

Section of Nematology, Department of Zoology,
Aligarh Muslim University, Aligarh - 202001 INDIA

BIOMETRIC ANALYSIS IN *BASIROLAIMUS INDICUS* (SHER)
SHAMSI, 1979
(NEMATODA: HOPLOLAIMIDAE)

by
M. I. S. WALIULLAH

In taxonomic studies of phytoparasitic and soil nematodes considerable emphasis is placed on the use of ratios of various body measurements, especially de Man's ratios, though several of them have become useless in the opinion of some workers. Geraert (1968, 1978) considers ratios 'a' and 'b' to be of no value and has also indicated limitations in the use of 'c' and 'V'. As the tail length behaves differently in different tylenchid species, Geraert suggested apparently in the light of Clark's (1962) observation, that « it will be necessary to demonstrate for the particular case studied that the tail-length depends on the body length before the 'c' ratio may be used ». The same is true for the other ratios.

Because of the controversy in the use of such ratios, investigations were undertaken on the reliability of ratios of various body parameters in the adults of a natural population of a tylenchid species. The linear dimension of the various sets of measurements of 80 specimens of *Basirolaimus indicus* (Sher, 1963) Shamsi, 1979, collected from a single habitat, were analysed with the help of some statistical methods.

Material and Methods

The adults of both sexes of *B. indicus* were obtained from soil around the roots of a single *Rosa indica* L. growing in the Department of Zoology, Aligarh Muslim University, Aligarh. They were extracted

by Baermann's technique then killed and fixed by immersion for 48 hrs in boiling F.A. (4:1) solution. The nematodes were mounted in lactophenol. All measurements were taken at 1,000 magnification. The following ratios were then calculated for both sexes:

- 1) Position of median oesophageal bulb (MB) taken from anterior end of body up to half of the bulb/ total oesophageal length taken up to the base of basal oesophageal glands.
- 2) Maximum width of median bulb (MBW) length of median bulb (MBL).
- 3) Maximum body width of nematode/ width of median bulb.
- 4) Length of nematode/ maximum width of nematode.

The relation between the following morphometric characters was studied separately for males and females:

- 1) Position of vulva from anterior end as percentage of total body length (V) compared with the tail length.
- 2) Position of vulva from anterior end as percentage of distance from anterior end to anus (V') compared with the tail length.
- 3) Total length of nematode compared with length of spicule.

Results

Table I gives the ranges of linear measurements of the variates and some of the de Man ratios, along with their mean values, standard deviations and coefficients of variance in both sexes of *B. indicus*.

Discussion

The ratio 'MB' proposed by Geraert (1968) gives the position of the median oesophageal bulb, at the middle of the valve-apparatus, as % of total oesophageal length in tylenchids having an offset terminal oesophageal bulb. The same author more recently (Geraert, 1978) suggested that the median bulb position can be used as a generic character. Siddiqi (1979) defined the ratio 'MB' as the distance from anterior end of body to the centre of median oesophageal bulb as % of oesophageal length, to accommodate those genera which either lack or have an indistinct valve-apparatus. However, the ranges of

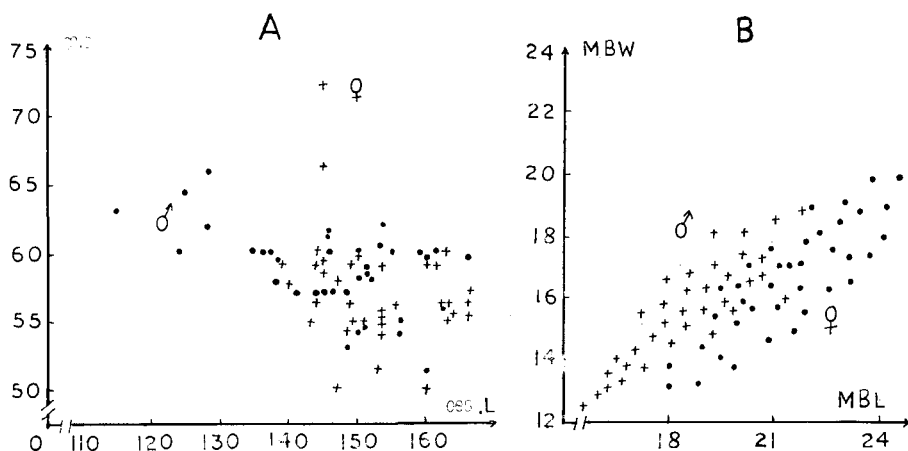


Fig. 1 - *Basirolaimus indicus*: A, the relationship between length of oesophagus (oes. L) and position of median bulb (MB); B, the relationship between maximum width of median bulb (MBW) and its length (MBL).

the ratio 'MB' given for some of the species belonging to the genera proposed by Andrassy (1968) and Siddiqi (1979) are overlapping and therefore Geraert's earlier indication that the use of this ratio has some limitations and that its usefulness must be investigated before it can be used indiscriminately seems correct.

When 'MB' was plotted with total oesophageal length for a population of *B. indicus*, a nematode in which the terminal oesophageal bulb is not offset, a large variability was found. In both sexes the relationship was not a straight line (Fig. 1A), further indicating that 'MB' cannot be used as a character at the generic level.

Shape of the median bulb, which has been utilized by some taxonomists as a reliable character in separating species of tylenchid nematodes, logically depends upon two factors namely maximum length of the bulb and its maximum width. Measurements of these parameters were analysed and found to be statistically correlated. The correlation coefficient (r) between maximum width and length of the median oesophageal bulb for the male is 0.828 and for the female 0.834 ($P < 0.001$). The ratio 'B' is proposed, i.e. maximum width of median oesophageal bulb/ length of median oesophageal bulb. However, its use is restricted (Fig. 1B).

Kline (1976) reared *Aphelenchus avenae* under various conditions of temperature, cultural medium, nutrition and time and noticed that

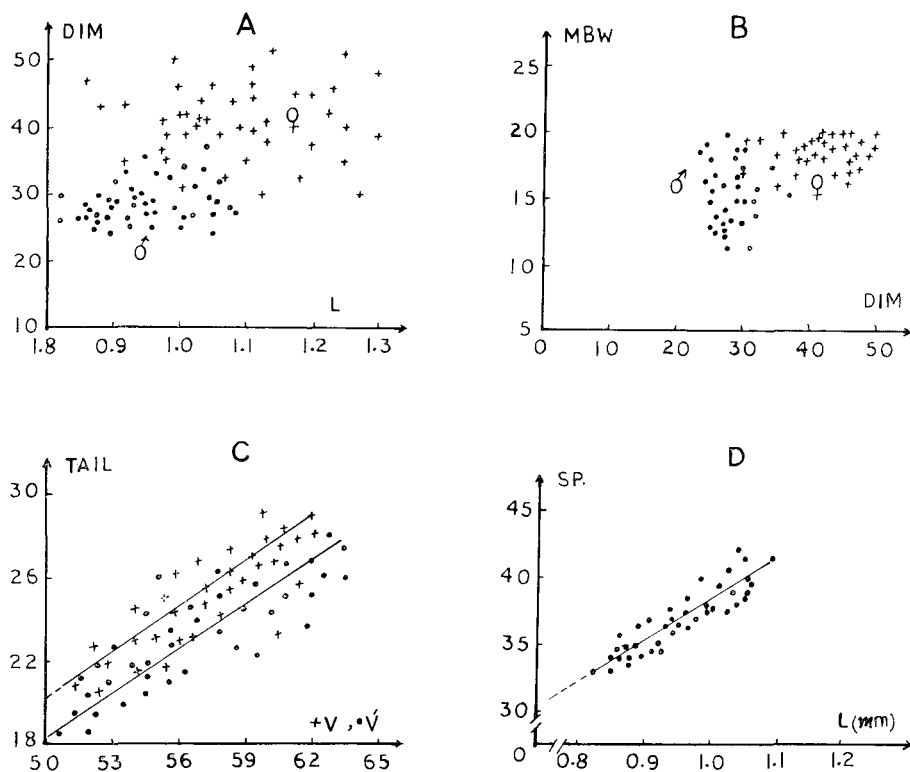


Fig. 2 - *B. indicus*: A, the relationship between total length of the body (L) and maximum body width (DIM); B, the relationship between maximum body width (DIM) and maximum width of the median bulb (MBW); C, the relationship between 'V' and 'V' and tail length; D, the relationship between total length of body (L) and length of spicule (SP).

the body length and its diameter were influenced by these factors to some extent. Further, Geraert (1978) concluded that the body width is not related to the body length and due to complexity of the relationship it cannot be expressed as a ratio. With reference to the family Heteroderidae, Geraert (1968) concluded that the body width is influenced by factors other than body length alone. Similar observations have also been made by some earlier workers (Goodey, 1952; Wu, 1960; Barraclough and Blackith, 1962; Mamiya, 1971).

Comparison of body width (diameter) with total body length in *B. indicus* revealed large variation in the females (Fig. 2A). This is because the development of the gonads in the females greatly in-

Table I. - *Morphometric characters of males and females of B. indicus.*

CHARACTERS	MALES (n ₁) = 40		CV (%)	FEMALES (n ₂) = 40		CV (%)
	Range	Mean \pm S.D.		Range	Mean \pm S.D.	
L (μm)	820.0 - 1082.0	955.0 \pm 72.66	7.61	860.0 - 1300.0	1077.0 \pm 106.10	9.85
'a'	29.0 - 34.7	32.5 \pm 3.22	9.90	21.1 - 33.5	25.84 \pm 3.47	13.43
'c'	31.4 - 44.0	36.2 \pm 3.29	9.08	44.8 - 57.7	53.7 \pm 6.45	12.01
Position of median bulb 'MB' (μm)	51.33 - 66.4	58.66 \pm 3.04	5.18	50.16 - 66.21	56.74 \pm 2.84	5.00
'MBL' (μm)	15.0 - 22.0	16.83 \pm 1.68	9.98	18.0 - 25.0	21.28 \pm 1.84	8.65
'MBW' (μm)	11.5 - 18.22	14.82 \pm 1.96	13.22	14.0 - 20.0	18.33 \pm 1.11	5.99
Totale oesophagus length (μm)	116.0 - 162.2	146.50 \pm 11.10	7.58	139.0 - 157.0	152.00 \pm 7.97	5.24
'V'	—	—	—	50.42 - 63.9	56.23 \pm 2.58	4.54
'V''	—	—	—	51.64 - 65.68	57.47 \pm 2.67	4.64
Spicule length (μm)	33.0 - 42.0	36.9 \pm 2.42	6.58	—	—	—
Tail length (μm)	—	—	—	18.0 - 29.0	24.13 \pm 2.77	11.48
Body width (μm)	24.00 - 32.00	28.35 \pm 2.40	8.46	30.0 - 51.00	42.22 \pm 5.23	12.40

fluences their maximum body width. The de Man ratio 'a' (total body length/maximum body width), therefore, is of limited utility and should be used only in males.

As with ratio 'a' there is no significant correlation between the maximum width of the median bulb and the maximum width of the nematode. In the adult female the two parameters are poorly correlated, contrary to the adult male (Fig. 2B). This further emphasises the uselessness of nematode body width in a ratio. This finding, however, supports Geraert's (1978) hypothesis that « growth in volume of the median bulb depends on the widening of the female ».

Geraert (1971) found that the position of the vulva remains constant in relation to the head-anus distance (L'). He indicated that the ratio 'V' which represents the position of the vulva as % of the total body length, is useful only in those cases where the tail depends on 'L'. Furthermore, he explained that 'V' is useful when the tail is very short in relation to 'L'. Monoson (1971) stated that « the 'V' value must be used with extreme caution in identification of nematode species because of its temperature dependence ». In the present study both the ratios 'V' and 'V'' were plotted and it was revealed that straight lines could be obtained in respect of both (Fig. 2C). Apparently this is because the tail is quite short in relation to 'L' in *B. indicus*. The regression line for 'V' — tail length does not pass through origin, nor does that for 'V'' — tail length. This is because the variation coefficient is 4.59 for 'V' and 4.64 for 'V'', the difference being significant ($t = 0.068$). However, it can be surmised here that the ratio 'V' may be useful only in those species which are monodelphic prodelphic, while in species didelphic ophisthodelphic outstretched, notwithstanding the differences in tail length, ratio 'V' and 'V'' are of equal value.

Spicule length is usually considered to be fairly constant for bisexual species in tylenchids and often is utilized as a taxonomic character. The length of the spicule, therefore, was plotted with the total body length (Fig. 2D). As the variation coefficients of the numerator ($CV = 7.61$) and of denominator ($CV = 6.56$) do not differ significantly ($t = 0.982$) and $r = 0.773$ (between the two parameters), this indicates, therefore, that the ratio nematode length/spicule length could be used as a character in this species.

I thank Dr. Shahid H. Khan for reviewing the manuscript and Prof. Nawab Hasan Khan, Head, Department of Zoology, A.M.U., Aligarh for providing laboratory facilities. Thanks are also due to

the University Grants Commission and the Council of Scientific and Industrial Research, New Delhi for financial support.

SUMMARY

Statistical analysis of the parameters: position of the median oesophageal bulb as % of the total oesophageal length; maximum width of the median bulb/ length of the median bulb; width of the median bulb/ maximum width of the nematode; length of the nematode/ length of the spicule and the ratios 'a', 'V' and 'V'' was conducted in a population of *Basirolaimus indicus* (Sher) Shamsi, 1979, to ascertain their taxonomic value. The results indicate that both the ratios 'V' and 'V'' and also the ratio nematode length/spicule length are useful, while ratio 'a' has some limitations. Conversely the ratio 'MB' cannot be used because of its discrete variation. The ratio 'B' is proposed: the maximum width of the median bulb (MBW) divided by the length of median bulb (MBL).

LITERATURE CITED

- ANDRASSY I., 1968, Fauna Paraguayensis 2. Nematoden aus den Galerienwaldern des Acaray-Flusses. *Opusc. Zool. Bpest.*, 8: 167-315.
- BARRACLOUGH R. and BLACKITH R.E., 1962, Morphometric relation in the genus *Ditylenchus*. *Nematologica*, 8: 51-58.
- CLARK W.C., 1962, Measurements as taxonomic criteria in Nematology. *Nematologica*, 8: 10.
- GERAERT E., 1968, Morphometric relation in nematodes. *Nematologica*, 14: 171-183.
- GERAERT E., 1971, Observation on the genera *Boleodorus* and *Boleodorides* (Nematoda: Tylenchida). *Nematologica*, 17: 263-267.
- GERAERT E., 1978, On growth and form in nematodes: oesophagus and body width in Tylenchida. *Nematologica*, 24: 137-158.
- GOODEY J.B., 1952, The influence of the host on the dimension of plant-parasitic nematodes, *Ditylenchus destructor*. *Ann. appl. Biol.*, 39: 468-474.
- KLINE J.P., 1976, Morphometric variation in *Aphelenchus avenae* with varied nutrition and time. *Nematologica*, 22: 94-102.
- MAMIYA Y., 1971, Effect of temperature on the life cycle of *Pratylenchus penetrans* on *Cryptomeria* seedlings and observation on its reproduction. *Nematologica*, 17: 82-92.
- SIDDIQI M.R., 1979, Seven new species in a new nematode subfamily Duosulciinae (Tylenchidae), with proposals for *Duosulcius* gen. n., *Zanenchus* gen. n. and *Neomalenchus* gen. n. *Nematologica*, 25: 215-236.
- WU L.Y., 1960, Comparative study of *Ditylenchus destructor* Thorne, 1945 (Nematoda: Tylenchida), from potato, bulbous iris and dahlia, with a discussion of de Man's ratios. *Can. J. Zool.*, 38: 1175-1187.

Accepted for publication on 7 December 1981.