

* *Dipartimento di Biotecnologie & Bioscienze, Università di Milano-Bicocca,
Piazza della Scienza 2, 20126 Milano, Italy and*

** *Laboratory of Nematology, Wageningen University, P.O. Box 8123,
6700 ES Wageningen, Netherlands*

STANDARDIZING NEMATODE MORPHOMETRICS

by

A. ZULLINI*, P. A. A. LOOF** and T. BONGERS**

Summary. Standardized methods for determining the index c' are proposed to ensure universal comparability of morphometrics.

Though considered less important nowadays than in the past, morphometrics are still an essential part of any species description. In order to compare the data from various descriptions, it is important that they really are comparable. However, this is not always the case. A very simple example is that of L , a , b , c and V in females of species of the genus *Hemicycliophora*: were these calculated along the outer or along the inner cuticular layer. A second example is the length of curved spicules: were these measured along the axis or along the chord. It is important that authors mention their methods, but to maximise comparability it is also desirable that the same method is followed or, in other words, that the methods are standardized.

In this paper are discussed the problems connected with the index c' (tail length divided by anal body diameter). With straight, regularly conoid tails there is no problem, but with tails of other shapes the anal body diameter can be measured in various ways: from anus along a line perpendicular to the dorsal body wall; along a line making equal angles with the ventral and the dorsal wall, etc. Some nematodes have tails that are strongly curved at the base (e.g. several species of

Mylonchulus) and thus provide an arbitrary choice. Tail length of course will depend on the inclination in which anal body diameter is measured. The result might be that, in the literature, two species are differentiated on the basis of clear differences in c' , but these differences really are wholly due to different methods of measuring.

Measuring anal body diameter (ABD) and tail length

The first step is always to make a drawing. What follows depends on the shape of the tail in question; there are three cases:

1. Tail curved regularly and usually longer (along axis) than anal body diameter, as for example in *Actinolaimoides angolensis* (Andrássy, 1963) and related species, or *Prionchulus muscorum* (Dujardin, 1845) and *P. punctatus* (Cobb, 1917), (Fig. 1A).

- Put a compass pin in the anal opening, in line with the ventral body contour.

- By circling the compass around the pin, find the point of the dorsal contour which has the

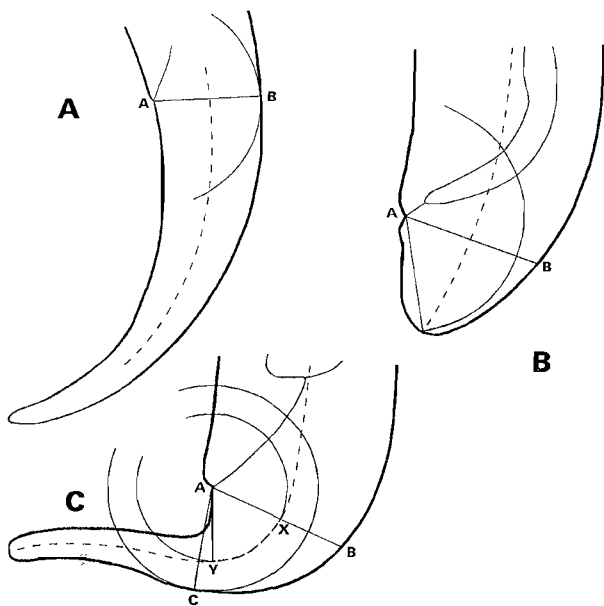


Fig. 1 - Tails of various nematodes and illustrations of measurements of the anal body diameter (AB) and the longitudinal body axis: A, female of *Actinolaimoides angolensis* (Andrássy, 1963) (redrawn from Siddiqi, 1981); B, male of *Ischiodyrolaimus ugandanus* Andrássy, 1969 (redrawn from Andrássy, 1969); C, female of *Mylonchulus signaturellus* Mulvey, 1961 (redrawn from Mulvey, 1961).

shortest distance to the anal opening. With regularly curved tails this often can be achieved by taking a radius slightly larger than ABD; the circle will then cross the dorsal contour at two points and the required point is in the middle between these.

- Draw a straight line from the anus to this point and measure ABD along it.

- Check that ABD is perpendicular to body axis line.

- Put the end of a piece of e.g. flexible wire on the point where this line crosses the body axis and follow this axis to the terminus. This gives the tail length.

- Division of tail length and ABD, as found above, gives a standardized value for c' .

2. Tail not curved and shorter than ABD (Fig. 1B). In this case the tail tip is nearer to the anal

aperture than any other point of the dorsal contour. Therefore the compass method is not applicable and the following procedure is recommended:

- Draw the longitudinal body axis line.
- Draw a straight line from the anal aperture, perpendicular to this axis; this is ABD.
- Then follow the two last steps of the previous procedure.

3. Tail longer than ABD but curved irregularly, as in many species of *Mylonchulus*, e.g. *M. signaturellus* Mulvey, 1961 (Fig. 1C) and *M. signaturellus* (Cobb, 1917). Applying the first procedure we would obtain the line AC as anal body diameter. But point C is not opposite the anus and the line AC runs partially outside the nematode body, so it cannot be considered to represent ABD. Therefore we would apply the second procedure, based on the line from the anal opening perpendicular to the body axis. In the case illustrated this body axis line partially coincides with the inner circle of Fig. 1C, so all points of the arc XY are equidistant from the anal aperture (A). To find the real ABD select the most anterior of the infinitely possible perpendicular lines drawn from A to the body axis, in Fig. 1C the line AB. Determination of tail length and c' are as in the preceding procedure.

We urge colleagues to follow this method and to mention in any relevant papers if they have done this.

Literature cited

- ANDRÁSSY I., 1969. Taxonomische Übersicht der Familien Prodorylaimiden n. fam. und Dorylaimidae de Man, 1876. *Opuscula Zoologica Budapest*, 9: 187-233.
- MULVEY R. H., 1961. The Mononchidae: a family of predaceous nematodes I. Genus *Mylonchulus* (Enoplida: Mononchidae). *Canadian Journal of Zoology*, 39: 665-696.
- SIDDIQI M. R., 1981. Six new genera of dorylaimid nematodes. *Nematologica*, 27: 397-421.