EFFECT OF TEMPERATURE ON THE TIME REQUIRED FOR HATCHING AND DURATION OF LIFE CYCLE OF FIVE MYCOPHAGOUS NEMATODES

BY

J. K. PILLAI AND D. P. TAYLOR

Department of Plant Pathology, University of Illinois, Urbana, U.S.A.

The effect of seven temperatures between 10 and 30° C was studied on the shortest time required for hatching, development to egg-laying females, and completion of one generation using Aphelenchus avenae, Neotylenchus linfordi, Paraphelenchus acontioides, and two isolates of a species of Ditylenchus. Minimum time required for the first egg to hatch and the first larva to develop to an egg-laying female in any one of the replicates was used as the criterion for assessing the effect of temperature on hatching and duration of life cycle. Time necessary for each process decreased as temperature increased until a minimum was reached above which the time required again increased or the temperature was lethal. The shortest generation times were at 25° for N. linfordi, 30° for the two isolates of Ditylenchus sp., and 35° for A. avenae and P. acontioides. No development occurred at 39° for any species, and although hatching occurred at 10°, in no case was the life cycle completed during the course of the experiment.

Since Christie (1933) demonstrated that certain stylet-bearing nematodes could complete their life cycles on fungus cultures, many other workers (e.g., Christie & Arndt, 1936; Hirschmann & Sasser, 1955; Franklin, 1957; Goodey, 1958; Faulknier & Darling, 1961; Hechler, 1962a; Townshend, 1964; and Cayrol, 1967) have shown that additional species can be reared on fungi in the laboratory. Nevertheless, little attention has been given to the effects of temperature on the length of life cycle, or portions of it, of mycophagous nematodes. This paper describes the effect of seven temperatures on the time necessary for hatching and subsequent egg-laying for five mycophagous nematode isolates.

MATERIALS AND METHODS

Nematodes used in this study were isolated at various times from soil in Illinois and stock cultures were maintained at room temperature, on the fungus Pyrenochaeta terrestris (Hans.) Gorenz, Walker & Larson, growing on one-quarter strength Difco Potato Dextrose Agar in petri dishes in the Department of Plant Pathology, University of Illinois, Urbana. Nematodes investigated included: Neotylenchus linfordi Hechler; Aphelenchus avenae Bastian; Paraphelenchus acontioides Taylor & Pillai; and two isolates, one bisexual reproducing and the other parthenogenetic, of a species of Ditylenchus closely resembling D. triformis Hirschmann & Sasser.
To obtain freshly laid eggs, a piece of agar from a stock culture containing many gravid females was teased apart in water and 50 to 60 females were rapidly transferred to water in a Bureau of Plant Industry watch glass. After 10 to 15 eggs had been deposited, the females were removed from the dish; thus, eggs in the same dish were of approximately the same age. In no case were females left in a dish for longer than 30 minutes. Immediately after removal of the females, the dishes containing eggs were moved to a cold storage room maintained at 5° and placed in incubators present at 10°, 15°, 20°, 25°, 30°, 35°, and 39°. Observations, made at 4-hour intervals or longer depending on the stage of development, were made within the 5° room so that the eggs were never exposed to temperatures higher than that of the incubator. Since this experiment was designed to detect the minimum time necessary for hatching at a given temperature, no data were taken after hatching of the first larva was detected. This experiment was replicated three times.

To determine the interval between hatching and subsequent egg-laying, eggs were collected as above and allowed to hatch at room temperature. Ten freshly hatched larvae were transferred to each 60 x 15 mm plastic petri dish containing approximately 7 ml of full-strength Difco Potato Dextrose Agar which had previously been inoculated with small plugs of P. terrae. One plate as described was placed in each of the seven incubators mentioned above and the experiment replicated three times. Observations were made as in the hatching study, and the time at which earliest egg-laying was detected was recorded.

RESULTS AND DISCUSSION

As shown in Fig. 1, minimum time required for hatching of eggs and subsequent development to egg-laying was greatly influenced by temperature. The time required for both of these processes decreased with an increase in temperature until a minimum was reached. Any further temperature increase either prolonged the time required or resulted in death. The minimum time for hatching was obtained at 35° for all species tested except N. linfordi for which the minimum time was achieved at 25°. In the latter species an increase in time required for hatching was detected at 30°. This phenomenon was not detected in other species perhaps because the next higher temperature increment was lethal; however, this phenomenon had been previously reported to occur in A. avenae (Taylor, 1962). A minimum temperature for hatching was not determined in this study and eggs of all species hatched at 10°, the lowest temperature used.

The minimum times for hatching and subsequent development to egg-laying were obtained at the same temperature for two species; 25° for N. linfordi and 35° for A. avenae. In the other nematodes the minimum time for development to egg-laying females occurred at lower temperatures than the temperatures at which hatching occurred most rapidly. Thus, for P. acintioides and both isolates of Ditylenchus sp., these processes appear to have different optima.

Although these experiments were designed to measure the direct effect of tem-