DEVELOPMENT OF GLOBODERA ROSTOCHIENSIS UNDER SIMULATED NORDIC CONDITIONS

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Development of Globodera rostochiensis was studied in growth cabinets with soil temperatures simulating conditions at the Arctic Circle in Finland, in central and southern Finland, and in southern Sweden. Within three months the nematode succeeded in completing its life cycle in the warmest treatment only. This treatment was followed by the two cooler treatments with about one week's difference in development between them. Development was arrested in the coldest conditions apparently because of low initial temperature and low rate of heat accumulation during the experiment. Based on the results, the use of early potatoes and early harvesting as a supplementary control method against the potato cyst nematode in central and northern parts of Fennoscandia is discussed.

Keywords: potato cyst nematode, hatching, life-cycle, temperature, heat accumulation, Fennoscandia.

Temperature ranges for hatching and development of the potato cyst nematodes (PCN), Globodera rostochiensis (Woll.) and G. pallida (Stone) have been frequently discussed. Hatching at temperatures as low as 4.5°C (40°F) was reported from Long Island (Feldmesser & Fassuliotis, 1950). Jones & Parrott (1969) assumed the basal developmental temperature to be 4.4°C in Britain for G. rostochiensis. Several authors have quoted 10°C as the lower limit of hatching and development for G. rostochiensis (Ferris, 1957; Ellenby & Smith, 1975; Hominick, 1979, 1982). In general, temperatures above 15°C have been reported to favour development of G. rostochiensis (Ferris, 1957; Foot, 1978; Mugniery, 1978; Franco, 1979; Hominick, 1979, 1982; Inagaki, 1984). However, it is proposed that development of nematodes is controlled by the rate of heat accumulation rather than by temperatures, except in situations of extreme temperatures (Jones & Parrott, 1969; Jones, 1975).

Observations reported above originate from studies performed at latitudes south of the Nordic countries. Problems with PCN have been known in Fennoscandia ever since the first half of the 20th century (Kemner, 1929; Vappula, 1954; Stoen, 1956). Now, the potato cyst nematode, G. rostochiensis, is known to be widely spread in these countries, and has been reported as far north as the Arctic Circle (Sarakoski, 1976b). So far, nothing is known about the adaptive capacity of G. rostochiensis to climatic conditions of northern Fennoscandia. The fact that this species is at present most successful south of
latitud e 64°N (Andersson, 1975, 1983; Sarakoski, 1976a) suggests that northern Fennoscandia remains a marginal area for its establishment. However, as production of clean seed potatoes is concentrated in this area, it is important to study the potential of *G. rostochiensis* to establish itself there. During the late 1970s a *G. rostochiensis* population at the Arctic Circle in Finland was observed to decrease, possibly a result of prevailing cooler conditions (Magnusson, 1984).

The present study is a follow-up of field experiments previously performed in northern and southern parts of Finland (Magnusson, 1984), and aims at investigating the combined effect of heat accumulation and day length on population development of *G. rostochiensis*.

**MATERIALS AND METHODS**

The developmental rate of the yellow potato cyst nematode, *G. rostochiensis*, was studied in growth cabinets with fluctuating temperatures. The rate of heat accumulation about 3-5 cm deep in soil is presented in Fig. 1. The basal temperature was 6°C. Soil temperatures were increased weekly by 1 degree, except for weeks 6-9 when temperatures were increased by 1°C at two-week intervals. The night temperatures were 3°C lower than the corresponding day temperatures. Soil temperatures were based on Finnish meteorological data for the Arctic Circle and southern Finland. In the experiment the coldest treatment (A) corresponds to conditions at the Arctic Circle, and treatment C to the climate in south Finland. Temperatures in treatments B and D were adjusted to simulate the conditions of Central Finland and southern Sweden respectively. Light periods in the cabinets simulated approximately the day lengths of the same areas. Thus, the light period in treatment A was extremely long with only a few hours of twilight in the middle of the night. The twilight-darkness period increased successively towards the warmer conditions.

Potato cv. Magnum Bonum was grown in plastic pots for 14 weeks in PCN infected soil obtained from a potato field near Uppsala (latitude 60°N). The initial population density was 35 eggs and juveniles per gram soil. Weekly sampling of four pots was made. Parameters measured were: a) 2nd stage juveniles in soil, b) 2nd stage juveniles in roots, c) 3rd-4th stage juveniles in roots, d) females and males in roots, e) cysts in soil, and f) viable eggs and juveniles in cysts. For extraction of juveniles from soil a Baermann funnel was used. When counting different stages in lactophenol-cotton blue-stained roots, the Marks and McKenna method (Marks & McKenna, 1981) was modified by using a 60-mesh sieve instead of the 85- and 250-mesh sieves normally used. Finally, the nematodes were collected from the suspension washed through the 60-mesh sieve. The cysts were extracted with Fenwick cans. The numbers of viable eggs and juveniles within the cysts were estimated after crushing the cysts and staining the contents with New blue R (Shepherd, 1962).