Effect of Initial Inoculum Densities of *Heterodera glycines* on Growth of Soybean and Kidney Bean and Their Efficiency as Hosts Under Greenhouse Conditions

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ABSTRACT

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There was no significant difference ($P = 0.05$) in the number of second-stage larvae of the soybean cyst nematode (SCN) that penetrated the roots of cultivar California Light Red Kidney bean (CLRK) and the soybean cultivar Amsoy 71, as determined by direct microscopic examination of stained roots or by the shaker technique. Larval development was similar in both crops. Mature males and females were first observed 14 and 18 days after planting, respectively. Oviferous females and brown cysts were detected 21 and 32 days after planting, respectively. The final population (P_f) densities of SCN in soils planted to both crops did not differ significantly. In a 6-wk greenhouse test, the P_f density in soil planted to Amsoy 71 and CLRK was 114 and 121 viable eggs and larvae per cubic centimeter of soil, respectively. There was a close correlation between initial population (P_i) density of the SCN and growth of Amsoy 71 but not of CLRK. In one test, plant dry weight of Amsoy 71 at 6 wk after planting was 0.56, 0.58, 0.56, 0.48, 0.43, and 0.31 g at P_i densities of 0, 3, 6, 12, 24, and 48 viable eggs and larvae of SCN per cubic centimeter of soil, respectively. Dry weight of CLRK at the same P_i densities was 1.47, 1.82, 1.61, 1.65, 1.16, and 1.40 g, respectively. Also, growth and root-rot severity ratings of CLRK were not significantly affected when soil from a bean field with a history of severe Fusarium root rot was infested with SCN at P_i densities from 1 to 100 eggs and larvae per cubic centimeter of soil.

The soybean cyst nematode (*Heterodera glycines* Ichinohe) (SCN) is widely distributed and has become a major factor in the production of soybeans (*Glycine max* L.) in several areas of the United States (21,23). The SCN was first reported from the southwestern tip of Illinois (Pulaski County) in 1959 (12). This nematode continued to spread north and has become established throughout much of the soybean-growing areas of the southern two-thirds of Illinois, including the east-central counties (12) where more than 5,000 ha also are planted annually to red kidney beans (*Phaseolus vulgaris* L.). Cropping sequences practiced by growers in this region of Illinois often involve the production of soybeans and red kidney beans in the same fields. The SCN is known to have a wide host range (7,8,13,16,17) including many members of the genus *Phaseolus*. However, detailed information on the reproduction efficiency of the SCN and its potential damage to plantings of cultivar California Light Red Kidney bean (CLRK), the major cultivar grown in Illinois, are lacking. Such data are essential for the development of an effective and practical crop rotation program to maintain SCN populations below the damaging level. Crop rotation has been demonstrated to be an effective and preferred control measure for the SCN, even where soybean cultivars resistant to the predominant race of the nematode are available (9,18).

The objectives of this investigation were to determine the efficiency of CLRK as a host for SCN, to define the relationship between initial population (P_i) density of SCN and growth of CLRK and soybean cultivar Amsoy 71, and to determine the effect of SCN on the severity of Fusarium root rot of CLRK. A summary of this investigation was reported previously (1).

MATERIALS AND METHODS

Development of *H. glycines* on kidney bean and soybean. A Drummer silty clay loam soil naturally infested with *H. glycines* was collected from a soybean field near Royal in Vermilion County, IL. Results of race determination tests indicated the presence of race 3 of SCN (D. I. Edwards, *personal cummunication*). The soil was passed through a 6.4-mm-mesh screen and mixed thoroughly. Untreated soybean cultivar Amsoy 71 (a known susceptible cultivar) and dry seeds of kidney bean cultivar CLRK were surface disinfested for 5 min in 0.25% NaOCl and then rinsed in distilled water. Uniform germination was achieved by placing disinfested seeds between moist paper towels in shallow trays, which were then enclosed in large plastic bags and incubated for 3–4 days at room temperature. Germinated soybean and CLRK bean seeds (with radicals 10–20 mm long) were transplanted singly into 10-cm-diameter clay pots filled with soil infested with *H. glycines*. Pots were kept in a greenhouse with a temperature that varied from 22 to 32 C; natural light was supplemented with fluorescent light for 14 hr per day. Plants were watered as needed daily and were fertilized with a complete liquid fertilizer (Peters professional water-soluble fertilizers, 20-20-20; Peters Fertilizer Products, Fogelsville, PA) once every 2 wk.

Penetration, development, and increase of *H. glycines* on CLRK bean and Amsoy 71 soybean were determined by harvesting plants 3, 7, 14, 18, 21, 24, 28, and 35 days after transplanting. Thirteen plants of each crop were harvested at each sampling date and their roots were washed thoroughly in running tap water. The number of *H. glycines* per gram of root tissue or per root system was determined by counting nematodes extracted from roots by a shaker technique or by direct microscopic examination. The shaker technique consisted of placing the washed root system of each plant in a 300-ml flask with 100 ml of water and shaking them for 3 days at room temperature. Ten-milliliter aliquots of the resultant nematode suspension were placed in a counting dish and nematode numbers were recorded at 30 or 60× magnification. Only second-stage larvae and males were extracted by this method. For direct microscopic examination, washed roots were either fixed in formalin-acetic acid-alcohol, stained in 0.01% acid fuchsin in lactophenol, and destained in lactophenol (22); or fixed and stained in boiling cotton blue in lactophenol, and then cleared in lactophenol (24). Whole mounts were prepared on slides for observation by placing stained root segments with lactophenol

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between two microscope slides and applying enough pressure to flatten the tissues. Total number of larvae and stages of development of *H. glycines* in root segments were determined at 60, 100, or 400× magnifications. Body width of 10 randomly selected larvae was measured with an ocular micrometer and recorded. Body width of developing females was measured after sex differentiation, which occurred 14 days after transplanting. This experiment was repeated once.

Cysts of *H. glycines* were extracted from thoroughly mixed soil samples (25, 50, or 100 cm^3 of soil per sample) by passing the soil through 25-mesh and 60-mesh (250-μm) screens. The debris and cysts collected on the 250-μm screen were forcefully and thoroughly washed, suspended in water, and then transferred onto a Whatman No. 1 filter paper in a Büchner funnel. A dissecting microscope was used to determine total number of cysts per sample. The number of viable eggs and larvae per cyst or volume of soil was determined according to the viability procedure of Abawi and Mai (2).

Relationship of P_i densities of *H. glycines* to growth of kidney bean and soybean. Effect of P_i densities of *H. glycines* on growth of both soybean and CLRK was studied in naturally infested (race 3 of SCN) soybean soil. This soil had a mean of 336 cysts per 100 cm^3 of soil with a mean of 32 eggs per cyst, which is a population density of 108 viable eggs and larvae per cubic centimeter of soil. Lower densities (54, 27, 14, and 7 viable eggs and larvae per cubic centimeter of soil) were obtained by diluting the infested soil with uninfested (below recovery level) soybean soil (Drummer silty clay loam) obtained from a field near Urbana, IL. Control treatments were uninfested soil and steam-treated portions of both infested and uninfested soils. A fourth control was established by transferring the cysts and debris caught on the 250-μm screen from the soil infested with *H. glycines* into an equal volume of the uninfested soil. For each treatment, 20 10-cm-diameter clay pots were filled with soil; 10 pots were planted with one seedling each of Amsoy 71 soybean and the other 10 were planted with a seedling of CLRK bean. Pots were placed in a completely randomized design on a greenhouse bench and maintained as described above. The experiment was terminated 35 days after planting, and total top fresh and dry (after 72 hr of drying at 80–90 C) weight per plant were recorded. This experiment was repeated by replanting the soil used in the above experiment. Soil from all pots was thoroughly mixed, and half of the resultant soil mixture was placed in 24-L metal cans and autoclaved for 2 hr. Viability counts of untreated and autoclaved portions of this soil (mean of six samples) was found to be 48 and 0 eggs and larvae per cubic centimeter of soil, respectively. Lower densities (24, 12, 6, and 3 eggs and larvae per cubic centimeter of soil) were established by diluting the infested soil. The experiment was terminated 25 days after planting.

Effect of *H. glycines* on bean root rot incidence and severity. Soil (Drummer silty clay loam) was obtained from a commercial kidney bean field near Hoopeston, IL, where severe root rot has occurred frequently in recent years. The soil was passed through 6.4-mm-mesh screen, and half of it was autoclaved for 2 hr at 8.1 kg/cm^2 pressure and 121 C. Autoclaved and untreated portions of this soil were placed in loosely covered 24-L cans and stored for 3–4 wk before use. The source of *H. glycines* used in this study was a naturally infested soybean field soil from Randolph County, IL. This soil had a mean of 278 cysts per 100 cm^3 of soil with a mean of 55 viable eggs and larvae per cubic centimeter of soil.

Population densities of 0, 1, 10, and 50 viable eggs and larvae of *H. glycines* per cubic centimeter of soil were established in both autoclaved and untreated soil from the field with a history of root rot. Cysts and debris extracted from the appropriate amount of the nematode-infested soil were transferred into the other soil and mixed thoroughly. Autoclaved and untreated portions of the soil infested with *H. glycines* also were included as control. Germinated, surface-disinfested CLRK bean seeds (radicals 10–20 mm long) were transplanted singly into 10-cm-diameter clay pots filled with soil of each treatment. Each treatment was replicated 10 times. The experiment was terminated 28 days after planting. Plants were removed from the soil, washed, and rated for disease severity. The hypocotyls and roots were rated separately on a scale of 0 to 6: 0 indicates no apparent symptoms, and 6 refers to the most severe disease symptoms (plant dead). Isolations were made by placing pieces of hypocotyl and root tissues (either washed for 1 hr in running tap water or surface-disinfested for 5 min in 0.5% NaOCl) on water agar and potato-dextrose agar. Total plant fresh weight was recorded immediately and total plant dry weight was determined by drying plants for 72 hr at 80–90 C. This experiment was repeated with 0, 10, 50, and 100 viable eggs and larvae of *H. glycines* per cubic centimeter in autoclaved or untreated soils from the field with a history of severe root rot.

RESULTS

Development of *H. glycines* on kidney bean and soybean. There was no significant difference ($P = 0.05$) in the number of second-stage larvae that penetrated roots of the bean cultivar CLRK or the soybean cultivar Amsoy 71 (Table 1). In addition, larval development and the length of the life cycle of the SCN in roots of both crops also were similar as larval growth, enlargement, and

TABLE 1. Comparative number of larvae of *Heterodera glycines* in roots of cultivar Amsoy 71 soybean and cultivar California Light Red Kidney dry bean plants grown in naturally infested soil in the greenhouse

Method of determination and crops	Mean no. of larvae at each sampling date[w,x]				
	3	7	14	18	21
Direct microscopic examination[y]					
Larvae per root system					
Soybean	15.3 a	244.6 a	288.3 a	616.4 a	932.9 a
Dry bean	23.0 a	411.3 b	232.3 a	455.9 a	1,409.4 a
Larvae per gram of root					
Soybean	206.1 a	585.8 a	614.6 a	603.6 a	705.7 a
Dry bean	141.4 a	478.9 a	423.9 a	241.3 a	558.9 a
Shaker technique[z]					
Larvae per root system					
Soybean	13.6 a	10.0 a	66.0 a	215.0 a	-
Dry bean	11.0 a	16.0 a	95.0 a	467.0 b	-
Larvae per gram of root					
Soybean	35.6 a	24.1 a	86.4 a	244.7 a	-
Dry bean	34.2 a	20.9 a	65.2 a	190.6 a	-

[w] Means in a column followed by the same letter do not differ significantly ($P = 0.05$) according to Duncan's multiple range test.

[x] Refers to days of incubation after transplanting 3-day-old seedlings into soil naturally infested with *H. glycines*.

[y] Washed roots were either fixed in FAA, stained with 0.1% acid fuchsin in lactophenol, and destained in lactophenol; or they were fixed and stained in boiling cotton blue in lactophenol, and then cleared in lactophenol. Nematodes in roots were counted under ×100 magnification. Each number is a mean of three replications (three root systems).

[z] Washed root systems were placed in 300-ml flasks with 100 ml of water and maintained on a shaker for 3 days. Ten-milliliter aliquots of the nematode suspension were placed in a counting dish, and number of nematodes was recorded at ×50 magnification.

molting were essentially the same (Table 2). Fully differentiated males and females were first observed 14 and 18 days after planting, respectively. Oviferous females and brown cysts were detected 21 and 32 days after planting, respectively. At 6 wk after planting, the population density of SCN in soil planted to soybean cultivar Amsoy 71 and bean cultivar CLRK was likewise similar (Table 3) and did not differ significantly ($P = 0.05$) when compared for number of cysts, number of viable eggs, or number of eggs per cyst. These data demonstrate that these two cultivars are equal in their efficiency as hosts for the SCN.

Relationship of initial densities of *H. glycines* to growth of kidney bean and soybean. Three separate experiments were conducted to determine the effect of several initial densities of SCN on growth of kidney bean and soybean. There was a close correlation between initial densities of the nematode and growth of soybean, but not with growth of the kidney bean (Table 4, Fig. 1A and C). These data indicate that dry weight of Amsoy 71 was reduced at a density of 12 eggs of SCN per cubic centimeter of soil and higher. In contrast, data from the two tests reported in Table 4 indicate that dry weight of kidney beans was increased slightly at the lower P_i densities of SCN. Data from a third test showed that weight of kidney beans was not reduced when grown in soybean soil infested with densities of SCN up to 55 eggs per cubic centimeter of soil. Interestingly, similar reduction in growth weight of soybean was obtained by transferring cysts and organic debris recovered from naturally infested soil into an equivalent volume of the diluent soils that were used (Table 4). Data obtained from this and other control treatments provided further substantiation of the negative correlation between P_i densities of SCN and growth of soybean.

Effect of *H. glycines* on bean root rot severity. The influence of several initial densities of SCN on severity of bean root rot was investigated in untreated and steam-treated bean field soil. Results of fungal isolations made from hypocotyl and root tissues of bean plants grown in the soil with a history of root rot suggested that *Fusarium solani* (Mart.) Appel & Wr. f. sp. *phaseoli* (Burk.) Snyd. & Hans. is the major pathogen in this soil. Recovery of this pathogen from surface-sterilized (5 min in 0.5% NaOCl) hypocotyl and root segments was 55 and 45%, respectively. *Fusarium oxysporum* Schlect. was the only other fungus isolated from surface-sterilized hypocotyl tissues. Other fungi isolated from root segments included *F. oxysporum, Fusarium* spp., *Pythium* spp., and Mycelia Sterilia.

Root rot severity on CLRK bean was not altered significantly ($P = 0.05$) by the SCN at P_i densities from 1 to 100 eggs per cubic centimeter of soil (Table 5, Fig. 1B and D). The SCN did not affect growth of CLRK bean in either untreated or steam-treated soil. However, the nematode slightly increased the discoloration of hypocotyl and root tissues as the data suggest in the steam-treated soil (Table 5). The steam treatment of the soil resulted in a significant increase of the growth weight of CLRK bean and greatly reduced root rot ratings.

DISCUSSION

Results of this investigation suggest that penetration, development, and reproductive efficiency of SCN in roots of the dry bean cultivar CLRK and the soybean cultivar Amsoy 71 were similar under the test conditions employed. Development of larvae in root tissues as reported in this study (ie, first appearance of mature males, oviferous females, cyst formation, etc.) was similar to that reported previously (5,6). Epps and Chambers (10) compared the reproduction rates of SCN on 12 hosts including snap bean (*Phaseolus vulgaris* 'Contender'), adzuki bean (*P.*

TABLE 2. Comparative development of *Heterodera glycines* as measured by larval width in roots of cultivar Amsoy 71 soybean and cultivar California Light Red Kidney dry bean grown in naturally infested soil in the greenhouse

	Mean larval width[w,x] (μm)/sampling day[y]				
Crop	3	7	14[z]	18	21
Soybean	18.8 a	29.9 a	158.9 a	198.7 a	280.3 a
Dry bean	19.0 a	31.1 a	148.8 a	207.4 a	269.8 a

[w] Means in a column followed by the same letter do not differ significantly ($P = 0.05$) according to Duncan's multiple range test.
[x] Width of fixed and stained larvae was measured at ×100 or ×400 magnification. Each number is a mean of 10 larvae.
[y] Refers to days of incubation after transplanting 3-day-old seedlings into naturally infested soil.
[z] Sex differentiation occurred at this day. Only female larvae were measured at 18 and 21 days of incubation.

TABLE 3. Final population densities of *Heterodera glycines* produced on cultivar California Light Red Kidney dry bean and cultivar Amsoy 71 soybean plants grown in naturally infested soil in the greenhouse as determined 6 wk after planting

	Viable eggs and larvae[x,y] per:		
Crop	cm^3 of soil[z]	cyst	Cysts per 100-cm^3 soil
Dry bean	120.7 a	37.7 a	324.0 a
Soybean	114.4 a	37.9 a	306.5 a

[x] Means in a column followed by the same letter do not differ significantly ($P = 0.05$) according to Duncan's multiple range test.
[y] Refers to number of viable eggs and larvae as determined by the viability procedure reported in Materials and Methods section. Each number is a mean of 10 replicates.
[z] Soybean field soil naturally infested with *H. glycines* was thoroughly mixed and placed in 10.2-cm (4-inch)-diameter clay pots; then one 3-day-old soybean or kidney bean seedling was planted per pot. All pots were maintained for 5 wk in a greenhouse at 22–32 C.

TABLE 4. Growth of cultivar Amsoy 71 soybean and cultivar California Light Red Kidney dry bean plants in the greenhouse in the presence of different initial population densities (P_i) of *Heterodera glycines*

		Total plant weight (g)			
	P_i (eggs per cm^3 soil)	Soybean		Dry bean	
Test[q]		Fresh	Dry	Fresh	Dry
1	0[r]	3.1[t]	0.56	11.7	1.47
	3	3.4	0.58	14.2	1.82
	6	3.5	0.56	13.4	1.61
	12	3.0	0.48	15.6	1.65
	24	2.7	0.43	11.5	1.61
	48[s]	1.8	0.31	11.7	1.40
	48[u]	2.4	0.39	12.2	1.29
	LSD ($P = 0.05$)	0.54	0.08	2.20	0.26
2	0[v]	7.4	1.63	15.3	2.46
	0[w]	9.6	2.11	21.8	3.12
	0[x]	6.3	1.33	15.3	2.33
	7	6.3	1.39	18.0	2.79
	14	5.2	1.17	14.6	2.44
	27	5.3	1.19	16.5	2.48
	54	4.7	1.03	16.5	2.53
	108[y]	4.2	0.84	17.7	2.78
	108[z]	4.3	0.98	16.4	2.52
	LSD ($P = 0.05$)	1.23	0.26	2.56	0.44

[q] Tests 1 and 2 were terminated 25 and 35 days, respectively, after transplanting a 3-day-old seedling to each 102-cm (4-inch)-diameter pot. Dry weight was recorded after 72 hr of drying in an oven at 80 C.
[r,s] Naturally infested soil was mixed thoroughly; one portion was steam-treated and the other left untreated to give P_i densities of 0 and 48, respectively. The other P_i densities were obtained by mixing steam-treated and untreated soil at the appropriate proportions.
[t] Each number is a mean of 10 replicates.
[u] Steam-treated soil to which were added washings of soil "s" caught on 60-mesh screen.
[v] Refers to steam-treated uninfested soil with *H. glycines* (below recovery level) used as dilutant.
[w] Refers to steam-treated portion of the soil naturally infested with *H. glycines* (108 viable eggs and larvae [3,4 cysts] per cubic centimeter of soil.)
[x,y] Untreated soils described in footnotes v and w, respectively.
[z] Uninfested soil (footnote v) plus the washings caught on a 60-mesh screen from 600 cm^3 of soil infested with *H. glycines* (footnote y).

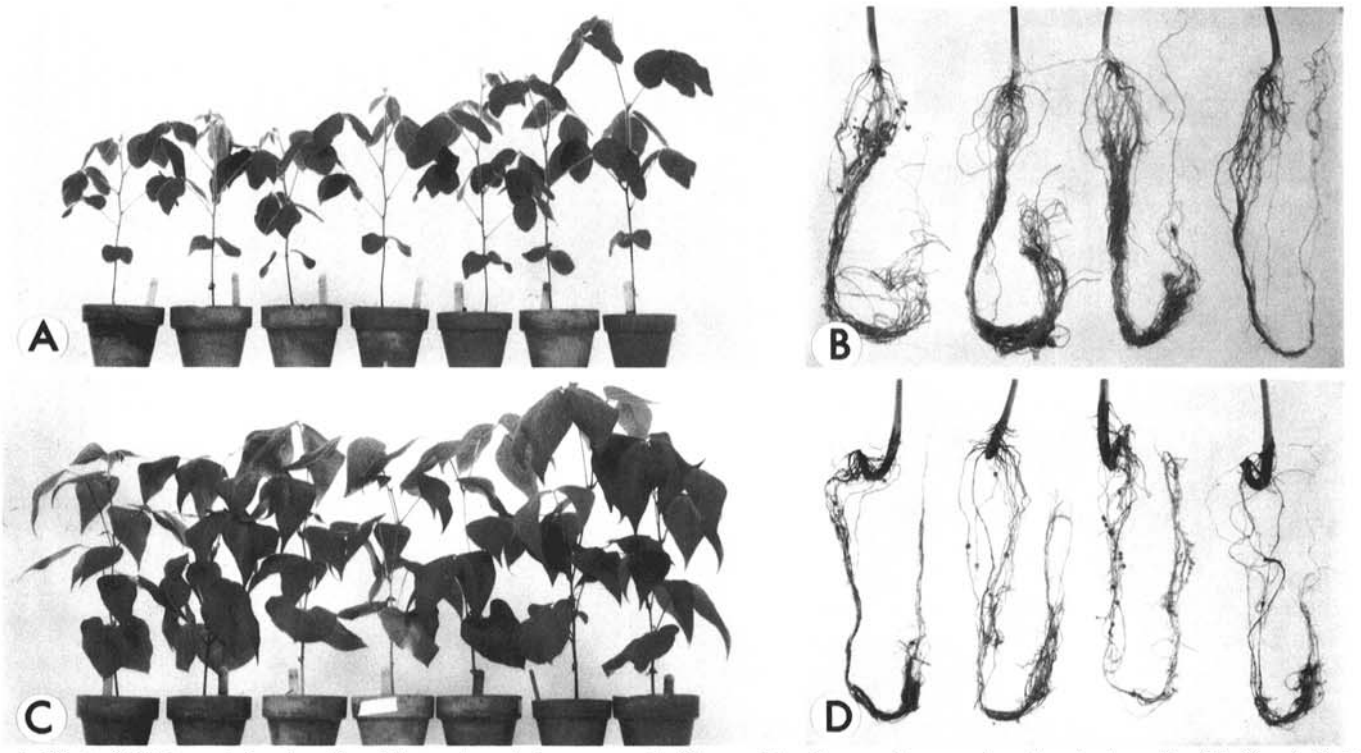

Fig. 1. Effect of initial population densities of *Heterodera glycines* on growth of Amsoy 71 soybean, and on growth and root rot severity of California Light Red Kidney dry bean. **A and C,** Soybean and kidney bean plants, respectively, growing in soil infested with (left to right) 108, 54, 27, 14, 7, 4, and 0 eggs of *H. glycines* per cubic centimeter of soil. **B and D,** Roots of bean plants growing in steam-treated and untreated root rot soil, respectively, artificially infested (left to right) with 0, 1, 10, and 50 eggs of *H. glycines* per cubic centimeter of soil.

TABLE 5. Growth and root rot severity of cultivar California Light Red Kidney dry bean grown in the greenhouse in untreated and steam-treated naturally infested soil with different initial population densities (P_i) of *Heterodera glycines*

Test	Soil source and condition	P_i[w] (eggs/cm³ of soil)	Total plant weight (g)		Disease severity rating[x]	
			Fresh	Dry	Hypocotyl	Root
1						
	Steamed root rot soil:[y]	0	15.7	1.9	0.0	0.0
		1	17.8	2.2	0.0	0.2
		10	17.2	2.0	0.0	0.4
		50	15.6	1.8	0.5	0.9
	Untreated root rot soil:[y]	0	10.8	1.4	3.7	3.3
		1	11.0	1.5	4.0	3.3
		10	11.2	1.4	3.9	3.5
		50	12.7	1.6	3.8	3.7
	Nematode source soil:[z]	0 (steamed)	21.2	2.5	0.0	0.4
		55 (untreated)	18.0	3.3	0.7	1.4
		LSD 0.05	2.11	0.27	0.34	0.47
2	Steamed root rot soil:	0	10.2	1.4	0.2	0.1
		10	11.2	1.6	0.7	0.3
		50	10.9	1.5	0.9	0.8
		100	10.0	1.3	1.1	1.1
	Untreated root rot soil:	0	6.2	1.0	2.9	2.9
		10	11.3	1.6	3.2	2.5
		50	7.5	1.1	3.3	2.3
		100	7.5	1.0	3.4	2.6
		LSD ($P = 0.05$)	1.60	0.20	0.62	0.41

[w] Refers to viable number of eggs of *H. glycines* as determined at planting time.

[x] The hypocotyl and roots were rated separately on a scale of 0 to 6 in which 0 indicates no apparent symptoms, and 6 refers to the most severe disease development (dead plant).

[y] Soil was obtained from a commercial kidney bean field near Hoopeston, IL, where severe root rot has often occurred in recent years.

[z] Commercial soybean field soil infested with *H. glycines* (55 viable eggs [2.8 cysts] per cubic centimeter of soil) near Royal, IL. Cysts of *H. glycines* recovered from this soil were used to infest the root rot soil.

angularis), and mung bean (*P. aureus*). They concluded that reproduction of SCN on mung bean and adzuki bean was statistically equal to its reproduction on soybean cultivar Lee in three of four greenhouse experiments. Reproduction of SCN on snap bean was significantly less than on Lee soybean in two of four experiments. Recently, Melton et al (13) evaluated the reaction of 23 snap bean cultivars to SCN by determining the number of white females developed per root system. They demonstrated that host suitability of the snap bean cultivars varied from approximately equivalent to susceptible (cultivar Williams 79) and resistant (cultivars Fayette, Franklin, and PI 90763) soybean cultivars. Ichinohe (11) reported that reproduction of SCN on adzuki bean was similar to its reproduction on soybean. However, he also showed that both kidney bean and Spanish runner bean (*P. multiflorus*) were very poor hosts for SCN. He indicated that larval penetration and development of larvae of SCN in kidney bean roots were identical to that in soybean roots. However, the young females were small, had poor egg production, and only very few of them broke the surface of the root. These data are in contradiction to those reported in this study. The differences among the two studies could be due to the cultivars used, race of the SCN population utilized, or other factors. Ross (19) demonstrated that soil temperature greatly affected the length of the life cycle as well as the male:female ratio of SCN. All tests conducted in this investigation were maintained in a greenhouse with a fluctuating temperature ranging from 22 to 32 C.

Although our data from greenhouse studies showed that the reproduction of SCN was equal on CLRK bean and Amsoy 71 soybean, we believe that the overall reproduction of the SCN under field conditions on CLRK bean may well be much higher than that on soybean. The SCN completes approximately five generations per season under Illinois conditions (12). Kidney beans have a much more extensive root system with a higher growth rate than soybeans and thus may support more nematodes in later generations. This information needs to be substantiated under commercial field conditions. Our data on the efficiency of CLRK bean as a host for SCN are useful in the future planning of cropping sequences for the management of SCN to keep it below the damaging level. The effectiveness of crop rotations in the management of SCN (9,18) and other plant parasitic nematodes (14) is well recognized.

Results of this investigation showed that growth of soybean was negatively correlated with P_i densities of SCN, but that of CLRK bean was not. It is not known, however, if a similar relationship between initial densities of SCN and growth of bean occurs under fluctuating field conditions. In addition, the effect of SCN on marketable yield (seed weight) may be quite different. Yield of soybean has been demonstrated to be related to SCN infestation level, although it is affected by nitrogen level, herbicide application, and other factors (4,12,21,23).

Plant parasitic nematodes are known to play a major role in predisposing many crops to various soilborne organisms that incite root rot and wilt diseases (15). On soybean cultivars, the SCN has been shown to increase the severity of Fusarium wilt (20) and seedling diseases incited by *Phytophthora megasperma* Drechs. var. *sojae* Hild. (3) (= *P. megasperma* f. sp. *glycinea* Kuan and Erwin). However, under our test conditions, the SCN did not alter the severity of root rot incited primarily by *F. solani* f. sp. *phaseoli* on kidney bean.

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