THE SURVIVAL OF DESICCATED LARVAE OF HETERODERA ROSTOCHIENSI S AND H. SCHACHTII

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Second-stage larvae of H. rostochiensis survived desiccation better, at all relative humidities, than larvae of H. schachtii. Using interference microscopy, it is shown that the H. schachtii larvae lose water at a significantly higher rate than the larvae of H. rostochiensis. The differences may be correlated, at least in part, with differences in the ability of the cysts of these species to survive desiccation.

It is well known that Heterodera species differ considerably in the ability of their cysts to survive desiccation. H. rostochiensis Woll. cysts are viable after 5 years dry storage (Ellenby, 1955) while those of H. avenae are particularly sensitive to drying (Winslow, 1955). H. schachtii Schmidt is also susceptible (Wallace, 1955; Viglierchio, 1961) though less so than H. avenae. As this ability may bear “some relation to the proportion of larvae that hatch in water” in the different species (Shepherd, 1965) it is possible that differences in desiccation survival may involve, at least in part, differences between the larvae.

A comparison of desiccation survival of the second-stage larvae of H. rostochiensis and H. schachtii showed that both forms are poor at surviving desiccation (Kämpfe, 1959). The purpose of that work was, largely, to demonstrate the importance of the cyst to the survival of these forms, but the results suggested that the larvae of H. schachtii were somewhat better at surviving than those of H. rostochiensis. This would be surprising: apart from the better survival of H. rostochiensis cysts, the larvae of this species are at least as likely to encounter dry conditions in the light soils which their hosts prefer. The fact that the water content of single larvae may be estimated by interference microscopy (Ellenby, 1968 a) justified a re-examination of the question.

MATERIALS AND METHODS

In general, techniques were similar to those already described (Ellenby, 1968 a, b).

The second-stage larvae used had emerged within the 24 hours prior to an experiment: H. schachtii larvae, from cysts immersed in tap-water, and larvae of H. rostochiensis from cysts stimulated by an appropriate glass-distilled water dilution of a hatching concentrate. Larvae of both species were transferred to tap-water before a test.
Kämpfe (1959) exposed larvae of these species to different relative humidities for periods of 10 min: the time of survival at different humidities is, perhaps, more informative. Accordingly, the $S^50$, that is, the time of exposure which 50 per cent of the larvae would survive, was determined for each of a series of relative humidities (Ellenby, 1968 b).

A number of larvae were transferred to tap-water on a slide. All superficial water was carefully removed with filter paper, and the slide then placed in a glycerol constant humidity chamber (Grover and Nichol, 1940). Wherever possible, both species were studied simultaneously, a series of slides being left at relative humidities (R.H.) from 20 to 100 per cent for varying times. Tap-water was then added to the larvae and their revival checked after 24 hours. For each relative humidity, the tests were repeated until the time of exposure which 50 per cent of the larvae would survive was determined. Because larvae are only able to survive for a matter of minutes at most humidities, the experiments were carried out at room temperature. Glycerol chambers maintain their humidity independently of temperature (Grover and Nichol, 1940), but the influence of temperature is not excluded.

Water content of certain of the specimens from the constant humidity chambers was estimated by interference microscopy (Ellenby, 1968 a, b).

RESULTS

Values for the time of exposure which 50% of the larvae survived ($S^50$) are plotted against R.H. in Fig. 1 for the two species: the curve for *H. rostochiensis* has already been presented (Ellenby, 1968 b). Only brief exposures are survived at most humidities; for example, at 22% R.H. the $S^50$ is 17 min for *H. rostochiensis*, and even at 75% R.H. it is only 28 min. But, clearly at all relative humidities, survival of the *H. rostochiensis* larvae is better than that of the *H. schachtii* larvae.

As already mentioned, in order to determine values of $S^50$ for the different humidities, repeated tests were necessary, in which the time of exposure was varied. The tests gave remarkably consistent results; in fact, when the work was advanced, and the form of the curves had more or less taken shape, "predicted" values for $S^50$ were frequently found to agree with subsequent experimental results.

The evidence that *H. rostochiensis* larvae were somewhat better at surviving desiccation than *H. schachtii*, suggested that the rate at which they lost water might be different. Accordingly, 9 *H. schachtii* and 11 *H. rostochiensis* larvae were individually dried for 1 hour at 94% R.H. and 18°C and their water content estimated by interferometry (Ellenby, 1968 a, b): it was thought that a comparison between the species at this relatively high humidity would approximate to conditions which could occur in the field. The results showed that under these conditions, the *H. schachtii* larvae lost more water than the *H. rostochiensis* larvae. The difference was very readily detectable: after an hour at 94% R.H., most