THE INFLUENCE OF MOISTURE STRESS ON THE DEVELOPMENT, HATCH AND SURVIVAL OF EGGS OF MELOIDOGYNE JAVANICA

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In non-electrolytes hatch decreased with increase in osmotic potential until it was almost zero at 12.5 atmospheres. In electrolytes the results were less consistent. The optimum osmotic potential in glycerol for larval emergence from the egg sac was 0.2 atmospheres. In 'perlite' of particle size 250-500 µ maximum emergence occurred at 0.05 atmospheres corresponding to the point of inflexion of the moisture characteristic of the 'perlite'. Little emergence occurred at suction or osmotic potentials of about 15 atmospheres. In glycerol hatching was almost zero at about 11 atmospheres and embryonic development stopped at about 15 to 20 atmospheres osmotic potential. Hatched and unhatched second stage larvae were more resistant to high osmotic potential than earlier developmental stages, although second stage larvae became inactive sooner. Second stage larvae became quiescent under dry conditions and probably have a physiological mechanism for conserving water. Embryos and first stage larvae resist desiccation by means of the impermeable vitelline membrane. It is suggested that prior to hatching second stage larvae secrete enzymes that dissolve the water resisting vitelline membrane.

Soil moisture stress is defined here as the total potential of the soil water energy whose chief components are suction potential and osmotic potential. Collis-George & Sands (1962) have defined these terms and compared their influence on plant behaviour. Wallace (1956) and Dropkin, Martin & Johnson (1958) state that the hatch of some species of plant nematodes stops at osmotic pressures of 15 to 16 atmospheres which corresponds to the total potential of soil water when plants permanently wilt; these authors assumed that osmotic and suction potentials were interchangeable in their quantitative influence on the nematode eggs. Suction and osmotic potential were not comparable in their influence on the expulsion of larvae from galls of Anguina agrostis (Collis-George & Blake, 1959) or on the migration of Ditylenchus dipsaci (Blake, 1961). One of the objectives of this paper is to try and resolve this problem.

There is little information on the influence of moisture stress on embryonic development in the egg. Dropkin and colleagues (1958) found that larval mobility in the egg and hatch were inhibited at lower osmotic potentials than embryonic development so providing a mechanism for survival in dry soil. Wilson (1957) obtained similar results with the animal parasitic nematode Trichostrongylus retortaeformis but interpreted his results in terms of an ionic effect. Wilson suggested that the permeability of the egg to water and, consequently, hatch were controlled by the ions in solution. This paper attempts to throw further light on this aspect of the hatching process in Meloidogyne javanica (Treub).
The survival of eggs of *M. javanica* in dry conditions is probably determined by the protection afforded by the egg membranes and the egg sac. Experimental evidence here suggests how this may be achieved.

**MATERIALS AND METHODS**

Egg sacs of *M. javanica* were removed from tomato roots grown in pots in the glasshouse. To obtain suspensions of free eggs, egg sacs were teased open in a drop of water, immersed in 0.12 per cent sodium-hypochlorite, agitated in a vibro-mixer at maximum speed for 3 min., sieved to remove remains of egg sacs and centrifuged three times in sterile distilled water at 150 g for 5 min. The suspension contained few larvae and little extraneous material.

To obtain larvae, egg sacs were placed in a thin layer of water about 1 mm deep in petri dishes in the dark at 25° C and larvae that emerged over 3 days were used in experiments.

The strengths of electrolytes and non-electrolytes were calculated from the data of Robinson & Stokes (1949).

Emergence of larvae from egg sacs was studied using replicate batches of ten egg sacs immersed in 2 ml of solution in solid watch glasses with glass lids. The rate of hatching was measured using polystyrene rings covered at one end with filter paper and floated on the solution in solid watch glasses (Bird & Wallace, 1965). Emergence at different suctions in perlite was studied by the sintered tube method (Wallace, 1954) and mobility by assessing the percentage of larvae moving downwards in a tube 2.5 cm long and 0.5 cm in diameter filled with saturated sand of particle size 150-250 μ (Wallace, 1958b). In hatching experiments aliquots of about 200 eggs were used per replicate and a similar number of larvae was used in the mobility experiments. All experiments were kept at 25° C in the dark with four replicates per treatment. Percent larval hatch from egg sacs was determined after eggs remaining in the egg sac had been removed by the hypochlorite treatment and counted. Where necessary data were analysed statistically by analysis of variance after transformation of percentages to angles of equal information (angle = \( \arcsin \sqrt{\frac{\text{percentage}}{100}} \)).

**RESULTS**

*Influence of osmotic potential on hatch and emergence of larvae from egg sacs*

There was no significant difference between the hatch in deionised distilled water and any of the solutions at 2.5 atmospheres osmotic potential (Fig. 1). As osmotic potential increased, hatch decreased until at 12.5 atmospheres in the non-electrolytes (sucrose, glycerol, glycine and urea) it was almost nil. In the electrolytes a less consistent picture emerged e.g. in Na₂SO₄ hatch at 2.5 atmospheres was significantly less than that in water (p = .02); in KI hatch was almost nil at 5 atmospheres and in CH₃COONa at 7.5 atmospheres. Unlike the data of