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ROOT DIAMETER INFLUENCES FEMALE SIZE IN THE CYST NEMATODE, *HETERODERA SCHACHTII*

by

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Summary. The size of adult female *Heterodera schachtii*, the sugar beet cyst nematode, is correlated with the diameter of the host root at the site of infection. The results of a brief investigation suggest that the growth and development of plant parasitic nematodes is influenced by variations in the morphology of host infection site.

The growth and development of cyst-forming, plant parasitic nematodes is influenced by nutrient availability from the host plant. Koliopanos and Triantaphyllou (1972) reported that at high infection densities of *Heterodera glycines* on the host, fewer juveniles developed into females on smaller branching roots than on larger primary roots. Their observations suggested that nematode infections on proximal roots impeded nutrient transport to developing nematodes on distal roots, leading to unfavourable host conditions and the subsequent production of fewer females. High infection densities have also been shown to decrease the rate of juvenile development (McClure and Viglierchio, 1966). Moreover, the proportion of juvenile *Globodera rostochiensis* or *Heterodera schachtii* that developed into females was shown to decrease in response to a reduction of nutrient supply available to host roots (Trudgill, 1967, Grundler *et al.*, 1991). Melakeberhan and Ferris (1988) demonstrated that the use of a "moderately resistant" host caused a significant decline in energy consumption and egg and gelatinous matrix production in *Meloidogyne incognita*, which provided further evidence of the effects of host condition on nematode development. In addition, variations in morphometric characters, particularly body length, in plant parasitic nematodes have been shown to be dependent on host species (Goodey, 1952; Bird and Mai, 1967).

The influence of host condition on the development of plant parasitic nematodes is clear, but a correlation between infection site morphology and nematode growth has not been examined. The objective of the present investigation was to determine if there is an association between the size of *H. schachtii* females during their development and the size of the host root at the site of infection. It is hypothesized that larger roots, having a larger vascular cylinder, provide developing juveniles with a greater supply of nutrients than smaller roots, thus promoting the growth of larger females.

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Materials and methods

Stonehead cabbage seedlings (*Brassica oleracea*, L. cv. *capitata*) were grown in transparent growth pouches (Mega International, Minneapolis, MN, USA) in a glasshouse at 18 °C and 16 h day length, and infected with 200 *H. schachtii* Schmidt juveniles (J2) per seedling. After 21 days, the pouches were placed directly onto a microscope stage (Dialux 20, Wild-Leitz, Wetzlar, Germany). A calibrated micrometer was used to measure the size of 30 randomly selected adult *H. schachtii* females, excluding the gelatinous matrix, and the diameter of the root at the corresponding site of infection. Females were measured before they entered the brown cyst stage to prevent detachment from the root during measurement or shrinkage of the females (Wilson, 1971). Female length was taken as the distance from the posterior extremity of the vulval cone to the anterior end. The width of the female was measured at its thickest region. The product of female length and width along the sagittal plane provided a value, in units of area (mm^2), that gave an estimate of female size. The diameter of the root cortex was measured 0.5 mm distal to the corresponding site of infection to avoid measuring lesioned root tissue enlarged by the action of infective nematodes. Female size was compared to root diameter using a linear regression model at 95% confidence.

Results and discussion

Females began to emerge 14 days after infection and developed normally into brown cysts after the experimental period. Regression analysis revealed a significant correlation ($P<0.0001$) between the diameter of the root 0.5 mm distal to the infection site and adult *H. schachtii* fe-

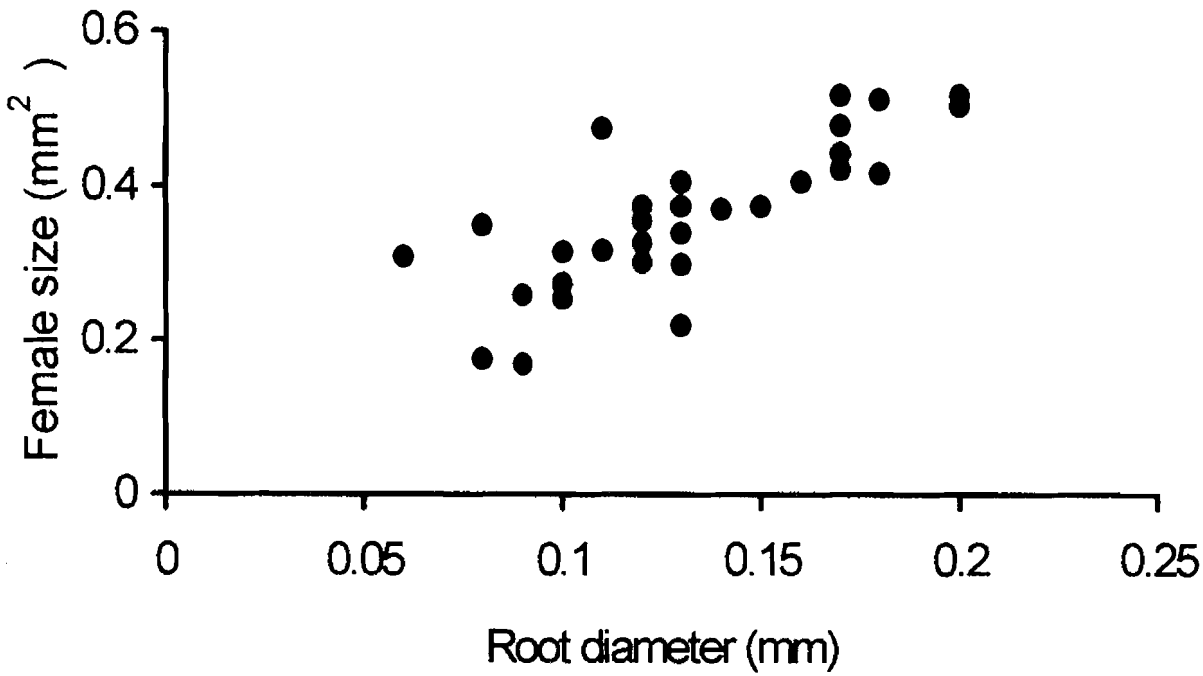

Fig. 1 Correlation between *Heterodera schachtii* female size and root diameter 0.5 mm distal to host plant infection site. Each point (n = 30) represents one *H. schachtii* female. Female size was estimated by the product of length and width. Variables are correlated, as determined by a linear regression analysis with 95% confidence: y = 2.06x + 0.09, $R^2 = 0.62$, $F = 44.68$, $P < 0.0001$.

male size 21 days after infection (Fig. 1). Large females developed on large roots, presumably because of the greater capacity of these roots for the transport of nutrients to developing females, and small females developed on small roots. Nutrient availability has been correlated with growth and development in *M. incognita* (McClure and Viglierchio, 1966) and this may have affected the growth of *H. schachtii* in the present study. Furthermore, the difference in size among females may be directly attributable to the number of eggs produced and retained by each female, which is related to feeding time and nutrient availability (Cook, 1977).

Linford (1941) observed that *M. incognita* females appeared to develop to a larger size on large veins of leaflets on the cowpea, suggesting that female size at maturity may have been related to host feeding site. Furthermore, Hollis (1963) suspected that a relationship between nematode development and root diameter may have existed. These results have verified that the size of the host root at the site of infection is correlated with female size in developing *H. schachtii*. They also suggest that variations in the morphology of infection sites within a single host species may influence the growth and development of plant parasitic nematodes.

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