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Penetration of *Crotalaria juncea*, *Dolichos lablab*, and *Sesamum indicum* Roots by *Meloidogyne javanica*[1]

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Abstract: Penetration of *Crotalaria juncea* (PI 207657 and cv. Tropic Sun) *Dolichos lablab* cv. Highworth, and *Sesamum indicum* by juveniles (J2) of *Meloidogyne javanica* was assessed to investigate the mechanism by which these plants may reduce nematode numbers in the field. Growth chamber experiments were conducted at 25 C, with vials containing 90 g sand infested with 450 J2; tomato (UC 204 C) was included as a susceptible host. Fifteen days after inoculation, roots were stained and the nematodes within stained roots were counted. Both *C. juncea* lines were highly resistant to penetration, as they contained significantly fewer nematodes per cm of root and per root system than the other plants. Although containing more nematodes per cm of root than *C. juncea*, *S. indicum* and *D. lablab* had significantly fewer nematodes per root system and per cm of root than tomato. Roots were significantly longer in the plants with the lowest nematode penetration. Although *C. juncea*, *D. lablab*, and *S. indicum* may have potential utility as cover or rotation crops in soil infested with *M. javanica*, further quantitative information on the reproduction of *M. javanica* and other nematodes in these plants is needed.

Key words: cover crop, *Crotalaria juncea*, *Dolichos lablab*, host status, *Meloidogyne javanica*, nematode, penetration, resistance, rotation, *Sesamum indicum*.

Environmental concerns, health hazards, and high costs of nematicides have stimulated research on alternative nematode management practices for plant-parasitic nematodes (5,8), including crop rotation and cover crops (6,12,13). Despite the wide host range of the root-knot nematode *Meloidogyne javanica*, it can sometimes be controlled by a suitable cover crop or crop rotation. For example, *Crotalaria juncea* L. (4,11,14), *Sesamum indicum* L. (12,13, 16), and *Dolichos lablab* L. (4) have reduced root-knot nematode numbers in soil.

Although growing *D. lablab*, *C. juncea*, or *S. indicum* can reduce nematode numbers in soil, the mechanism of the reduction is unknown. This research was conducted to determine if root penetration is involved in the mechanism and to assess the host status of these plants to a California population of *M. javanica*.

Materials and Methods

Treatments included the following plants: *C. juncea* PI 207657 (accession from USDA Southern Regional Plant Introduction Station, Griffin, GA) and *C. juncea* cv. Tropic Sun, *D. lablab* cv. Highworth, *S. indicum*, and *Lycopersicon esculentum* Miller cv. UC 204 C. Seeds were germinated at 25 C on moist Whatman No. 4 filter paper in 9-cm-d petri dishes. One germinated 4-day-old seedling was then transplanted into each of 25 plastic vials (20 dram snap-cap, Baxter Diagnostics, Hayward, CA) containing 90 g of autoclaved white silica sand (No. 60, Corona Industrial Sand Co., Corona, CA). The bottoms of the vials were perforated once (3.0-mm hole), and a 2.5-cm-d nylon mesh patch was inserted to prevent sand loss.

The vials were placed in open plastic boxes in a growth chamber at 25 C with 12 hours light per day from two F40CW lamps. A completely randomized design was used with five plant treatments and five replications. The experiment was conducted three times (trials 1–3).

Two days after seeds were transplanted, the vials were infested with a hydroponically cultured (7) *M. javanica* suspension containing approximately 450 J2, providing a population density of 5 J2/g sand. Following inoculation, and daily thereafter, each vial was irrigated with distilled water.

Fifteen days after inoculation, roots were rinsed free of sand, root lengths were

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measured, and the entire root system was cleared and stained with acid fuchsin (1). Root systems were pressed between glass plates (7.5 × 5.0 cm), and the nematodes in the roots were counted at 40× magnification.

Because the data lacked normality and homogeneity of variance, they were log-transformed ($\log_{10}$) and subjected to analysis of variance and mean separation using the Waller–Duncan test (15). The means of non-transformed data are presented.

Results

The interaction between experiments and cultivars was not significant for root length ($F = 0.63$, $P = 0.75$), nematodes per root system ($F = 0.58$, $P = 0.78$), or nematodes per cm of root ($F = 0.37$, $P = 0.93$). Accordingly, the data from all three trials were pooled for statistical analyses.

Root lengths of *D. lablab* and both *Crotalaria* lines were greater than those of *S. indicum* and *L. esculentum* ($P < 0.005$) (Fig. 1A). Tomato roots had significantly ($P < 0.05$) more nematodes than the other plant roots (Fig. 1B). *Dolichos lablab* and *S. indicum* roots contained more nematodes ($P < 0.05$) than either *Crotalaria* line. The lowest nematode penetration was observed in *Crotalaria,* 2.2 and 2.5 J2 per root system in Tropic Sun and PI 207657, respectively.

More ($P < 0.05$) nematodes per cm of root occurred in *L. esculentum* than in the other plants, and *S. indicum* and *D. lablab* had more ($P < 0.05$) nematodes per cm of root than did either *C. juncea* line (Fig. 1C).

Discussion

Previous research has shown that *Crotalaria* species can reduce numbers of *Meloidogyne* species (11,14,17) or other nematode species (2) in soil, and can yield up to 170 kg N/ha after 120 days growth (10). Similarly, *S. indicum* reportedly can reduce numbers of *M. javanica* (20), *M. arenaria* race 1 (12,13), *Heterodera glycines* race 4 (16), *Pratylenchus brachyurus* (12), and *Meloidogyne* spp. (9). The mechanism for this reduction in nematode numbers is unknown.

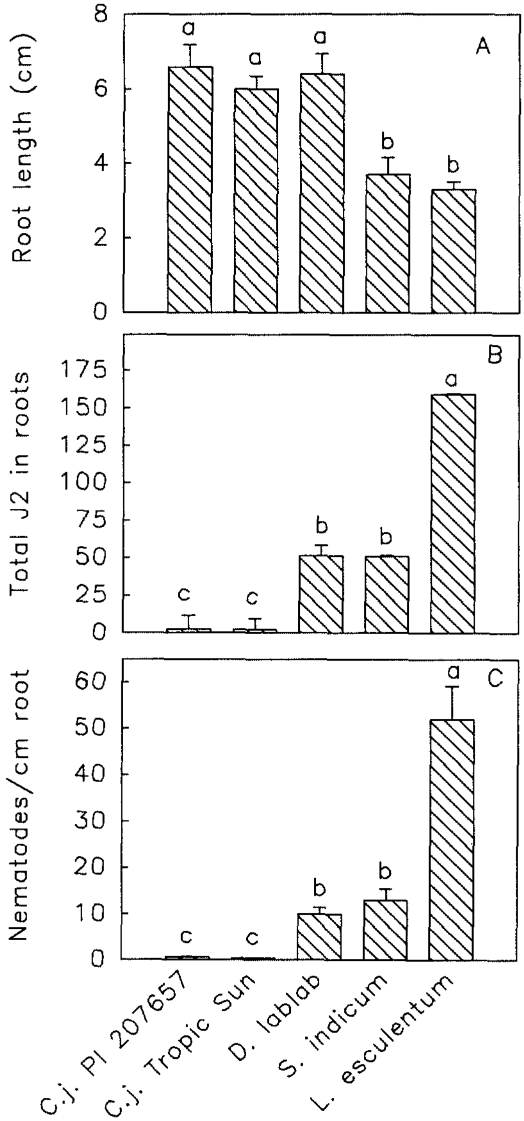

FIG. 1. Root lengths and number of nematodes in roots of five plants (*Crotalaria juncea* PI 207657 and 'Tropic Sun', *Dolichos lablab, Sesamum indicum,* and *Lycopersicon esculentum*) inoculated with 450 second-stage juveniles (J2) of *Meloidogyne javanica* 15 days after inoculation. A) Root length. B) Total number of J2 in roots. C) Number of J2 per cm of root. Data are means of 15 replicates ± SE. Values with the same letters are not significantly different ($P < 0.05$) according to the Waller–Duncan test.

Lack of root penetration by nematodes is a resistance mechanism (3). Because our results reveal that roots of *C. juncea, S. indicum,* and *D. lablab* are not readily penetrated by *M. javanica,* these plants may be considered as resistant to *M. javanica.* The low penetration may be partially responsible for reduced nematode numbers when *C. juncea, S. indicum,* and *D. lablab* are grown in the field. The observed differences in root penetration were not simply a result of differences in root biomass among the plants, because roots were longer in the species with the lowest nematode penetration. The use of small vials should have enhanced the nematode's ability to find roots while minimizing energy expenditure in locating roots. The experimental temperature of 25 C is within the optimal range (25–30 C) for *M. javanica* growth and reproduction (18) and should have been appropriate for root penetration. It is possible that the plant roots contained or secreted toxins that inhibited nematode penetration or motility, or that nematodes invaded the roots but left them after finding them unsuitable. Our experiments did not specifically address these possibilities.

Further quantitative information is necessary on the ability of *M. javanica* to reproduce on *C. juncea, S. indicum,* and *D. lablab* because even though penetration is low, reproduction may be high. Moreover, the use of any of these plants in rotations requires consideration of additional characteristics, such as suitability for crop production programs, ease of establishment, improvement of soil fertility and subsequent crop yield, water use, potential for erosion control, and susceptibility to other plant-parasitic nematodes, pathogens, or insects.

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