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Nonhost Root Penetration by Soybean Cyst Nematode[1]

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Abstract: A total of 66 plants in 50 species were inoculated with eggs and juveniles of soybean cyst nematode, *Heterodera glycines*. Roots were stained and observed for penetration and development of the nematode. Twenty-six plants were not penetrated; twenty-three were penetrated, but there was no development of the nematode; eight were penetrated with some nematode development; two were penetrated and had considerable nematode development, but few nematodes, if any, matured; and seven were penetrated with many nematodes maturing. The penetration of nonhosts may imply some susceptibility and that populations eventually would build up on the penetrated plants. Plants not penetrated may be useful as rotation plants because no reproduction would occur.

Key words: Heterodera glycines, nonhosts, soybean cyst nematode.

Endoparasitic nematodes are known to penetrate roots of plants that are not good hosts. Skotland (10) checked the invasion of soybean cyst nematode (SCN), *Heterodera glycines* Ichinohe, into a number of plants. Plants were divided into three categories: 1) no penetration, 2) penetration but no development, and 3) penetration and development of the nematodes. He was probably using race 1, as the population being used at that time came from Castle Hayne, North Carolina, a population later identified as race 1.

The purpose of this research was to determine penetration by a SCN race 3 population into roots of previously tested plants as well as additional untested plants.

Materials and Methods

Seeds of all plants to be tested were germinated in vermiculite and transplanted into fine sand in 7.5-cm-d clay pots, one plant per pot. After 48–72 hours, SCN race 3 inoculum, consisting of ≈ 4,000 eggs and second-stage juveniles (J2) in 2.5 ml water, was injected into the soil around the roots in each of five pots. The soybean *Glycine max* cv. Lee was used as a susceptible check. Plants were grown in a greenhouse at a temperature of 25–34 C.

Mature females and cysts were dislodged from the roots of greenhouse-grown Lee soybean and suspended in water. The suspension was poured through nested 850-μm-pore and 250-μm-pore sieves. Females, cysts, egg masses, and associated debris from the 250-μm-pore sieve were washed into a Waring blender to break the females and cysts and release the eggs and J2. The blended mixture was poured back through the 250-μm-pore sieve to remove unbroken females and cysts. Only eggs and J2 were used in the inoculum.

After 8 days, roots from two pots were washed free of sand and stained using bromphenol blue (3). The stained roots were observed at 30× magnification under a stereomicroscope. Plants were placed in five groups as follows: 1) no penetration, 2) penetration but no development, 3) penetration and development only to J3, 4) penetration and development to J4 but the number of adult females produced was less than 10% of the number on Lee soybeans, and 5) penetration and development of mature females > 10% of the number on Lee. Identification of *Heterodera* juveniles was made from 2–5 specimens teased from each root tissue. The stage of development was also determined. Third-stage juveniles were sausage shaped, and early fourth-stage juveniles were ovoid. Three pots were retained for 30 days to check for mature females (6,7).

Results and Discussion

The 66 plant species and varieties tested were divided into five groups based on the penetration and development of SCN. Group one included 26 plants from 21 gen-

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TABLE 1. Plants not penetrated by *Heterodera glycines* juveniles.

Common name	Cultivar	Scientific name	Family
Lettuce		*Lactuca sativa* L.	Compositae
Zinnia		*Zinnia* sp.	Compositae
Radish		*Raphanus sativus* L.	Cruciferae
Spinach		*Spinacea oleracea* L.	Cruciferae
Oats		*Avena sativa* L.	Gramineae
Rye		*Secale cereale* L.	Gramineae
Wheat		*Triticum aestivum* L.	Gramineae
Corn		*Zea mays* L.	Gramineae
Spanish peanut		*Arachis hypogaea* L.	Leguminosae
Jack bean		*Canavalia ensiformis* (L.) DC.	Leguminosae
Blue lupine	Bitter	*Lupinus angustifolius* L.	Leguminosae
Yellow lupine	Domestic	*L. luteus* L.	Leguminosae
Yellow lupine	Weiko III	*L. luteus* L.	Leguminosae
Sensitive vine		*Mimosa pudica* L.	Leguminosae
Pea	Romack	*Pisum sativum* var. *arvense* L.	Leguminosae
Winter pea	Austrian	*Pisum sativum* var. *arvense* L.	Leguminosae
Kudzu		*Pueraria lobata* (W.H.) Ohwi	Leguminosae
Wild bean		*Strophostyles helvola* (L.) Ell.	Leguminosae
Clover		*Trifolium vesiculosum* Savi	Leguminosae
Crimson clover		*T. incarnatum* L.	Leguminosae
Wooly pod vetch	Auburn	*Vicia dasycarpa* Ten.	Leguminosae
Common vetch	Doark	*Vicia sativa* L.	Leguminosae
Asparagus bean		*Vigna unguiculata* subsp. *sesquipedalis* (L.) Fruw.	Leguminosae
Strawberry	Albritton	*Fragaria* sp.	Rosaceae
Tomato	Manalucie	*Lycopersicon esculentum* Mill.	Solanaceae
Ornamental pepper		*Capsicum annuum* L. var. *abbreviatum*	Solanaceae

TABLE 2. Plants penetrated by juveniles of *Heterodera glycines* but in which no development occurred.

Common name	Cultivar	Scientific name	Family
Cantaloupe	Hale's Best	*Cucumis melo* L.	Cucurbitaceae
Cucumber	Model	*C. sativa* L.	Cucurbitaceae
Watermelon	Charleston Grey	*Citrullus lanatius* (Thunb.) Matsum Nakai	Cucurbitaceae
Squash	Butternut	*Cucurbita pepo* L.	Cucurbitaceae
Crotalaria		*Crotalaria spectabilis* Roth.	Leguminosae
Guar		*Cyamopsis tetragonoloba* (L.) Taub	Leguminosae
Hyacinth bean		*Dolichos lablab* L.	Leguminosae
Sweet pea		*Lathyrus odoratus* L.	Leguminosae
Blue lupine	Borre Sweet	*Lupinus angustifolius* L.	Leguminosae
Ornamental lupine		*Lupinus* sp.	Leguminosae
Alfalfa	Ranger	*Medicago sativa* L.	Leguminosae
Scarlet runner bean		*Phaseolus coccinneus* L.	Leguminosae
Pea	Popago	*Pisum sativum* var. *arvense* L.	Leguminosae
Rose clover		*Trifolium hirtum* All.	Leguminosae
White clover	Ladino	*T. repens* L.	Leguminosae
Wooly pod vetch	Oregon	*Vicia dasycarpa* Ten.	Leguminosae
Wooly pod vetch	Lana	*V. dasycarpa*	Leguminosae
Hungarian vetch		*V. pannonica* Crantz.	Leguminosae
Common vetch	Williamette	*V. sativa* L.	Leguminosae
Cowpea	Monarch	*Vigna unguiculata* (L.) Walp.	Leguminosae
Cotton	DPL 15	*Gossypium hirsutum* L.	Malvaceae
Strawberry	Midway	*Fragaria* sp.	Rosaceae
Pepper	Cal. Wonder	*Capsicum frutescens* L.	Solanaceae

TABLE 3. Plants penetrated by *Heterodera glycines* juveniles and in which slight development occurred.

Common name	Cultivar	Scientific name	Family
Turnip		*Brassica rapa* L.	Cruciferae
Alfalfa	Grimm	*Medicago sativa* L.	Leguminosae
Lima bean	Henderson Bush	*Phaseolus lunatus* L.	Leguminosae
Bean	Michelite	*P. vulgaris* L.	Leguminosae
Hairy vetch		*Vicia villosa* Roth.	Leguminosae
Cowpea	Black	*Vigna unguiculata*	Leguminosae
Cowpea	Victor	*Vigna unguiculata*	Leguminosae
Tomato	Rutger	*Lycopersicon esculentum* Mill.	Solanaceae

era in 6 families (Table 1). Group two consisted of 23 plants representing 17 genera in 5 families (Table 2). All Cucurbitaceae tested were in this group. Only eight plants were in group three with six genera in three families (Table 3). The fourth group consisted of garden pea (*Pisum sativum*) and Lahontan alfalfa (*Medicago sativa*) only, both legumes. The last group contained six legumes (Table 4).

Previous work (1,2,8,9) showed that resistant soybean cultivars are penetrated readily by SCN J2. This research confirms some of the findings of Skotland (10) on the lack of penetration of nonhosts and adds to the number of poor hosts penetrated by SCN. Plants invaded in this study but not in Skotland's were cowpea (three cultivars), cucumber, butternut squash, tomato, and pepper. Crimson clover and bitter blue lupine were reported by Skotland to be penetrated but were not penetrated in this study.

Skotland probably used SCN race 1 in his study, whereas SCN race 3 was used in the present study. The differences in races used and (or) differences in cultivars tested may have influenced the results. Small numbers of juveniles might have been overlooked or not stained well in either study.

In this study, one of the tomato cultivars was penetrated, and some development of the nematode was observed, but no mature females were recovered. Miller (4,5), however, reported that some SCN biotypes will mature on some tomato and sugar beet cultivars. Tomato was not penetrated in Skotland's study.

SCN has a wide host range (6,7), and the number of poor hosts penetrated indicates that it has the potential for a considerably wider range of good hosts. Just as Miller found certain SCN populations that reproduce on tomato, other populations may be found that will reproduce on the plants reported here to be poor hosts. The wide host range may affect the ability of SCN to survive long periods without a good host. There may be common weed hosts on which some reproduction occurs during periods when a good host is not present, including late fall, early spring, and even winter in some areas. This could prevent the decrease in population expected when a nonhost is planted.

TABLE 4. Plants penetrated by juveniles of *Heterodera glycines* and in which nematodes developed to maturity.

Common name	Cultivar	Scientific name	Family
Lespedeza	Korean	*Lespedeza stipulacea* Maxim.	Leguminosae
White lupine	Chilton	*Lupinus albus* L.	Leguminosae
White lupine		*L. albus* L.	Leguminosae
Bean		*Macroptilium atropurpurea*	Leguminosae
Bean		*M. lathyroides*	Leguminosae
Tepary bean		*Phaseolus acutifolius* A. Gray var. *latifolius*	Leguminosae
Adzuki bean		*Vigna angularis* (Willd.) W. F. Wright	Leguminosae

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