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MORPHOMETRICS OF *TYLENCHORHYNCHUS CLAYTONI* STEINER FROM OLIVE TREES, IN CYPRUS

by
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Summary. Body measurements taken throughout nematode development of *Tylenchorhynchus claytoni* showed that stylet length, position of excretory pore and de Man ratios a, b, and c were highly correlated to body length (size-grouping) while the position of vulva, as observed from individuals, was not. The smallest and largest stylets, observed throughout nematode development, were 13.5 and 20.5 µm, respectively. Measurements of individuals also showed that all parameters recorded overlapped each other. While Cyprus specimens were 47 to 180 µm longer as compared to specimens from other countries, they were similar in other body measurements.

Morphological characters, including body measurements and ratios, are used to describe a nematode species and to assist in nematode identification. These refer to adult females and males of the species concerned but measurements of pre-adult stages also can be useful. Body measurements, however, usually overlap those of other similar species thus creating difficulties in proper nematode identification. This problem becomes even more critical when only a few specimens are examined. Several plant nematologists (Brzeski, 1963; Jones, 1964; Tarjan, 1969) have discussed the practical use of certain body measurements for distinguishing nematode species, observing that several of these parameters cannot overall be used to assist in nematode identification due to environmental or other influences on the nematode. Also, Geraert (1968) pointed out that ratios of body measurements should be used with extreme care. The present work reports on certain body measurements and their ratios of *Tylenchorhynchus claytoni* Steiner throughout its development, collected from soil around the roots of olive trees (*Olea europaea L.*). The usefulness of such measurements and their ratios, as observed in this study, is briefly discussed.

Materials and methods

Soil samples were collected in July-August, 1997 from around the roots of irrigated olive trees (cv. Coroneiki), situated 20 km north west of Nicosia. Nematodes were extracted by a combination of the sieving-decanting Baermann funnel methods. Specimens were put on slides in a drop of distilled water and killed by gently applying heat.

Measurements were made with an ocular micrometer at X1,000 only of those specimens whose morphological characteristics were clearly visible. Nematode length was classified within eleven group sizes starting from 250-300 µm and ending with 751-800 µm (Table I). Measurements included: de Man a, b and c ratios, stylet

TABLE I - *Measurements of* Tylenchorhynchus claytoni *(females) as reported by various authors.*

Parameter	Steiner, 1937 (U.S.A.) n=9	Golden *et al.*, 1987 (U.S.A.) n=15	Loof, 1974 (Netherlands) n=20	Braasch, 1977 (Germany) n=15	Author's (Cyprus) n=42
L (μm)	640-730	589-753 (667±48)	520-620	550-740	565-800 (681±44)
a	24-25	22-28 (25.4±1.1)	23-28	22-30 (27.7)	26-30 (27.9±2.3)
b	5.0-6.2	4.3-5.7 (4.8±0.4)	4.6-5.6	4.4-5.4 (4.8)	4.7-5.7 (5.2±0.4)
c	17.9-19.4	15-20 (16.8±1.1)	17-20	18-23 (20.1)	17-22 (19.9±3.0)
V	55-57	54-60 (58.6±1.3)	54-59	54-59	55-62 (58.6±1.6)
Stylet (μm)	20	18.4-21.0 (19.3±0.5)	17.0-19.0	18.0-22.5 (19.8)	17.0-20.5 (18.9±0.8)
Excret. pore (μm)	–	94-115 (102±5.5)	–	93-110 (102)	87-120 (103±6.4)
Tail annules	9	–	11-16	8-16	12-19 (14.3±1.5)

length, position of excretory pore, position of vulva (V%) and number of tail annules. No observations were made on males.

Results and discussion

The overall body length of 113 specimens examined ranged from 250 to 800 μm, thirty seven per cent of this number being females. The average female body length was 681±44 μm (n=42) ranging from 565 to 800 μm this, to a great extent, being close to those reported by Steiner (1937), Braasch (1977), Golden *et al.* (1987) and Loof (1974) while exceeding them, on the basis of maximum length recorded, by 47 to 180 μm (Table I). The longer size of the Cyprus specimens could be due either to environmental influence or the result of measurements from only a small number of specimens examined.

Overall female stylet length (n=42) averaged 18.9±0.8 μm (Table I) while absolute minimum-maximum values of 17.5 to 20.5 μm of female stylet length were reached for size-groups seven to eleven, respectively (Table II). Pre-adult stages (n=72), within group-sizes 1 to 6 inclusive, had a stylet length ranging from 13.5 to 18.5 μm (Table I), with an almost continuous overlapping between the different group-sizes (Table I). However, correlating body group-sizes with their respective mean stylet lengths, for the total number of nematodes examined (groups 1 to 11) and for each individual female (n=42), a high correlation was obtained in the first case (r=0.991) (Fig. 1) while in the second case the correlation was lower (r=0.682) (Fig. 2).

Based on group-size measurements, the least distance from the head to the position of the excretory pore was 72 μm (group 1), reaching a maximum of 111±7.0 (group 11) while individual measurements (n=111) placed its position from 72 to a maximum of 120 μm (Table II). A high correlation was found between body length and the position of the excretory pore based on either the distance of the excretory pore from the head (Fig. 3) or the ratio between body length divided by the distance of the excretory pore from the head of the nematode (Fig. 4).

From 42 females examined, the mean value of the position of the vulva, expressed as a percentage of the total length, was 58.6±1.6, this coinciding with the findings of Golden *et al.* (1987) while reaching close proximity with measurements from different countries (Table I). Of the females examined, 81% had a V-value ranging from 57 to 60% while extreme values (55.2-62.1%) throughout the whole body length pattern were also recorded (Fig. 5). Evidently,

TABLE II - *Measurements of* T. claytoni *from Cyprus in various stages of development.*

Body group size	Length (range µm)	n	Ratios a	Ratios b	Ratios c	n	Stylet length (µm)	n	Distance from head to excr. pore (µm)	Body length/ Head-excr. pore distance
1	250-300	3	18.5±0.6 (17.6-19.3)	2.9±0.4 (2.9-3.1)	13.2	3	14.3±0.8 (13.5-15.0)	1	72	3.81
2	301-350	8	21.2±1.3 (19.7-23.3)	3.4±0.2 (3.0-3.6)	14.1±0.7 (13.2-14.7)	8	15.1±0.4 (14.5-15.5)	8	75±3.5 (72-81)	4.33±0.2
3	351-400	11	23.5±1.7 (21.3-26.3)	3.6±0.2 (3.3-3.9)	14.0±1.4 (12.8-16.5)	14	15.9±0.4 (15.0-17.0)	12	80±8.3 (76-86)	4.68±0.2
4	401-450	20	24.6±2.5 (19.1-28.0)	3.7±0.3 (3.5-4.3)	15.6±1.9 (13.2-20.3)	19	16.5±0.7 (15.5-17.5)	20	83±3.4 (74-87)	5.12±0.2
5	451-500	11	25.1±1.5 (21.7-27.3)	4.3±0.3 (3.8-4.6)	15.8±2.6 (10.3-17.8)	11	16.8±0.8 (15.5-18.0)	11	90±8.8 (86-100)	5.27±0.4
6	501-550	17	26.1±1.6 (23.2-29.6)	4.4±0.2 (3.9-4.7)	16.7±1.5 (13.7-18.1)	17	17.4±0.9 (15.0-18.5)	14	92±7.4 (87-97)	5.70±0.2
7	551-600	8	28.3±2.3 (24.8-32.2)	4.7±0.2 (4.5-5.0)	17.3±2.1 (15.3-20.5)	6	18.3±0.9 (17.5-19.5)	8	98±5.4 (93-105)	5.86±0.2
8	601-650	7	27.8±2.5 (24.3-32.3)	5.1±0.2 (4.8-5.4)	20.2±3.0 (17.2-24.9)	8	18.5±0.9 (17.0-20.0)	8	98±7.0 (92-105)	6.37±0.4
9	651-700	9	27.7±2.6 (25.0-32.0)	5.3±0.2 (5.0-5.5)	21.9±3.1 (18.4-24.7)	9	18.7±0.4 (18.0-19.0)	10	103±3.8 (96-109)	6.55±0.2
10	701-750	12	29.7±1.8 (25.6-33.4)	5.4±0.3 (5.1-6.1)	21.7±2.4 (19.4-27.3)	12	19.4±0.6 (18.5-20.5)	12	107±4.5 (104-115)	6.77±0.2
11	751-800	7	28.1±3.2 (24.3-32.8)	5.7±0.2 (5.6-6.0)	21.9±2.7 (16.7-23.6)	7	19.7±0.5 (19.0-20.5)	7	111±7.0 (104-120)	6.98±0.4

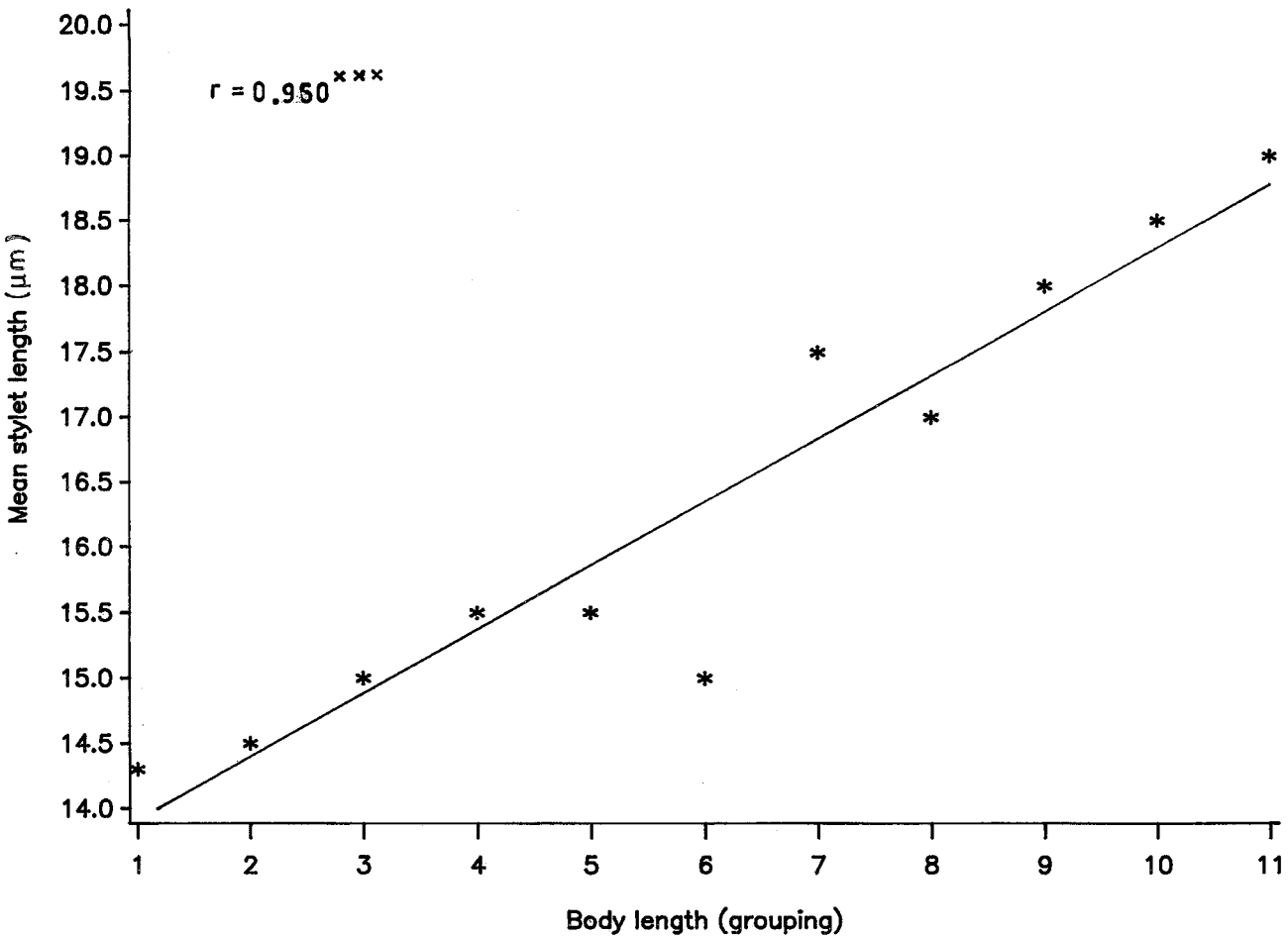

Fig. 1 - Relationship between body and stylet length throughout development of *Tylenchorhynchus claytoni*.

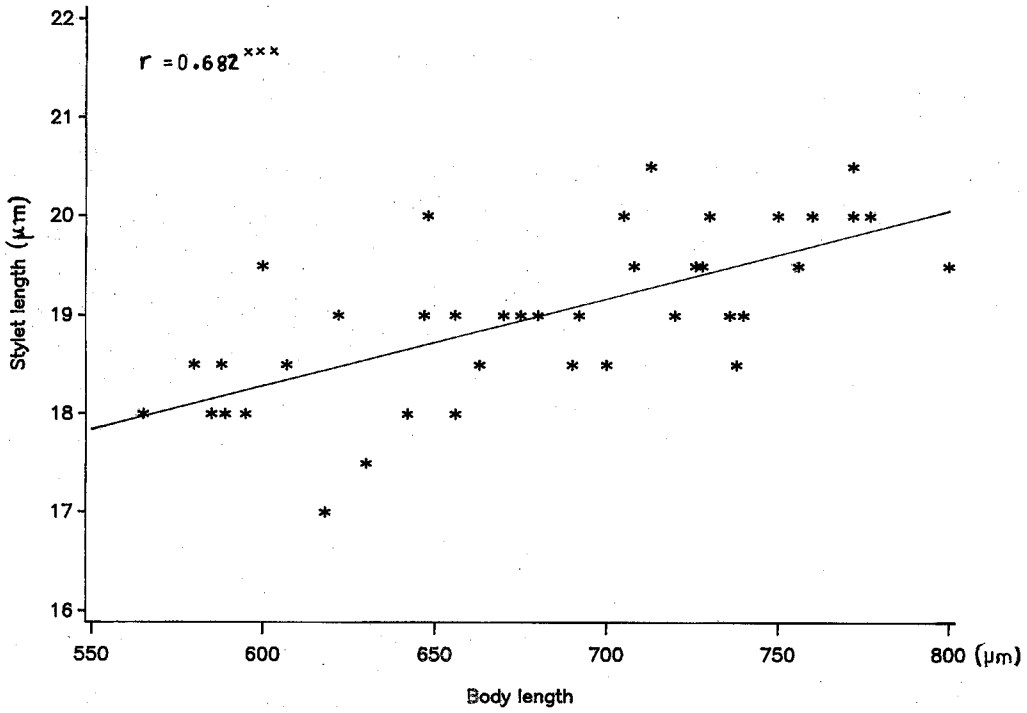

Fig. 2 - Relationship between body and stylet length in *T. claytoni* females.

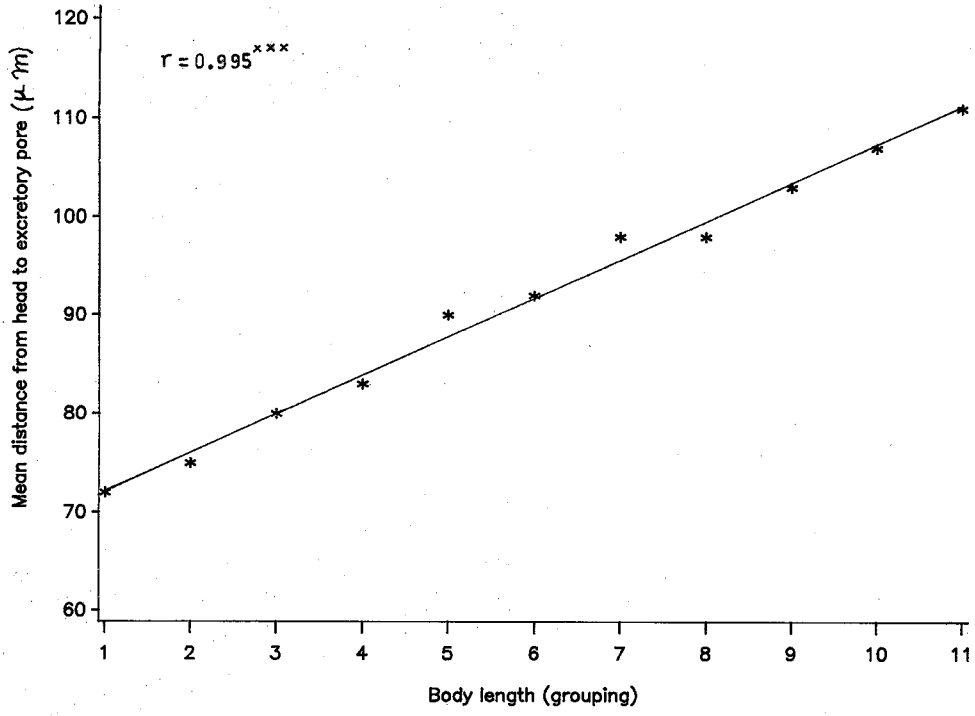

Fig. 3 - Relationship between body length and position of excretory pore in *T. claytoni*.

the position of the vulva, as concerns its relation to body length, showed great variability these two body measurements having a very low correlation. There was a tendency, however, between lower V-values and increased body length.

Considering measurements on a group-size basis, ratios a, b and c showed similar patterns in their relation to body length their values following to a great extent the regression line (Fig. 6). Ratio b, however, showed the least dispersion from the regression line, its values ranging from 2.9±0.4 to 5.7±0.2 for the smallest and largest group-size, respectively (Table II; Fig. 6). Maximum values of ratio b coincided with those reported by Golden *et al.* (1987) and Loof (1974) while Jones (1964) considers this ratio of measurements as a useful criterion for describing and studying the size of a species. All ratios showed an overlapping among the different group sizes (Table II).

The number of tail annules on females (n=42) varied, ranging from 12 to 19 with an average of 14±1.5. This morphological character, obviously, is genetically determined and not influenced by nematode size. The number of females with 13-15 tail annules was 75.4%.

The results suggest that certain essential body parameters for a specific nematode species, recorded throughout its development, can be useful in nematode identification. Variability of individual measurements within a species is large thus creating difficulties in making taxonomic diagnoses. However, correlating different sizes of a particular nematode species with certain parameters, whould make things easier and, in any case, would add to our overall knowledge of the real influence of body increase on such parameters. It would also assist, along with other morphological and morphometric features, in the possible use of a diagnostic model for several nematode genera (i.e.

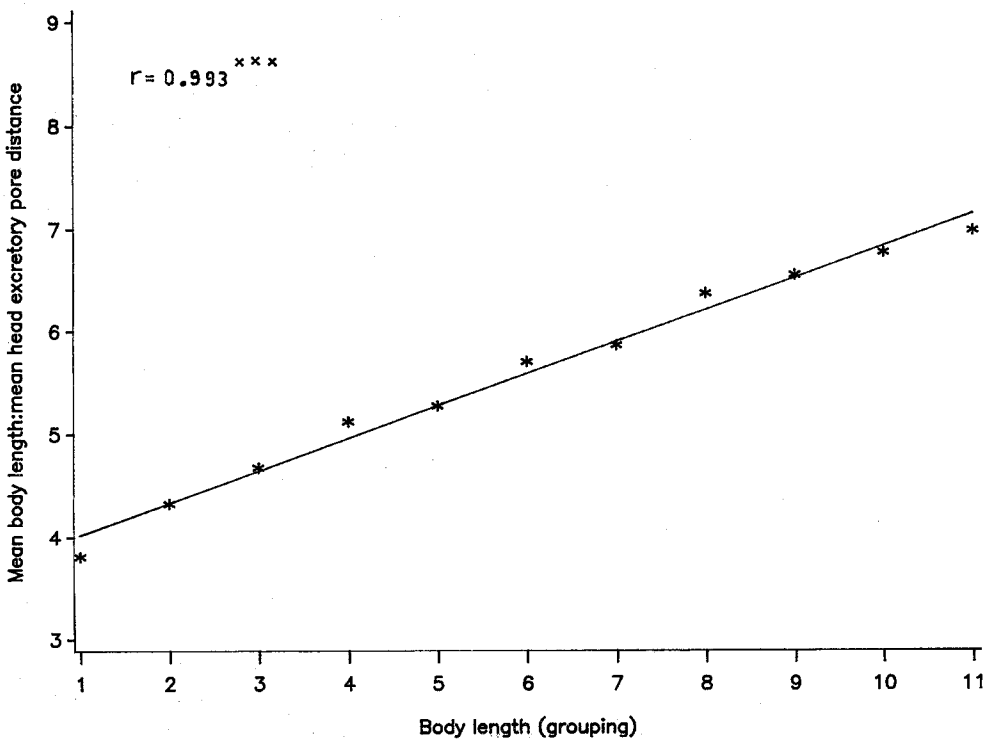

Fig. 4 - Relationship between body length and ratio body length to excretory position in *T. claytoni.*

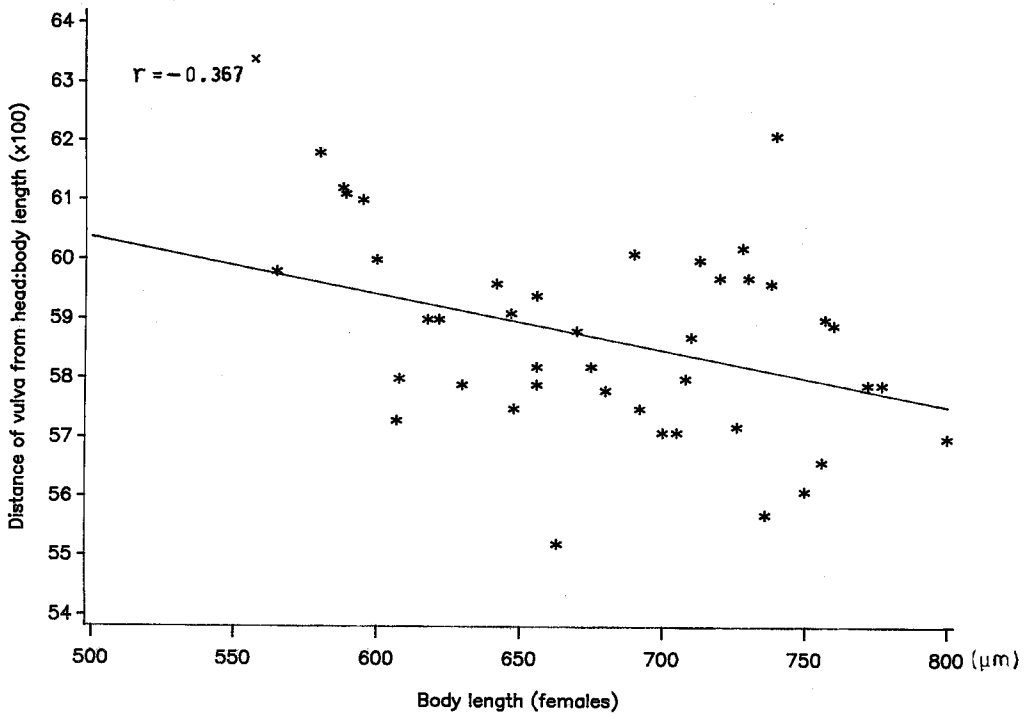

Fig. 5 - Relationship between body length and position of vulva in *T. claytoni*.

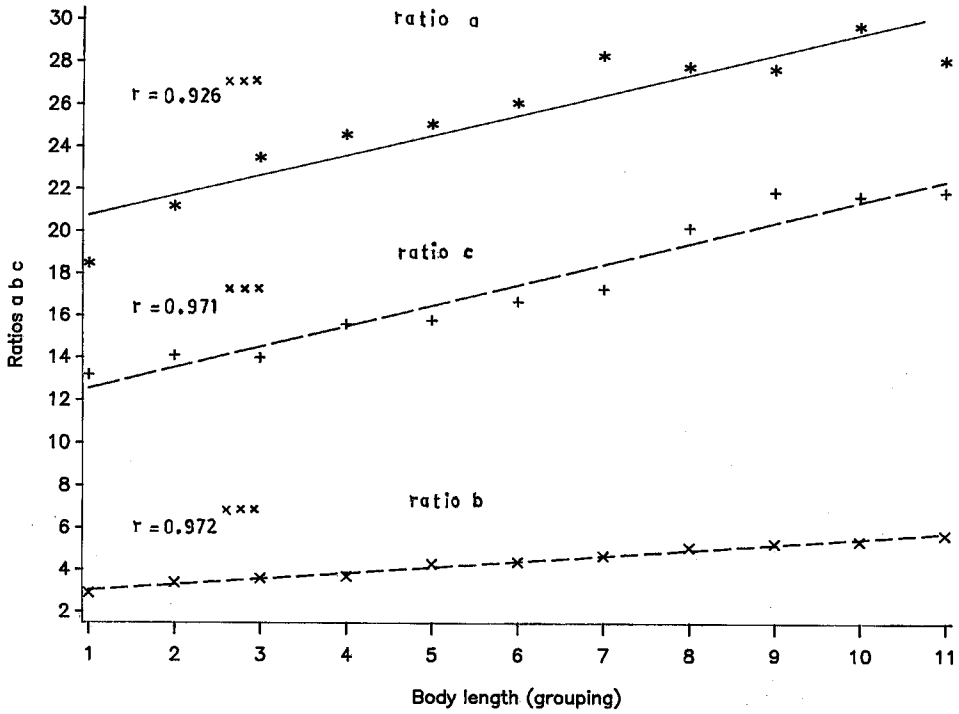

Fig. 6 - Relationship between a b, and c ratios and body length in *T. claytoni*.

Tylenchorhynchus), also adding to our knowledge on the effect of environmental influence on nematode morphological variability.

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