail length	49.9	40.0	40.0, 37.6	40.8	28.0-36.9 (33.6 $\pm$ 3.54)	48.0, 48.0
Anal body diam.	17.7	24.0	22.4, 24.0	26.9	26.4-29.7 (27.9 $\pm$ 1.25)	32.0, 32.8
h	10.0	12.0	10.4, 8.0	10.0	8.0-12.0 (9.5 $\pm$ 1.6)	21.6, 22.4
Spicule						58.0, 59.0
Body diam. at lip region	9.6	9.6	9.6, 9.6	10.0	11.5-12.0 (11.9 $\pm$ 0.2)	12.0, 12.0
Body diam. at guid. ring	21.1	24.0	25.6, 27.2	26.8	28.8-32.6 (30.9 $\pm$ 1.6)	32.0, 33.0
Body diam. at base of oesoph.	26.4	28.8	29.6, 33.6	33.6	34.4-41.0 (37.3 $\pm$ 2.7)	36.0, 35.2
Body diam. at mid body or vulva	29.2	32.0	29.6, 33.6	38.4	37.6-47.2 (41.8 $\pm$ 3.94)	38.4, 38.4
Body diam. at beginning of h	8.1	9.6	9.6, 8.8	13.4	12.8-16.0 (14.6 $\pm$ 1.31)	16.8, 16.0

the base of lip region, more thickened in the tail where it is 4-6  $\mu\text{m}$  ventrally and 7.0-8.5  $\mu\text{m}$  dorsally. Radial striae distinct on tail located in inner thicker cuticle layer. Female with 50 lateral body pores along the body of which 20 pores are in the oesophageal region and two dorsal and four ventral pores are also conspicuous in the anterior region. Lip region 4-5  $\mu\text{m}$  high and 11.5-12.0  $\mu\text{m}$  wide, almost rounded, offset by a slight depression. Amphids large, stirrup shaped, aperture

about 9.5  $\mu\text{m}$  wide. Stylet conform to the genus; basal flanges well developed, 10-12  $\mu\text{m}$  wide. Basal enlarged portion of oesophagus 72-97  $\mu\text{m}$  long and 14.5-19.0  $\mu\text{m}$  wide, containing one dorsal and two subventral gland nuclei. Oesophageal intestinal valve small, conoid. Female reproductive system amphidelphic with both branches equally developed. Vulva a transverse slit. Vagina thick-walled, occupying 50 % of the corresponding body diameter. Each branch consisting of a reflexed ovary,



**Fig. 1.** *Xiphinema karachiense* n. sp. A : Oesophageal region; B : Anterior body region; C : Male, entire; D : Female, entire; E : Posterior branch of female reproductive system; F, G : Four spherical inclusions of pseudo-Z-differentiation; H : Male tail; I : Posterior body region of male; J.-M. : Tails of juveniles; N : Female tail.

oviduct; *pars dilatata oviductus*; sphincter muscle; relatively large *pars dilatata uteri*, with numerous spermatozoa distally, considerably convoluted uterus with a well developed pseudo-Z-differentiation containing three or four large spherical bodies. Ovejector well developed. Prerectum 292-405  $\mu\text{m}$  long. Tail dorsally convex conoid with broadly rounded terminus. Terminal blind canal absent; five caudal and two adanal pores on each side of the tail.

**Male** : Similar to female in general appearance, in cephalic region and stylet length, but different tail shape i.e. convex conoid with peg (digitate). Posterior part of body curved ventrad more strongly than in the female. Male reproductive system typical of the genus. Spicules well developed. One pair of adanal papillae and three ventromedian supplements evenly distributed.

**Juveniles** : Morphologically similar to adult females but smaller in size and having relatively longer and more slender tails in J1, J2 and J3. Tail of J1 and J2 regularly tapered and more elongated than that of the other stages. Tails of J3 and J4 dorsally convex conoid; J4 tail longer than that of the adult. Hyaline terminal portion in tail of juveniles same as in adults.

#### TYPE HABITAT AND LOCALITY

Soil around the roots of citrus (*Citrus* spp.) from National Nematological Research Centre, University of Karachi, Karachi, Pakistan.

#### TYPE SPECIMENS

**Holotype** (female) : Slide No. NNRC-121/112 and **paratype** slides Nos. NNRC-121/113-122 (four females, one male and one juvenile) deposited in the National Nematode Collection of NNRC, University of Karachi, Karachi, Pakistan. Slide No. NNRC-121/123 (two females one male and one juvenile) deposited in USDA Nematode Collection, Beltsville, Maryland, USA.

#### DIAGNOSIS AND RELATIONSHIPS

*X. karachiense* n. sp. belongs to the group 5 of Loof and Luc (1990) by having two complete genital branches with same length or nearly so and the presence of pseudo-Z-organ in the uterus. *X. karachiense* n. sp. can be separated from all the species of genus *Xiphinema* by a combination of following characters : body and odontostyle length,  $c'$  value, sexual dimorphism in tail : convex conoid with broadly rounded terminus in female and digitate in males.

The new species closely resembles *X. imitator* Heyns, 1965 and *X. melitense* Lamberti *et al.*, 1982 and is also quite similar to *X. majus* Bos & Loof, 1984 by its more posterior vulva, in the presence of males and in the heat relaxed body posture, but it can be distinguished from *X. imitator* in the length of the body (2.6-3.2 *vs* 1.9-2.6 mm), odontostyle length (113-123  $\mu\text{m}$  *vs* 74-101  $\mu\text{m}$ ), greater  $c'$  value (1.0-1.4 *vs* 0.8-1.0), tail convex conoid with broadly rounded terminus against

terminus either bluntly rounded or with a small digitate non protoplasmic process, smaller number of inclusions in the pseudo-Z-organ in contrast to large number of inclusions and also the absence of sexual dimorphism in tail *vs* sexual dimorphism in tail in *X. karachiense* n. sp.

It differs from *X. melitense* by much smaller size, shorter spear, greater  $c'$  value, head with slight depression and pseudo-Z-organ without spines (in *X. melitense* : L = 4.0-4.9 mm; odontostyle = 132-168  $\mu\text{m}$ ; odontophore = 81-100;  $c'$  = 0.7-0.9) lip region rounded, offset from the body by a slight depression and moreover presence of spiniform structures (spines) and pseudo-Z-organ in the uterus.

It can further be distinguished from *X. majus* by its shorter body, smaller odontostyle and odontophore, greater  $c'$  value and in the general shape of the tail.

According to the polytomous key given by Loof & Luc (1990) *X. karachiense* n. sp. has the following code numbers : A4, B2, C6, D5, E5/6, F3, G2, H2, I3/4, J6, K2, L2.

### ***Enchodelus macrodorus* (de Man, 1880)**

**Thorne, 1939**

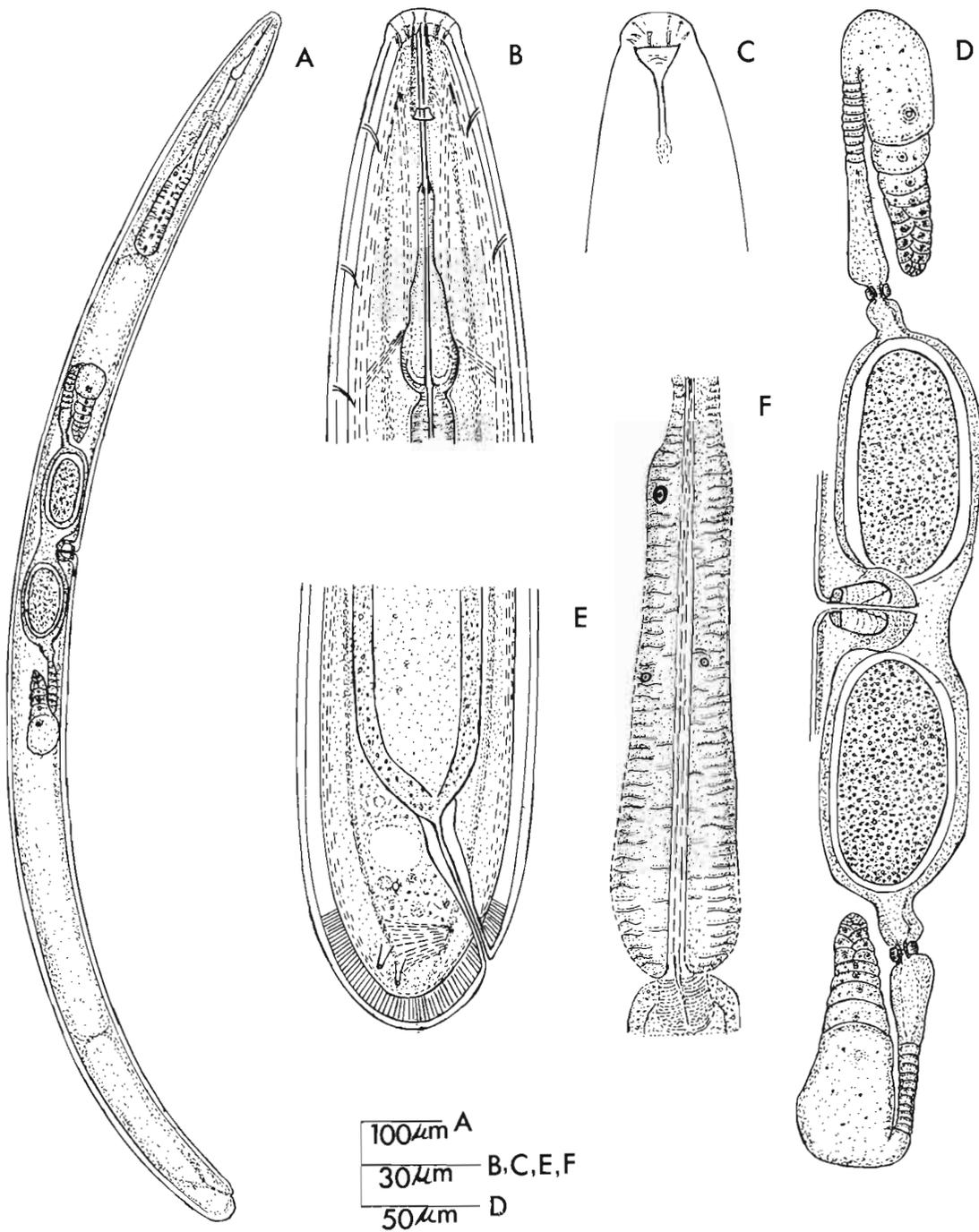
(Fig. 2)

#### DIMENSIONS

**Females** (n = 9) : L =  $1.56 \pm 60.05$  (1.47-1.65) mm; a =  $22.2 \pm 1.94$  (19.4-25.1); b =  $4.7 \pm 0.23$  (4.4-5.2); c =  $75.2 \pm 6.70$  (59.1-81.2);  $c'$  =  $0.52 \pm 0.04$  (0.48-0.6); V =  $44.2 \pm 1.11$  (42.4-45.3); l =  $14.6 \pm 0.97$  (13.2-15.8); G2 =  $14.8 \pm 1.27$  (12.1-16.7); odontostyle =  $41.2 \pm 3.1$  (33-43.2)  $\mu\text{m}$ ; odontophore =  $45.3 \pm 6.2$  (34-48)  $\mu\text{m}$ ; lip width =  $18.6 \pm 0.64$  (18-19.4)  $\mu\text{m}$ ; spear =  $86.8 \pm 9.0$  (78-92)  $\mu\text{m}$ ; tail =  $20.7 \pm 2.9$  (18-22)  $\mu\text{m}$ ; prerectum =  $199.8 \pm 13.7$  (180-249.6)  $\mu\text{m}$ ; rectum =  $36.4 \pm 2.2$  (34.8-42)  $\mu\text{m}$ .

#### DESCRIPTION

**Female** : Body ventrally curved upon fixation. Cuticle with minute transverse striae, fine radial striae visible especially on tail. Lateral pores visible throughout the body length. Lip region set off from body by slight depression. Amphids cup-shaped with slit like aperture. Spear provided with broad flanges at its base. Odontostyle and odontophore nearly equal in length. Guiding ring double, fixed ring at 22-23  $\mu\text{m}$  from anterior end of body. Oesophagus suddenly enlarged slightly anterior to middle. Only three oesophageal gland nuclei are observed (one dorsal, two subventral). Cardia elongate. Prerectum four to five times as long as rectum. Rectum about one anal body width long. Vulva a transverse slit, vagina extending over about half body width. Reproductive system amphidelphic, opposed with reflexed ovaries lying dorsally and ventrally to the oviduct. A well developed sphincter present between uterus and oviduct. Female tail hemispherical to convex conoid with



**Fig. 2.** *Enchodelus macrodorus*. A : Female, entire; B : Anterior body region; C : Head end showing amphid; D : Female sexual system; E : Female tail; F : Expanded region of oesophagus.

well developed anal muscles and two caudal pores on each side.

*Male* : Not found.

#### REMARKS

Specimens of *Enchodelus macrodorus* were collected from soil around roots of weeds and grasses from Saifulmuluk, Azad Kashmir. *E. macrodorus* is recorded for the first time in Pakistan. Measurements of these specimens closely fit to the original description of *E. macrodorus* (de Man, 1880) Thorne, 1939. The identification was confirmed by M. T. Vinciguerra.

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