Effect of Heterodera schachtii Infection on Sugarbeet Leaf Growth

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ABSTRACT

A significant increase in petiole length was observed in nematode infected over noninfected sugarbeet plants, 8 and 9 weeks after inoculation with *Heterodera schachtii* larvae. The average size of the spongy parenchyma cells of the petioles (measured with a phase contrast microscope) was significantly greater in the nematode-infected plants (1.44×10^{-4} mm^2) than in healthy plants (0.79×10^{-4} mm^2). A highly significant correlation coefficient of 0.89 was obtained between cell size and length of the petioles. No difference was found in the lower epidermal cells of the leaf between healthy and nematode-infected plants. Phytopathology 61:40-41.

Additional key words: nematode, petiole, growth-promoting substance.

Over the past few years, the authors observed that petioles of nematode-infected hybrid sugarbeets are longer than those of noninfected plants. Daley & Sayre (2) reported a similar response in safflower hypocotyls infected with *Puccinia carthami*. He attributed the greater elongation of hypocotyls in infected plants to the higher auxin levels found in infected plants (1). Since *Heterodera schachtii* Schm. attacks the fibrous roots of sugarbeets, a stimulating response on other plant parts is of major interest. This study was initiated to measure the stimulation of sugarbeet leaf growth by nematode invasion.

Petiole lengths of nematode-infected and noninfected sugarbeet plants of hybrid F58-554H1 (test 3) and inbred 52-305 (test 1 and 2) were measured in three tests conducted in the greenhouse in steam treated soil. Tests 1 and 2 were in a randomized block design with six replicates of six plants each (test 1) and eight replicates of two plants each (test 2). Test 3 was completely randomized, with 16 plants/treatment. Nematode inoculum (7) in tests 1 and 2 was 10 larvae/g of soil, while in test 3 it was 0.4, 2.0, and 10.0 larvae/g of soil. Beginning 4 weeks after planting, larvae were added each week for 5 weeks. Increasing numbers of larvae were added in ratios of 2:3:4:5:6 with initial inoculations of 80, 400, and 2,000 larvae for 0.4, 2.0, and 10.0 larvae/g of soil, respectively.

Induced elongation of the petioles was not observed until approx 2 months after the first inoculation. The effect was most pronounced during the 8th and 9th weeks, but was evident for about a 4-week period. Thereafter, severe wilting developed at the 10.0 larvae/g of soil level, with many leaves dying and no measurable nematode effect on petiole length. Petiole length had increased significantly during the 8th and 9th weeks after inoculation for 10.0 larvae/g of soil, and also for 2.0 larvae/g of soil in test 3 (Table 1).

All leaves (blades and petioles) measured in test 2 were saved for cell-size measurements. Longitudinal sections of the same region of all petioles were killed and fixed in Craf III solution (5). Tissue sections were embedded in paraffin, sectioned, and examined with a phase contrast microscope. An ocular grid was used to make three counts of spongy parenchyma cells for each petiole. The average cell size was computed from the magnification, grid-size, and number of cells. The average size of the spongy parenchyma cells of the petioles was significantly greater in the nematode-infected plants (1.44×10^{-4} mm^2) than in healthy plants (0.79×10^{-4} mm^2). The LSD 5% was $.30 \times 10^{-4}$. A highly significant correlation coef of 0.89 was obtained between cell size and length of the petioles.

Sections of the lower epidermis of the leaves were stripped off, mounted on slides, and photographed. The resulting negatives were projected on a gridded screen, and the number of cells and stomata in a given grid counted. The number of epidermal cells and stomata did not differ between healthy and nematode-infected plants.

These data indicate that nematode-infection induces cell elongation in the sugarbeet petiole about 8 or 9 weeks after inoculation, which suggests the involvement of a growth-promoting substance. Moriarty (4) suggested that auxin activity could be responsible for the bearding of nematode-infected sugarbeet roots. Viglierchio & Yu (6) suggested that indoleacetic acid, indoleacetonitrile, and indoleacetic acid ethyl ester may exist in second stage *H. schachtii* larvae, but could detect no growth regulator activity in cysts or either uninfected or heavily infected sugarbeet roots. In second stage larvae of *H. schachtii*, Johnson & Viglierchio (3) described an auxin with an R_F value similar to that of indoleacetic acid. In the present study, there was no attempt made to detect growth promoting substances.

TABLE 1. Mean petiole length (cm) of healthy and *Heterodera schachtii*-infected sugarbeet plants 8 and 9 weeks after inoculation

Larvae/ g soil	Test 1[a]		Test 2[b]	Test 3[a]
	8[c]	9[c]	9[c]	8[c]
0.0	8.5	8.0	8.7	10.0
0.4				10.2
2.0				11.1
10.0	10.9	10.7	11.4	10.8
LSD .05	1.1	1.1	2.0	0.2

[a] All petioles on plants were measured.
[b] Every third petiole was measured.
[c] Weeks after inoculation began.

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