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Institute of Biology, Faculty of Science, University of Novi Sad, 21000 Novi Sad, Serbia

SPECIES OF THE *XIPHINEMA AMERICANUM*-GROUP (NEMATODA: DORYLAIMIDA) ON THE TERRITORY OF THE FORMER YUGOSLAVIA [1]

by
L. Barsi

Summary. Four species of the *Xiphinema americanum*-group, *X. incertum* Lamberti, Choleva *et* Agostinelli, *X. pachtaicum* (Tulaganov) Kirjanova, *X. simile* Lamberti, Choleva *et* Agostinelli and *X. taylori* Lamberti, Ciancio, Agostinelli *et* Coiro were found in the territory of the former Yugoslavia. In order to confirm species identification, cluster analysis (CA) was used to study the relationship between *X. incertum*, *X. pachtaicum*, *X. simile* and closely related species *X. californicum* Lamberti *et* Bleve-Zacheo, *X. intermedium* Lamberti *et* Bleve-Zacheo and *X. opisthohysterum* Siddiqi on the one hand and *X. taylori* and *X. brevicolle* Lordello *et* da Costa, *X. diffusum* Lamberti *et* Bleve-Zacheo, *X. parvum* Lamberti, Ciancio, Agostinelli *et* Coiro and *X. pseudoguirani* Lamberti, Ciancio, Agostinelli *et* Coiro on the other hand. Measurements used in CA were taken from 23 populations found on the territory of the former Yugoslavia and 34 populations from literature. CA confirms the identification of the four above mentioned species. Morphological characteristics, morphometrics and distribution of the species are presented. The use of value c' is suggested as a new distinguishing criterion instead V in paragraph 11 in the dichotomous key of Lamberti and Carone (1991) for separating closely related *X. opisthohysterum* from *X. simile*.

In 1991 Lamberti and Carone published a dichotomous key for the identification of 38 species of the *X. americanum*-group. In many cases the correct identification of species in this group is difficult, because some are morphologically similar, i.e. many of their morphometric and morphological features overlap. Recently some methods of multivariate statistical analysis have been used to facilitate identification and separation of various populations of these closely related species and to study their interspecific and intraspecific variation (Georgi, 1988; Alkemade and Loof, 1990; Griesbach and Maggenti, 1990; Lamberti *et al.*, 1991).

In this study cluster analysis (CA) was used to confirm and support identification of species found on the territory of the former Yugoslavia comparing them with other populations of the same or the closely related species.

Materials and methods

Nematodes were extracted using a modified Cobb's decanting and sieving technique (Flegg, 1967). Specimens were killed by hot FP 4-1, processed to glycerin by Andrássy's (1984) rapid method and mounted on permanent slides in dehydrated glycerin.

Measurements were taken directly on specimens used in this study or were obtained from the literature. Table I contains the list of 25 selected populations and their origin. In Table II those populations and their origin are listed which were added to the Table I of Lamberti *et al.* (1991).

Cluster analysis was performed on nontransformed data using the average population values of a set of 13 characters (Table III and IV) signed as in Lamberti *et al.* (1991). To make dendrograms comparable the unweighted pair group average as a clustering method and standardized Euclidean distance as a coefficient were selected. Using the original set of data (Table II, p. 313) of these authors this combination produced an almost identical dendrogram (Fig. 1) as on page 314.

Results and discussion

Four species of *Xiphinema*: *X. incertum*, *X. pachtaicum*, *X. simile* and *X. taylori* were found in the territory of the former Yugoslavia. The first three species are clearly different from *X. taylori* and will be discussed separately.

Figure 2 shows the dendrogram obtained by clustering analysis of 25 populations (Table I) of *X. incertum*, *X. pachtaicum*, *X. simile*, *X. californicum*, *X. intermedium* and *X. opisthohysterum*. CA indicated the occurrence of six

Former Yugoslavia: as a whole geographical territory

TABLE I - *Population of* Xiphinema *selected for cluster analysis (CA).*

Population/Origin	Original identification	Reference
A Male Pijace DS10	*X. simile*	original
B Sanad DR39	*X. simile*	original
C Žabalj DR32	*X. simile*	original
D Žabalj DR32	*X. simile*	original
E Žabalj DR22	*X. simile*	original
F Niš EN89	*X. simile*	original
G Ulcinj CM54	*X. simile*	original
H Konsko FL15	*X. simile*	original
I Kovachitsa, Bulgaria	*X. simile* (*p)	Lamberti *et al.*, 1983
J Kovachitsa, Bulgaria	*X. simile* (*h)	
K Aligarh, Northern India	*X. opisthohysterum*	Lamberti and Bleve-Zacheo, 1979
L Bakersfield, California, U.S.A.	*X. californicum*	"
M Riverside, California, U.S.A.	*X. californicum*	"
N Hermosillo, Mexico	*X. californicum*	"
O Fort Pierce, Florida, U.S.A.	*X. intermedium*	"
P Novi Sad DR01	*X. pachtaicum*	original
Q Liparija DR00	*X. pachtaicum*	original
R Čoka DR38	*X. pachtaicum*	original
S Gedići UL91	*X. pachtaicum*	original
T Ferenci VL01	*X. pachtaicum*	original
U Trebinje BN83	*X. pachtaicum*	original
V Various localities, Bulgaria	*X. incertum* (*h)	Lamberti *et al.*, 1983
W Various localities, Bulgaria	*X. incertum* (*p)	"
X Ferenci VL01	*X. incertum*	Barsi, 1989
Y Gedići UL91	*X. incertum*	original

*h = holotype; *p = paratypes

distinct entities. The first entity comprises ten populations. Eight of them (A-H) are originally identified as *X. simile*, and I and J are holotype and paratypes of *X. simile* respectively (Lamberti *et al.*, 1983). The second entity comprises only the population of *X. opisthohysterum* (K), from Northern India. The third group is formed by populations L and M from U.S.A. and N from Mexico. All of them were identified by Lamberti and Bleve-Zacheo (1979) as *X. californicum*. The fourth group comprises six populations of *X. pachtaicum* (P-U). The fifth entity comprises four populations of *X. incertum*: V (holotype) and W (paratypes) from Bulgaria (Lamberti *et al.*, 1983), X from Slovenia (Barsi, 1989) and Y also from Slovenia. The sixth entity comprises only the population O, from U.S.A., identified by Lamberti and Bleve-Zacheo (1979) as *X. intermedium*. It has the greatest dissimilarity value among the other populations. CA clearly separated these closely related species.

Figure 3 shows the dendrogram obtained by clustering analysis of 32 populations of *X. brevicolle*, *X. diffusum*, *X. parvum*, *X. pseudoguirani* and *X. taylori*. As shown in this dendrogram, populations a-g (Table II and IV) from the territory of the former Yugoslavia, which were previously identified as *X. brevicolle*, were placed in the third entity with populations of *X. taylori* (Lamberti *et al.*, 1991). These

TABLE II - *Populations of* Xiphinema *selected* for cluster analysis.

Population/Origin	Original identification	Reference
a Rožno WL39	*X. taylori*	original
b Baćin Dol XL81	*X. taylori*	original
c Lipnica VM33	*X. taylori*	original
d Zidani Most WM10	*X. taylori*	original
e Deliblato sand EQ06	*X. taylori*	original
f Deliblato sand EQ06	*X. taylori*	original
g Deliblato sand EQ06	*X. taylori*	original

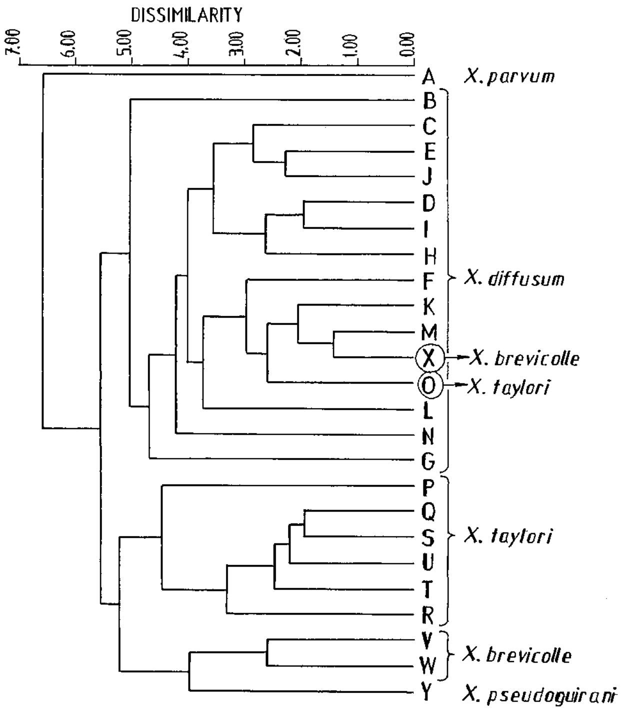

Fig. 1 - Dendrogram showing the clustering of 25 populations of *Xiphinema brevicolle*, *X. diffusum*, *X. parvum*, *X. pseudoguirani* and *X. taylori* and the dissimilarity values between clusters.

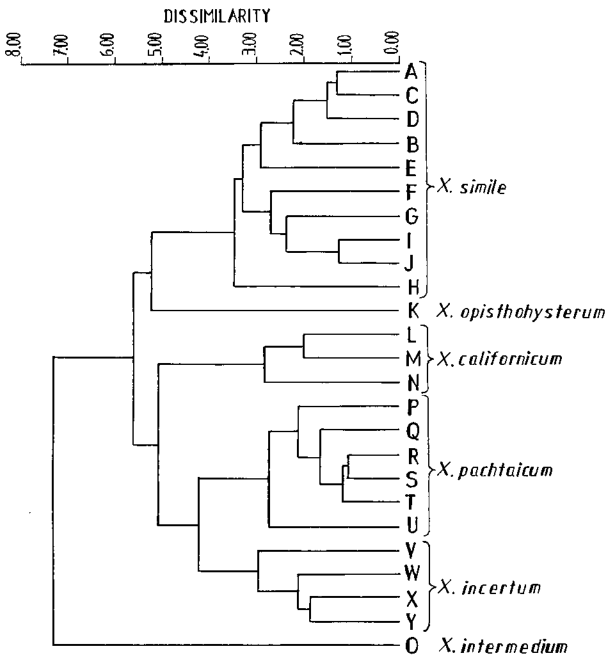

Fig. 2 - Dendrogram showing the clustering of 25 populations of *Xiphinema californicum*, *X. incertum*, *X. intermedium*, *X. opisthohysterum*, *X. pachtaicum* and *X. simile* and the dissimilarity values between clusters.

results support the statement of the previously mentioned authors that "*X. taylori* is certainly a European species and it is likely that all previous records of *X. brevicolle* from Italy and other European countries should be referred to this species". Population O from Bulgaria, considered as *X. taylori* and originally placed in the second group in the dendogram with the populations of *X. diffusum* (Lamberti *et al.*, 1991), is now placed in the third entity with the other populations of *X. taylori.* The biometrics of population L from Pakistan put it in *X. taylori*, but according to the above mentioned authors they consider it as *X. diffusum.*

XIPHINEMA INCERTUM Lamberti, Choleva *et* Agostinelli, 1983 (Fig. 4: A and B)

The morphometrics of two females found in the mixed population with *X. pachtaicum* in the rhizosphere of grapevine at Gedići (UTM square UL91) in Istria are: L = 1.91-1.96 mm; a = 65.3-60.6; b = 6.2-6.4; c = 67.6-78.2; c' = 1.61-1.42; V = 58.8-58.6; odontostyle = 90.5-90.5 µm; odontophore = 50.3-49.0 µm; oral aperture to guiding ring = 81.7-84.2 µm; tail length = 28.3-25.1 µm; J = 7.5-8.2 µm; body diameter at lip region = 8.8-8.8 µm; body diameter at guiding ring = 22.6-23.6 µm; body diameter at base of oesophagus = 27.0-28.9 µm; body diameter at vulva = 29.3-32.4 µm; body diameter at anus = 17.6-17.6 µm; body diameter at beginning of J = 10.0-9.7 µm.

They are similar to the type population from Bulgaria (Lamberti *et al.*, 1983) and to a single female previously found at Ferenci VL01 (Barsi, 1989).

XIPHINEMA PACHTAICUM (Tulaganov, 1938) Kirjanova, 1951 (Fig. 4: C-F)

The morphometric characters of eight populations of *Xiphinema pachtaicum* are given in Table V. The morphometric differences between these populations, even of the same geographical origin, reflect intraspecific variability being only a manifestation of phenotypic response to the different environmental conditions. They generally agree with populations previously reported from the territory of the former Yugoslavia (Hržić, 1978; Barsi, 1989) and fit within the range of other populations of *X. pachtaicum* from various regions such as Mediterranean, Central Asia and Central Europe (Lamberti and Bleve-Zacheo, 1979).

Males of *X. pachtaicum* are extremely rare. They have been reported from Israel (Cohn, 1969), Italy (Lamberti and Martelli, 1971), Iran (Sturhan, 1983) and from Crete (Vovlas and Avgelis, 1988).

A single male collected in the rhizosphere of *Tilia argentea* Desf. at Novi Sad (DR01) had the following morphometric characters: L = 1.83 mm; a = 67.8; b = 6.2; c =

Table III - *Population and average values of the variables used for cluster analysis.*

Population and n. of specimens	L	A	B	C	CIP	V	EST	J	LA	STY	AG	TAL	DV
A 20	2.14	78.3	7.1	74.6	1.64	54.7	42.0	6.1	9.4	66.0	60.7	28.8	27.4
B 2	2.10	78.3	6.7	68.8	1.73	57.5	42.4	8.0	9.3	66.3	61.6	30.6	26.9
C 5	2.18	79.3	7.1	72.2	1.67	56.7	43.2	6.7	9.6	67.6	58.8	30.0	27.2
D 6	2.24	75.7	7.0	75.7	1.60	55.4	42.5	5.8	9.5	65.6	60.4	29.6	29.8
E 5	2.37	78.8	7.6	73.0	1.79	55.2	44.1	6.9	9.9	68.7	62.9	32.5	30.1
F 15	1.86	69.5	6.2	63.8	1.69	56.2	42.9	6.3	9.2	66.3	60.8	29.2	26.8
G 6	1.97	68.7	7.4	68.9	1.72	56.6	42.0	7.0	8.9	67.9	62.7	28.5	28.7
H 1	1.93	74.3	6.5	72.3	1.50	54.5	42.7	6.9	10.0	66.5	61.5	26.4	26.0
I 1	1.90	75.0	7.3	67.0	1.60	53.0	38.0	7.0	9.0	67.0	50.0	29.0	29.0
J 9	1.90	71.0	7.2	67.0	1.70	53.0	39.0	7.0	9.0	66.0	51.0	29.0	27.0
K 2	1.82	59.5	7.5	56.0	1.95	57.5	36.0	6.5	9.0	66.0	49.5	33.0	30.5
L 20	2.00	60.0	6.8	63.0	1.60	51.0	48.0	6.0	10.0	90.0	76.0	31.0	33.0
M 4	1.90	61.0	7.0	69.0	1.50	50.0	47.0	7.0	10.0	82.0	70.0	31.0	31.0
N 19	1.90	56.0	6.9	58.0	1.70	51.0	48.0	8.5	10.5	86.0	74.0	33.0	34.0
O 15	1.60	43.0	6.0	47.0	1.50	52.0	45.0	10.0	10.5	76.0	63.0	33.0	37.0
P 5	2.07	67.4	6.5	65.3	1.73	57.5	50.3	10.9	9.1	90.8	72.6	31.8	30.8
Q 10	1.98	66.4	6.0	63.5	1.70	57.6	49.9	9.2	8.8	89.0	80.8	31.2	29.8
R 8	1.96	68.9	5.8	60.2	1.81	57.2	50.9	9.9	8.9	89.1	83.8	32.7	28.4
S 7	2.00	66.7	6.0	60.0	1.86	56.4	50.8	10.4	9.1	87.9	83.0	33.4	29.9
T 10	1.91	63.4	5.9	60.0	1.81	57.8	50.3	9.9	9.0	89.6	83.1	31.9	30.1
U 8	1.85	61.3	6.2	63.7	1.67	57.5	49.3	10.8	8.5	82.3	70.0	29.1	30.1
V 1	1.70	54.0	5.3	64.0	1.50	56.0	51.0	7.0	8.0	88.0	77.0	27.0	32.0
W 4	1.90	57.0	6.4	69.0	1.50	57.0	51.0	7.0	9.0	92.0	71.0	28.0	34.0
X 1	1.85	60.0	5.7	67.0	1.56	56.5	49.0	7.5	9.0	89.0	78.0	27.5	31.0
Y 2	1.93	62.9	6.3	72.9	1.53	58.7	49.6	7.8	8.8	90.5	82.9	26.7	30.8

L = body length (mm); A,B,C,V, = de Man's a,b,c,v ratios; CIP = c'; EST = odontophore length (μm); J = length of the hyalin portion of tail (μm); LAB = body diameter at lip region (μm); STY = odontostyle length (μm); AG = distance of the guiding ring from the anterior extremity (μm); TAL = tail length (μm); = DV = body diameter at vulva (μm).

Table IV *Population and average values of the variables used for cluster analysis.*

Population and n. of specimens	L	A	B	C	CIP	V	EST	J	LA	STY	AC	TAL	DV
a 23	2.04	45.9	6.6	72.6	0.96	49.0	55.0	8.6	12.8	88.8	79.8	28.2	44.5
b 3	2.01	46.4	6.4	75.3	0.90	50.1	55.9	9.2	13.4	91.3	78.9	26.8	43.3
c 2	2.19	46.8	6.4	81.0	0.89	49.0	55.7	9.6	13.9	91.7	82.1	27.0	46.8
d 1	2.07	49.0	7.1	70.2	0.98	48.7	57.7	7.9	13.5	91.6	79.7	29.5	42.3
e 13	2.07	47.0	6.1	84.3	0.82	52.5	55.6	8.1	13.7	92.9	81.0	24.6	44.1
f 8	2.10	47.6	6.3	79.0	0.89	50.6	57.6	9.3	13.8	95.4	83.0	26.8	44.3
g 3	2.03	46.6	6.0	86.3	0.82	52.5	55.6	8.4	13.8	92.5	79.9	24.8	40.2

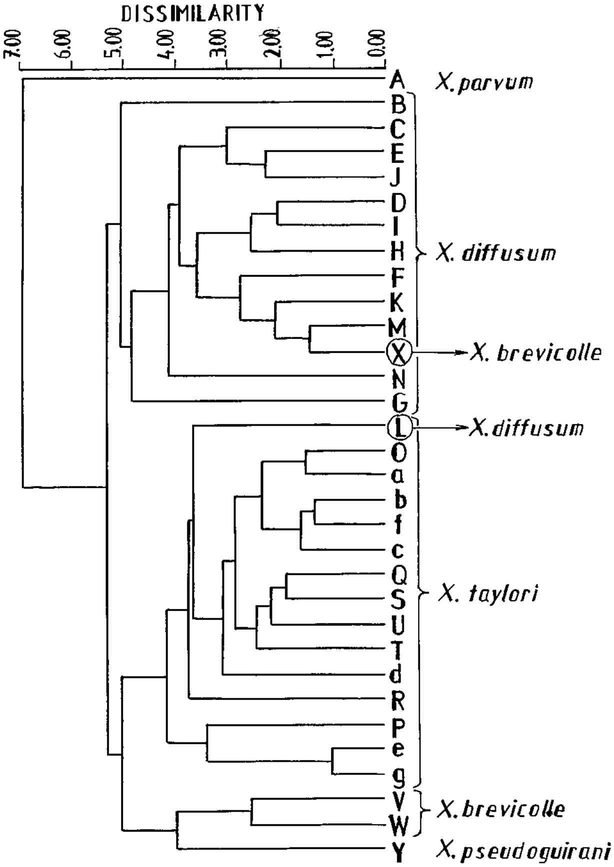

Fig. 3 - Dendrogram showing the clustering of 32 populations of *Xiphinema brevicolle*, *X. diffusum*, *X. parvum*, *X. pseudoguirani* and *X. taylori* and the dissimilarity values between clusters.

56.0; c´= 1.65; odontostyle = 85.5 μm; odontophore = 47.8 μm; oral aperture to guiding ring = 69.8 μm; tail = 32.7 μm; J = 11.3 μm; spicules = 33 μm; body diameter at lip region = 8.8 μm; body diameter at guiding ring = 20.1 μm; body diameter at base of oesophagus = 24.8 μm; body diameter at middle body = 27.0 μm; body diameter at anus = 19.8 μm; body diameter at beginning of J = 7.5 μm.

It is similar to the female in general morphology and body shape, except that it is more curved in posterior region. Testes two, dorylaimid, containing apparently normal sperm. Supplements consists of an adanal pair and a series of 5 ventral papillae. Tail short, conical, more pointed and more gradually tapering toward the terminus than that of the female.

Distribution: BN83: Trebinje (grapevine); CM54: Ulcinj (*Pteridium aquilinum* (L.) Kuhn)); CR41: Mikluševci (pea, onion); CR55: Doroslovo (grapevine); CR57: Sombor (grapevine); DQ68: Glogonj (grapevine); DR00: Novi Ledinci (*Acer campestre* L., *Vitis* sp.), Liparija (*T. argentea*, hazelnut, *Vitis* sp.); DR01: Novi Sad (*Abies alba* Mill., *Tilia argentea*); DR22: Žbalj (*Euphorbia* sp.); DR29: Senta-Nadrljan (grass-land); DR30: Titel (*Trifolium* sp.); DR38: Čka (grapevine); DR52: Zrenjanin (poplar); DR53: Jankov Most (*Euphorbia cyparissias* L.); DS10: Male Pijace (grass-land); Male Pijace-Horgoš (grapevine); EL99: Negotino (grapevine); EN89: Sičevo (grapevine); EQ06: Deliblato sand (*Robinia pseudoacacia* L.); UL91: Gedici (grapevine); UL91: Kaštelir (grapevine); VL14: Kubed (grapevine); VL38: Hotedršica (*P. aquilinum*); WL37: Prekropa (grass-land).

XIPHINEMA SIMILE Lamberti, Choleva *et* Agostinelli, 1983 (Fig. 4: G-K)

The morphometric characters of eight populations of *Xiphinema simile* are given in Table VI. Besides evident intraspecific variability, which is probably due to the host, environment and geographical origin, specimens from all populations appear to be anatomically similar to the type population from Bulgaria (Lamberti *et al.*, 1983). They differ only in their morphometrics.

CA placed them in one group and they were clearly separated from the most closely related species, *X. opisthohysterum*. Therefore, all populations from the territory of the former Yugoslavia belong to one species, *X. simile*. These additional data extends the known range of variability for this species (Lamberti *et al.*, 1983). In the dichotomous key for the identification of species of the genus *Xiphinema* attributed to the *X. americanum*-group (Lamberti and Carone, 1991) in paragraph 11 *X. opisthohysterum* and *X. simile* were separated by the position of vulva (V): V more than 55 - *X. opisthohysterum*; V less than 55 - *X. simile*. Value of V is now extended in *X. simile* to maximum 58.6 (range of average values: 54.7-57.4) and therefore this criterion cannot be used further on. I suggest that value c´ be used as a new distinguishing criterion for separating these two species. Taking into consideration mean, minimum and maximum values of c´ of *X. opisthohysterum* (Lamberti and Bleve-Zacheo, 1979; Sturhan, 1983) and of *X. simile* (Lamberti *et al.*, 1983; Table VII in this paper) paragraph 11 sould be as follows:

11. Value of c´ about 2 (1.9-2.4) *X. opisthohysterum* (10) Siddiqi, 1961
Value of c´ about 1.7 (1.43-2.0) *X. simile* (11) Lamberti, Choleva et Agostinelli, 1983

A male specimen only was found in the rhizosphere of *Euphorbia* sp. at Žabalj; its morphometrics are the following: L = 1.98 mm; a = 77; b = 5.9; c = 61.5; c´ = 1.55; odontostyle = 62.7 µm; odontophore = 45.2 µm; oral aperture to guiding ring = 57.1 µm; tail = 32.2 µm; J = 5 µm; spicules = 30 µm; body diameter at lip region = 10 µm; body diameter at guiding ring = 18.8 µm; body diameter at base of oesophagus = 23.5 µm; body diameter at middle body = 25.7 µm; body diameter at anus = 20.7 µm; body diameter at beginning of J = 6.3 µm.

It is similar to the female in general morphology and body shape, except that it is more curved in posterior region. Both testes developed, dorylaimid, containing apparently normal sperm. With adanal pair and 4 weak ventromedian supplements. Tail short, conical, similar to that of the female.

It is the first record of *X. simile* from the territory of the former Yugoslavia.

TABLE V *Morphometrics of eight populations* of Xiphinema pachtaicum.

Locality and rhizosphere of	Negotino EL99 *Vitis vinifera*	Trebinje BN83 *V. vinifera*	Gedići UL91 *V. vinifera*	Gedići UL91 *V. vinifera*	Liparija DR00 *Corylus avellana*	Čoka DR38 *V. vinifera*	Novi Sad DR01 *Tilia argentea*	Novi Sad DR01 *Abies alba*
n	(original) 4♀♀	(original) 8♀♀	(original) 15♀♀	(original) 7♀♀	(original) 10♀♀	(original) 8♀♀	(original) 7♀♀	(original) 5♀♀
L mm (*)	1.84,0.06 (1.73-1.90)	1.85,0.13 (1.58-2.02)	1.85,0.11 (1.67-2.05)	2.00,0.15 (1.83-2.26)	1.98,0.06 (1.88-2.09)	1.96,0.13 (1.72-2.12)	1.91,0.11 (1.75-2.07)	2.07,0.12 (1.95-2.23)
a	64.6,4.0 (59.9-70.5)	61.3,2.2 (57.4-63.8)	62.4,2.2 (56.4-64.9)	66.7,3.0 (62.0-71.1)	66.4,1.8 (63.0-70.3)	68.9,3.8 (62.7-73.3)	65.0,3.5 (58.2-70.1)	67.4,1.5 (65.5-69.8)
b	6.4,0.2 (6.2-6.7)	6.2,0.5 (5.3-6.9)	5.8,0.4 (5.1-6.4)	6.0,0.4 (5.5-6.6)	6.0,0.2 (5.6-6.3)	5.8,0.4 (5.3-6.6)	6.3,0.3 (5.9-6.9)	6.5,0.4 (6.0-7.0)
c	60.2,1.5 (59.1-62.8)	63.7,4.4 (56.3-69.1)	58.1,4.2 (50.2-66.9)	60.0,5.5 (52.8-67.9)	63.5,3.4 (58.7-69.7)	60.2,5.0 (52.7-68.8)	65.6,4.8 (60.2-73.1)	65.3,1.8 (63.4-68.8)
c'	1.75,0.10 (1.66-1.92)	1.67,0.07 (1.57-1.79)	1.87,0.13 (1.64-2.08)	1.86,0.09 (1.67-1.96)	1.70,0.11 (1.53-1.93)	1.81,0.10 (1.67-2.00)	1.64,0.08 (1.46-1.73)	1.73,0.10 (1.57-1.87)
V	57.4,0.8 (56.3-58.5)	57.5,1.2 (54.7-58.7)	58.7,0.9 (56.1-60.1)	56.4,0.8 (54.7-57.7)	57.6,1.5 (55.6-61.0)	57.2,0.5 (56.5-58.0)	58.1,1.5 (56.8-60.8)	57.5,1.3 (55.4-59.2)
Total spear lenght µm	135.5,2.4 (132.0-138.3)	131.7,6.6 (123.2-142.0)	139.1,3.1 (133.2-143.3)	138.8,1.7 (137.0-142.0)	138.9,1.6 (137.0-142.0)	140.0,1.5 (137.0-142.0)	136.5,1.9 (133.3-138.7)	141.1,2.2 (138.3-144.5)
Odontostyle µm	85.5,2.0 (83.0-88.0)	82.3,5.1 (74.2-89.2)	89.1,1.7 (85.5-91.8)	87.9,2.3 (85.5-93.0)	89.0,1.8 (85.5-91.7)	89.1,1.3 (86.7-90.5)	85.8,2.0 (83.0-88.0)	90.8,1.9 (88.0-93.0)
Odontophore µm	50.0,0.6 (49.0-50.3)	49.3,2.2 (45.2-52.8)	50.1,2.1 (45.2-52.8)	50.8,1.6 (49.0-54.0)	49.9,1.3 (47.8-52.8)	50.9,1.3 (49.0-52.8)	50.6,0.5 (50.3-51.5)	50.3,0.8 (49.0-51.5)
Oral aperture to guiding ring µm	76.2,1.5 (74.2-77.9)	70.0,4.1 (65.4-75.4)	84.1,2.1 (80.4-88.0)	83.0,1.3 (81.1-84.8)	80.8,1.2 (79.2-82.3)	83.8,1.6 (81.7-86.7)	71.3,2.5 (67.8-76.0)	72.6,0.9 (71.6-74.1)
Tail µm	30.6,0.9 (29.3-31.4)	29.1,2.0 (26.4-32.7)	31.9,1.8 (28.9-35.2)	33.4,1.0 (31.4-34.6)	31.2,1.7 (28.3-33.9)	32.7,2.2 (29.5-36.4)	29.2,1.0 (28.3-31.1)	31.8,2.5 (28.3-35.2)
J (hyaline portion of tail) µm	9.7,0.5 (8.8-10.0)	10.8,1.1 (8.8-12.5)	10.2,0.7 (8.8-11.3)	10.4,1.3 (8.8-13.2)	9.2,0.6 (8.2-10.0)	9.9,0.6 (9.2-11.3)	10.5,0.6 (10.0-11.3)	10.9,1.1 (9.4-12.5)
Body diameter at lip region µm	8.7,0.1 (8.5-8.8)	8.5,0.4 (7.5-8.8)	8.8,0.3 (8.2-9.4)	9.1,0.3 (8.8-9.7)	8.8,0.2 (8.5-9.4)	8.9,0.6 (8.8-9.4)	9.1,0.7 (8.5-10.7)	9.1,0.3 (8.8-9.4)
Body diameter at guiding ring µm	20.8,0.6 (20.1-21.4)	21.0,0.6 (20.1-21.8)	22.2,0.5 (21.4-23.2)	22.5,0.7 (21.8-23.9)	21.7,0.3 (21.4-22.3)	21.9,0.6 (21.0-22.6)	21.0,0.7 (20.1-22.6)	21.7,0.4 (21.4-22.3)
Body diam. at base of oesophagus µm	25.6,1.2 (23.9-27.3)	26.9,1.7 (23.2-28.9)	26.6,1.0 (25.1-28.3)	27.0,1.0 (25.8-28.9)	26.8,0.4 (26.4-27.6)	26.3,1.0 (25.1-27.6)	25.7,1.1 (25.1-28.1)	26.9,1.2 (25.5-28.9)
Body diameter at vulva µm	28.6,1.4 (26.4-30.2)	30.1,2.1 (25.5-32.4)	29.7,1.4 (27.6-32.7)	29.9,1.9 (27.6-33.3)	29.8,0.7 (28.6-31.1)	28.4,1.2 (27.0-30.2)	29.5,2.0 (27.6-32.7)	30.8,1.7 (29.3-33.6)
Body diameter at anus µm	17.5,0.7 (16.3-18.2)	17.4,0.9 (16.3-18.8)	17.1,0.7 (16.0-18.5)	17.9,0.5 (17.3-18.8)	18.3,0.5 (17.6-18.8)	18.0,0.6 (17.3-18.8)	17.8,1.0 (16.7-19.8)	18.3,0.7 (17.6-19.5)
Body diameter at beginning of J µm	8.4,0.1 (8.2-8.5)	9.2,0.7 (8.2-10.0)	8.0,0.7 (6.9-9.4)	7.9,0.6 (7.5-8.8)	8.3,0.6 (7.5-9.4)	7.5,0.7 (6.3-8.5)	9.0,0.4 (8.8-10.0)	8.4,0.8 (7.5-10.0)

(*) Mean, Std (Min-Max).

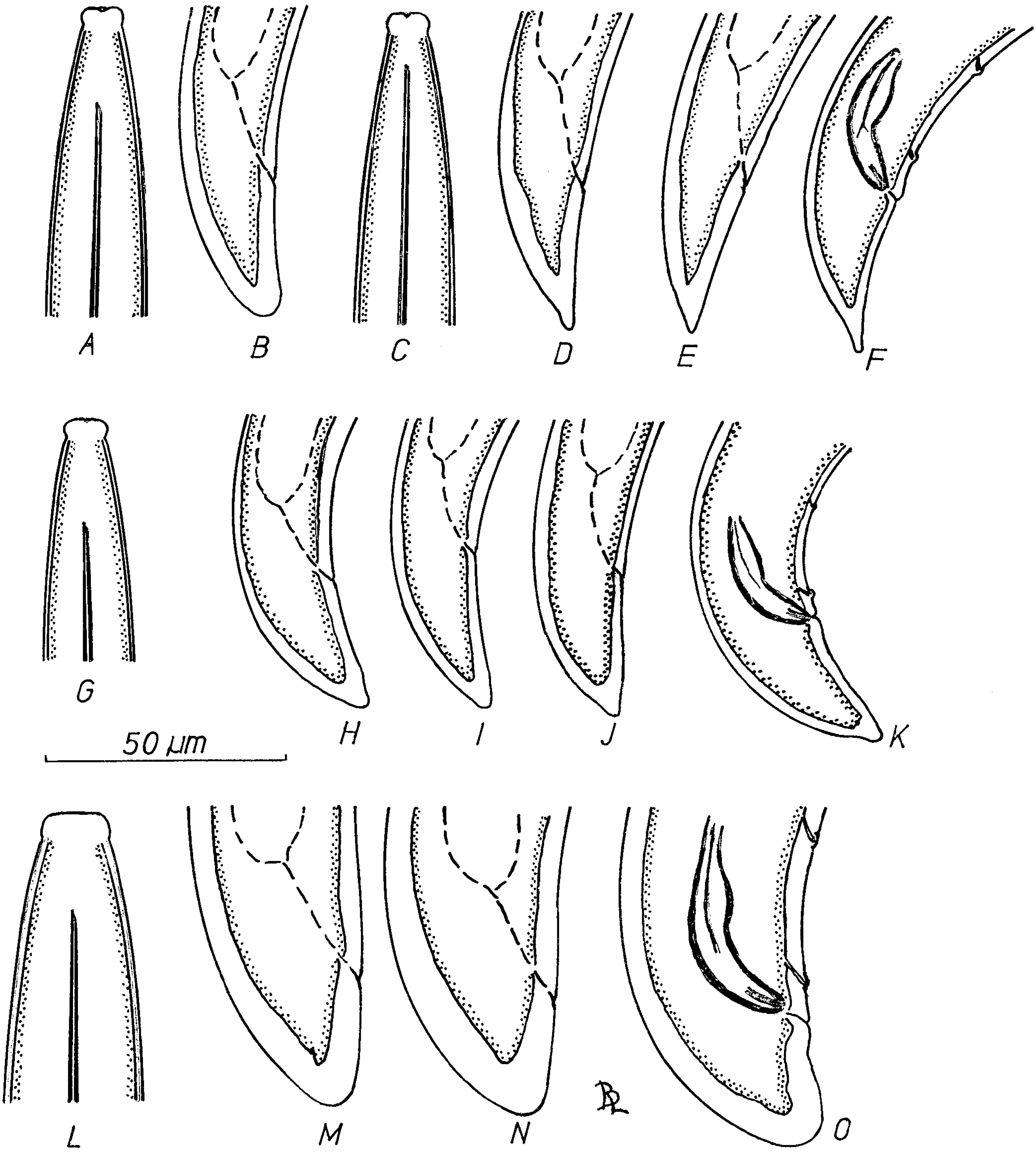

Fig. 4 - A-B: *Xiphinema incertum*. A: Female anterior region; B: Female tail; C-F: *Xiphinema pachtaicum*. C: Female anterior region; D-E: Tails of females; F: Male tail; G-K: *Xiphinema simile*. G: Female anterior region; H-J: Tails of females; K: Male tail; L-O: *Xiphinema taylori*. L: Female anterior region; M-N: Tails of females; O: Male tail.

TABLE VI - *Morphometrics of eight populations* of Xiphinema simil

Locality and rhizosphere of	M. Pijace DS10 grasses	Sanad DR39 *Trifolium campestre*	Žabalj DR32 *Euphorbia* sp.	Žabalj DR32 *Euphorbia* sp.	Žabalj DR22 *Euphorbia cyparissias*	Niš EN89 *V. vinifera*	Ulcinj CM54 *Pteridium aquilinum*	Konsko FL15 *Platanus orientalis*
n	(original) 20♀♀	(original) 2♀♀	(original) 5♀♀	(original) 6♀♀	(original) 5♀♀	(original) 15♀♀	(original) 6♀♀	(original) 1♀
L mm	2.14,0.10 (1.94-2.30)	2.10,2.11	2.18,0.06 (2.09-2.27)	2.24,0.06 (2.17-2.34)	2.37,0.10 (2.26-2.53)	1.86,0.09 (1.71-2.08)	1.97,0.14 (1.71-2.11)	1.93
a	78.3,2.6 (72.4-81.9)	78.4,78.2	79.3,3.7 (73.8-83.7)	75.7,4.2 (69.0-81.2)	78.8,4.8 (72.1-86.3)	69.5,2.6 (64.3-73.4)	68.7,2.3 (64.6-72.1)	74.3
b	7.1,0.3 (6.6-7.7)	6.8-6.7	7.1,0.4 (6.7-8.0)	7.0,0.3 (6.3-7.4)	7.6,0.5 (7.1-8.3)	6.2,0.4 (5.7-7.3)	7.4,0.7 (6.2-8.4)	6.5
c	74.6,4.7 (65.7-84.6)	67.6,70.1	72.2,5.2 (63.5-78.3)	75.7,4.2 (73.4-76.7)	73.0,3.2 (69.8-77.7)	63.8,3.7 (58.1-70.8)	68.9,5.9 (60.5-80.0)	73.2
c'	1.64,0.11 (1.43-1.96)	1.76,1.71	1.67,0.10 (1.57-1.83)	1.60,0.10 (1.48-1.77)	1.79,0.15 (1.58-2.00)	1.69,0.07 (1.54-1.81)	1.72,0.12 (1.50-1.85)	1.50
V	54.7,1.0 (52.9-56.5)	56.4,58.5	56.7-0.4 (55.9-57.1)	55.4,1.2 (53.6-56.7)	55.2,0.8 (54.5-56.6)	56.2,1.0 (54.8-58.2)	56.6,1.4 (54.2-58.6)	54.5
Total spear length µm	108.0,2.0 (104.1-111.7)	108.0,109.3	110.8,2.0 (108.1-113.1)	108.0,1.9 (106.0-111.7)	112.8,2.0 (109.2-115.5)	109.2,2.9 (104.3-114.4)	109.9,1.7 (107.9-112.9)	109.2
Odontostyle µm	66.0,2.2 (61.5-70.3)	67.2,65.3	67.6,0.9 (66.6-69.1)	65.6,1.5 (63.4-67.8)	68.7,0.9 (67.8-70.3)	66.3,1.9 (62.8-70.4)	67.9,1.1 (66.5-69.0)	66.
Odontophore µm	42.0,1.4 (40.1-44.6)	40.8,44.0	43.2,1.3 (41.5-45.2)	42.5,1.9 (40.2-45.8)	44.1,1.5 (41.4-45.5)	42.9,1.5 (41.5-45.2)	42.0,1.7 (38.9-43.9)	42.7
Oral aperture to guiding ring µm	60.7,2.2 (54.6-63.4)	62.2,61.0	58.8,3.1 (52.8-61.0)	60.4,0.8 (59.0-61.5)	62.9,1.4 (60.2-64.0)	60.8,2.0 (57.8-66.6)	62.7,1.3 (61.5-65.3)	61.5
Tail µm	28.8,1.7 (25.1,32.6)	31.1,30.1	30.0,2.3 (27.6-33.9)	29.6,0.9 (28.9-31.1)	32.5,2.0 (29.8-36.0)	29.2,1.2 (26.4-30.8)	28.5,1.4 (26.4-30.1)	26.4
J (hyaline portion of tail) µm	6.1,0.7 (5.0-7.5)	8.5,7.5	6.7,0.5 (6.3-7.5)	5.8,0.6 (5.0-6.9)	6.9,0.4 (6.3-7.5)	6.3,0.5 (5.0-6.9)	7.0,1.1 (5.0-8.2)	6.9
Body diameter at lip region µm	9.4,0.3 (8.8-10.0)	9.2,9.4	9.6,0.4 (8.8-10.0)	9.5,0.2 (9.2-9.7)	9.9,0.1 (9.7-10.0)	9.2,0.4 (8.8-9.7)	8.9,0.5 (8.5-10.0)	10.[illegible]
Body diameter at guiding ring µm	19.5,0.5 (18.2-20.1)	18.5,18.8	19.4,0.5 (18.5-20.1)	19.6,0.5 (18.8-20.1)	20.5,0.5 (19.8-21.3)	19.0,0.5 (18.2-20.1)	19.5,0.4 (18.8-20.1)	20.7
Body diam. at base of oesophagus µm	24.5,0.9 (22.0-25.7)	23.6,24.8	24.3,1.0 (22.6-25.1)	25.9,1.0 (23.8-27.6)	25.8,1.1 (23.8-26.7)	23.8,0.7 (22.6-25.1)	24.6,1.0 (23.2-26.0)	23.8
Body diameter at vulva µm	27.4,1.2 (25.1-30.1)	26.8,27.0	27.2,1.2 (25.1-28.3)	29.8,1.9 (27.0-32.0)	30.1,1.7 (27.0-32.0)	26.8,0.9 (25.1-28.9)	28.7,1.8 (26.0-30.7)	26.0
Body diameter at anus µm	17.6,0.7 (16.0-18.8)	17.6,17.6	17.9,0.5 (17.3-18.5)	18.6,1.0 (17.6-19.8)	18.2,1.1 (16.3-19.5)	17.3,0.8 (16.0-18.8)	16.6,0.6 (15.7-17.6)	
Body diameter at beginning of J µm	7.8,0.7 (6.3-8.8)	7.2,8.8	8.1,0.6 (7.5-8.8)	7.4,0.8 (6.3-8.2)	7.7,0.7 (6.9-8.8)	8.3,0.5 (7.5-8.8)	7.4,0.5 (6.7-8.2)	8.8

Distribution: CM54: Ulcinj (*Pteridium aquilinum*); DR22, DR32: Žabalj (*Euphorbia cyparissias, Euphorbia* sp., *Carduus nutans* L.); DR39: Sanad (*Trifolium campestre* Schreb.); DS10: Male Pijace (saliferous grass-land); EN89: Niš (grapevine); FL15: Konsko (*Platanus orientalis* L.).

XIPHINEMA TAYLORI **Lamberti, Ciancio, Agostinelli *et* Coiro, 1991** (Fig. 4: L-O)

The morphometric characters of seven populations of *Xiphinema taylori* collected from the rhizosphere of different plants are given in Table VII. They generally fall in the range of the type population and other populations from Italy and Bulgaria (Lamberti *et al.*, 1991), but is seems that morphometrically they are closer to Bulgarian one rather than to those from Italy.

A single male found in the rhizosphere of *Crataegus* sp. in Deliblato sand (EQ06) had the following morphometric characters: L = 1.98 mm; a = 51; b = 5.8; c = 77.2; c´ = 0.8; odontostyle = 91.6 µm; odontophore = 59 µm; oral aperture to guiding ring = 81.6 µm; tail = 25.7 µm; J = 6.9 µm; spicules = 54.3 µm; body diameter at lip region = 14.2 mm; body diameter guiding ring = 30.7 µm; body diameter at base of oesophagus = 36.4 µm; body diameter at middle body = 38.9 µm; body diameter at anus = 32.0 µm; body diameter at beginning of J = 16.7 µm.

It is similar to the female in general morphology and body shape, except that it is more curved in posterior region. Testes two, dorylaimid, containing apparently normal

TABLE VII - *Morphometrics of seven populations of* Xiphinema taylori.

Locality and rhizosphere of	Rožno WL39 grasses	Baćin Dol XL89 *Doricnium sericeum*	Lipnica VM33 grasses	Z. Most WM10 *Rubus caesius*	Deliblato sand EQ06 *Prunus machaleb*	*Crataegus* sp.	*Sambucus nigra*
	(original)	(original)	(original)	(original)	(original)	(original)	(original)
n	23♀♀	3♀♀	2♀♀	1♀	13♀♀	8♀♀	3♀♀
L mm	2.04,0.11 (1.84-2.24)	2.01,0.09 (1.94-2.14)	2.06-2.32	2.07	2.07,0.10 (1.89-2.26)	2.10,0.10 (2.0-2.3)	2.03,0.17 (1.79-2.19)
a	45.9,2.1 (39.3-49.1)	46.4,3.2 (43-49.4)	43.7-49.9	49.	47.0,1.4 (44.3-49.5)	47.6,1.6 (45.9-51.0)	46.6,0.6 (45.9-47.3)
b	6.6,0.4 (6.1-7.5)	6.4 (6.4-6.4)	6.2-6.7		6.1,0.3 (5.6-6.6)	6.3,0.2 (6.0-6.6)	6.0,0.3 (5.6-6.4)
c	72.6,4.5 (65.5-82.1)	75.3,5.7 (71.0-81.3)	78.0-84.1	70.2	84.3,6.3 (73.6-94.9)	79.0,5.4 (74.1-89.6)	86.3,1.6 (84.7-88.4)
c'	0.96,0.05 (0.85-1.04)	0.90,0.06 (0.82-0.94)	0.92-0.87	0.98	0.82,0.04 (0.75-0.80)	0.89,0.05 (0.81-0.95)	0.82,0.03 (0.79-0.86)
V	49.0,1.3 (46.5-51.8)	50.1,1.6 (48.3-51.3)	48.6-49.4	48.7	52.5,1.3 (50.1-54.5)	50.6,0.6 (49.9-51.4)	52.5,0.9 (51.3-53.3)
Total spear length µm	143.8,3.5 (134.5-149.6)	147.2,2.8 (144.5-150.2)	42.0-153.0	149.3	148.5,3.4 (143.0-154.3)	153.0,2.2 (149.4-156.9)	148.1,3.5 (145.6-153.1)
Odontostyle µm	88.8,3.4 (77.9-94.3)	91.3,0.7 (90.5-91.7)	85.5-98.0	91.6	92.9,2.5 (87.8-96.6)	95.4,1.8 (92.9-97.9)	92.5,2.6 (89.1-95.4)
Odontophore µm	55.0,1.4 (52.8-57.8)	55.9,2.3 (54.0-58.4)	56.5-55.0	57.7	55.6,1.4 (52.8-57.8)	57.6,1.2 (55.2-59.0)	55.6,2.1 (52.7-57.7)
Oral aperture to guiding ring µm	79.8,2.2 (75.5-83.6)	78.9,2.0 (76.6-80.4)	79.8-84.5	79.7	81.0,1.4 (77.8-82.8)	83.0,2.0 (79.1-84.7)	79.9,2.4 (76.6-82.2)
Tail µm	28.2,1.5 (25.1-30.8)	26.8,3.1 (23.9-30.1)	26.4-27.6	29.5	24.6,1.2 (23-26.8)	26.8,2.1 (23.5-29.3)	24.8,0.2 (24.5-25.1)
J (hyaline portion of tail) µm	8.6,1.1 (6.3-10.7)	9.2,0.7 (8.8-10.0)	10.0-9.2	7.9	8.1,1.1 (6.3-10.7)	9.3,0.7 (8.5-10.7)	8.4,0.8 (7.5-9.4)
Body diameter at lip region µm	12.8,0.3 (12.5-13.5)	13.4,0.7 (12.5-13.8)	13.2-14.7	13.5	13.7,0.3 (13.2-14.4)	13.8,0.3 (13.5-14.4)	(13.8-13.8)
Body diameter at guiding ring µm	30.4,0.5 (29.3-31.4)	31.7,0.2 (31.4-31.8)	30.6-32.0	31.8	31.9,0.6 (30.7-32.6)	31.0,0.6 (30.1-31.8)	30.9,1.4 (29.3-32.6)
Body diam. at base of oesophagus µm	38.7,1.0 (36.4-40.8)	39.4,1.0 (38.3-40.2)	39.6-42.7	38.3	39.5,0.6 (38.1-41.1)	38.9,1.0 (37.0-40.2)	38.8,2.0 (36.4-41.4)
Body diam. at vulva or mid body µm	44.5,2.2 (40.2-48.2)	43.3,1.8 (41.5-45.2)	47.1-46.5	42.3	44.1,1.5 (41.4-46.4)	44.3,1.7 (41.4-46.8)	43.5,4.5 (38.3-46.4)
Body diameter at anus µm	29.2,0.9 (27.6-31.1)	29.7,1.9 (28.3-31.8)	28.6-31.4	30.	30.1,1.0 (27.6-32)	29.8,1.4 (27.6-31.8)	28.5,1.3 (26.8-29.8)
Body diameter at beginning of J µm	15.8,1.4 (12.5-18.5)	18.4,2.9 (15.0-20.1)	19.5-18.8	17.6	18.0,1.7 (15.1-20.1)	17.5,1.9 (15.1-21.0)	17.2,1.5 (15.1-18.8)

sperm. Supplements consist of an adanal pair and a series of six ventral papillae. Tail is short and conoid rounded, with the ventral surface slightly arcuate.

The earlier record of *X. brevicolle* from Yugoslavia (Barsi, 1989) should be reffered to *X. taylori.*

Distribution: EQ06: Deliblato sand (*Prunus machaleb* L., *Crataegus* sp., *Sambucus nigra* L.); VM33: Lipnica (grass-land); WL39: Rožno (grass-land); WM10: Zidani Most (*Rubus* sp.); XL81: Baćin Dol (*Doricnium* sp.).

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