THE INFLUENCE OF SOIL MOISTURE ON SURVIVAL AND HATCH
OF MELOIDOGYNE JAVANICA

BY

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Egg sacs do not appear to possess any marked powers of water retention; even at suction of 50 cm of water there is a marked shrinkage of the egg sac and most of the water is removed at 200 cm of water suction. In an atmosphere of relative humidity 98% (equivalent to 28 × 10³ cm of water suction) the percentage of second stage larvae in eggs increased from 7 to 45% in 5 days resulting in an increased rate of hatch when the egg sacs were placed in water. The egg sac matrix is an efficient barrier to water loss for the eggs contained inside. Eggs removed from the egg sac showed a marked decline in hatch in water after exposure to 98% R.H.; the experiment failed to demonstrate any difference in resistance to desiccation between eggs containing embryos and those containing second stage larvae. The level of the maximum hatch in glass beads decreases with decrease in size of the pores. It is suggested that eggs stop hatching when the pores empty because the egg sac shrinks thereby exerting a mechanical pressure on the egg shell and this factor plus the low hydraulic conductivity and the suction inhibit uptake of water by the egg. Swelling and distortion of the egg which are prerequisites for hatching are consequently inhibited. A hypothetical hatching curve in soil relating suction, soil moisture, crumb size and aeration is given.

Studies on the relationship between hatch and the moisture characteristic of a soil has indicated that when the pores are full of water hatch is inhibited probably by a lack of aeration (Wallace 1968). As the soil drains air enters the pores and consequently the rate of hatch increases. With further increase in suction there is a marked decrease in hatch possibly caused by inhibition of nematode locomotion at the surface of the egg sac (Wallace, 1966a). This explanation does not appear to be wholly satisfactory, however, because it implies that whereas hatch may continue, emergence from the egg sac is inhibited. Observations indicate that in fact, hatch itself is inhibited and there is little indication of an accumulation of larvae within the egg sac. Thus if the eggs can hatch conditions in the egg sac seem to be suitable for emergence of the larvae from the sac. Hence in this paper hatch and emergence are considered to be synonymous. The question — why does hatch decrease when the pores have emptied of water? — still remains unanswered. The purpose of this work is to examine this problem, to determine the effect of high suction on survival of larvae and of eggs in differing stages of development and consequently to ascertain whether the egg sac provides any substantial protection against desiccation. Finally a hypothesis is put
forward on the basis of these results to explain the relationship between hatch, soil moisture, soil type and damage to agricultural crops.

MATERIALS AND METHODS

Batches of 50 egg sacs on small aluminium discs 1 cm diameter were placed in each of nine air-tight glass vials containing various saturated solutions so as to provide relative humidities ranging from 50.5 to 98.0% (Winston & Bates, 1960). Drops of water of about the same initial weight as the egg sacs were set up in a similar way. The egg sacs and water drops were weighed at 30 min intervals for 3 hrs and at wider intervals for a further 16 hrs. Probit analysis of the curves enabled the time for a 50% loss of water to be calculated. Each weighing took only 5 sec and did not cause any major error. The relative humidities were transposed to cm of water suction and the results were expressed graphically (Fig. 1a).

To determine the effect of low suctions on the moisture relations of egg sacs, a vertical plastic tube 3 cm long and 0.5 cm diam. was inserted over the end of a glass tube containing a sintered plate. The plastic tube and the glass tube above the sintered plate were then filled with a fine grade alumina. Plastic tube was connected to the bottom of the glass tubing and the whole system filled with water to give a system for exerting suction on the water-alumina column as described previously (Wallace, 1958). The alumina retained water in its pores against suctions of 250 cm of water. Individual egg sacs, 1.5 mm in diameter when saturated, were embedded in the surface of the alumina and covered with a coverslip to prevent evaporation. Suction was exerted and after 15 min the maximum width of the egg sac was measured. The observations were repeated on sixteen further egg sacs at suctions ranging from 10 to 215 cm of water.

To study the influence of high suctions on survival of larvae and subsequent embryonic development and hatch in water, the organisms were placed on a glass slide and excess water was allowed to evaporate before they were placed in an airtight container over a saturated solution of potassium dichromate that gave an atmosphere of 98% relative humidity or 28 × 10^3 cm of water suction (wilting point of soil, 15 × 10^3 cm of water). The hatch from egg sacs at various suctions was determined by methods described previously (Wallace, 1966b).

The influence of cohesion between particles on the migration of larvae was studied by measuring the downward movement of larvae through fine glass beads at various suctions from 0 to 80 cm of water. Over this range the pores retained water but as has been demonstrated previously (Wallace, 1966b) the cohesion between particles increases so that the force required to move the particles increases. Suction in the glass beads was exerted using the standard sintered tube technique.

All experiments were done in darkness in an incubator at 27°C. Where necessary data were analysed statistically after transformation of percentages to angles of equal information.