*Nematologica* 8 (1962): 51-58. Leiden, E. J. Brill

# MORPHOMETRIC RELATIONSHIPS IN THE GENUS *DITYLENCHUS*

BY

RUTH BARRACLOUGH [1]) AND R. E. BLACKITH

Imperial College Field Station, Sunninghill, Ascot, Berks., England

The shapes and sizes of *D. dipsaci* living in different host-plants are compared. These differences of form are shown to be distinct from normal growth differences so that the suggestion that distinct races are selected during host transfer experiments is strengthened. The observed differences of shape cannot, however, be paralleled by the difference between the forms of *D. dipsaci* and *D. myceliophagus*. Sexual dimorphism in the races of *dipsaci* is identical with that in *myceliophagus*.

The stem eelworm, *Ditylenchus dipsaci* (Kühn) exists as several biological races or strains; populations may attack a wide range of hosts or be confined to a few. The hosts include onions, narcissus and lucerne, and attempts to transfer nematodes from one group of hosts to another are not successful. The status of the races or strains reared on the different hosts is little understood, and the experiments described examine the morphometric relationships between such strains.

That nematodes of this genus can differ in shape and size according to the host-plant is known from work with *D. destructor* (J. B. Goodey, 1952). Moreover, T. Goodey (1941) found exceptionally large specimens of *D. dipsaci* in broad bean plants. Some information about the differences of size among groups of eelworms can be obtained from an analysis of their lengths, regarded as absolute measurements (Fenwick & Franklin, 1951) but any attempt to evaluate systematic relationships requires a study of the shapes of the organisms. The comparison of shapes involves the appreciation of the simultaneous changes in a suite of morphometric characters, and a first approximation to such an appreciation has often been made in the form of a ratio of two characters. The use of ratios implies certain prior knowledge about the nature of the systematic variation which, if set out explicitly, would almost certainly be denied by any experienced worker; ratios continue in widespread use partly because they are conventions which pass unexamined, partly because of an impression that it is not practicable to assess the joint variation of more than two characters simultaneously. In fact, efficient methods of handling any number of measurements in one and the same function have long been known and have focussed attention on the weaknesses of the manipulation of ratios. The mathematical bases of multivariate analysis are described by Rao (1952) and Kendall (1957). The weaknesses of ratios include:

---

[1]) Present address: National Agricultural Advisory Service, Kings Road, Evesham, Worcestershire.

(i) The fact that a ratio will not be constant for organisms of the same shape unless these are also of the same size, by virtue of the almost universal occurrence of allometric or heterogonic patterns of growth.

(ii) As generally used, ratios contain only two characters and thus afford a poor appreciation of what may be an involved contrast between shapes. Ratios with more than two characters are special cases of more general multivariate techniques.

(iii) As already hinted above, to compound two characters into a ratio involves the implicit assumption that there is only one type of shape difference by which the groups of organisms in question are differentiated and that one knows in advance that this unique type of difference is of such a nature that it is well represented by a combination of the two characters in which their weights are equal in magnitude but opposite in sign. The assumption that a single pattern of growth is capable of accounting for all the observed diversity of form in the experimental material, an assumption which begs the whole question as to the number and nature of such patterns, is particularly misconceived.

## MATERIAL AND MEASUREMENTS

This study was done chiefly on the narcissus, lucerne and oat/onion races of *Ditylenchus dipsaci*; *D. myceliophagus* Goodey was obtained from agar cultures for comparison. The narcissus race of *dipsaci* was from daffodil bulbs (*Narcissus* sp.), and the lucerne and oat/onion races from living plants of lucerne (*Medicago sativa* L.) and oats (*Triticum aestivum* L.) respectively.

The nematodes were extracted by Seinhorst mistifier and killed by adding 10 ml of nematode suspension to a test tube and plunging this in a water-bath at 60° C for two minutes. They were fixed and mounted in TAF under a coverslip supported by glass fibres slightly larger in diameter than the nematodes. The coverslip was ringed with Glyceel.

Measurements were made of twenty males and twenty females in each group and of twenty large and twenty small larvae, arbitrarily divided into the two sizes, in the oat/onion race only. Six characters were chosen for study: — the total length, making an allowance, by eye, for any curvature of the nematode; the length of the oesophagus, measured to the posterior end of the oesophageal lobe; the width of the nematode measured at the base of the oesophagus; the spear length; the tail length, measured from the anus, and the body width, measured at the anus and excluding the anal papilla in the male. The measurements were made with a micrometer eyepiece at a magnification of × 100 for the total length and × 400 for the other characters. The mean values of these measurements are in Table I.

The six characters were selected as common to both sexes. The size distinction in *dipsaci* larvae was made so that change of shape during normal growth could be followed. The inclusion of adult *D. myceliophagus* permitted the comparison