WAVE FORMATION BY INFECTIVE LARVAE OF THE PLANT PARASITIC NEMATODE MELOIDOGYNE JAVANICA

BY

H. R. WALLACE

Division of Horticultural Research, C.S.I.R.O., Glen Osmond, 5064, South Australia

Measurements of the wave characteristics of *M. javanica* on different concentrations of agar suggest that the nematode increases its muscular effort to overcome increased resistance to locomotion while conserving its energy reserves for infectivity and maintaining an efficient means of orienting to exudates released by the host plant root.

When a larva of *M. javanica* hatches it is endowed with food reserves that are depleted as the nematode migrates through the soil. As the larva does not appear to feed during its freeliving period in the soil it has the dual problem of actively migrating to the host and at the same time conserving its energy reserves in an environment which is constantly changing from conditions that permit rapid locomotion to those that inhibit any movement at all. Several adaptations have been described that increase the nematode’s chances of reaching and infesting the root of the host plant. This paper attempts to show how the nematode, by changing its wave form during its characteristic undulatory locomotion, is able to overcome resistance to movement; the nature of the wave changes in terms of adaptations for increasing infection are also discussed.

Muscular activity and wave form — a hypothesis

The kinetics of undulatory locomotion have been analysed in detail by Gray (1946, 1953) and Gray & Lissmann (1950) and later studies have indicated that the same general principles apply to nematodes (Gray & Lissmann, 1964; Wallace (in press)).

To explain how a nematode increases its propulsive force to overcome increasing resistance to movement e.g. in a drying soil, and how the wave form changes, four assumptions are made:

1. the muscles of the nematode function as if they occurred in discrete sectors along the body (Fig. 1). Nematodes have longitudinal muscles only, which in transverse section appear as four blocks, two dorso-lateral, two ventro-lateral. Each block may be divided into sub-blocks according to species. Although their general structure is known from electron micrograph studies of transverse sections, there seems to be no information on the arrangement of the muscles along the body.
body i.e. whether they are arranged in sectors and how many such sectors there are. The hypothetical nematode discussed in this paper is assumed to have twenty-four sectors, as this is a convenient number for geometrical studies of wave formation.

(2) When the body transmits a wave posteriorly there is a train of contraction and relaxation of the dorsal and ventral muscles such that any sector has an increased curvature from the adjacent posterior sector. Thus as the nematode glides forward in a horizontal plane a sector increases its curvature to say the left and then having reached the crest of a wave it starts to bend to the right. This point can best be illustrated by reference to Fig. 2 which is based on a similar diagram by Gray (1946). In Fig. 2a, the various positions of one sector of the body are shown as it travels along a sinusoidal track of the same length as the nematode, i.e. 24 sectors. Eight particular positions are shown in relation to the adjacent posterior sector. Thus in position 1 the sector makes an angle of 0° to the posterior sector. When the ventral muscles contract sector 1 glides forward one sector to position 2 where it makes an angle of 5° with the posterior sector. At the next move forward this angle increases another 5° to 10° and so on until it reaches the extremity of its bend to the right at 20° (position 5). The sector now begins to bend to the left in the same way as the dorsal muscles contract. The increase in angle or phase change (Φ) is thus 5° and the maximum angle or amplitude (A) is 20°. Fig. 2 (b) shows a similar train of events but in this case Φ is 20° and A is 40°. A comparison of Fig. 2 (a) and (b) indicates the difference in wavelength, amplitude and pitch of the waves resulting from the variation in Φ and A.

(3) There are two factors that determine the difference in curvature of two adjacent sectors and the form of the resulting wave, the phase difference (Φ) and the amplitude (A). Φ is determined by the difference in the number of fibres