Responses of Soybeans and Soybean Cyst Nematodes to Cropping Sequences

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ABSTRACT

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Nine cropping treatments were compared in fields infested with soybean cyst nematodes (SCN) in Arkansas, Missouri, and Tennessee for 6 yr. Seven continuous-culture treatments were six race 3-resistant soybean lines with varying levels of resistance to race 4 (including resistant Bedford and susceptible Forrest) and a 70:30 Bedford/Forrest blend. Two rotations, Bedford with nonhost crop and Bedford with Forrest and SCN-susceptible Essex, were included. At the three locations, there was a trend for more SCN reproduction on race 4-resistant cultivars relative to susceptible cultivars after the resistant cultivars were grown for 4–6 yr. However, cyst densities did not significantly increase, and seed yields of continuously grown resistant cultivars were not significantly different from those of resistant cultivars in alternative cropping treatments. At the Arkansas and Missouri locations, seed yields of the susceptible and resistant cultivars were not significantly different. In Tennessee, mean seed yield for 6 yr of continuous Bedford was 515 kg/ha greater than for continuous Forrest. Cyst densities in soil of continuous Forrest plots were about 2.5 times those in continuous Bedford plots. At all locations, no treatment was superior to continuous Bedford in seed yield.

Additional key words: *Glycine max*, *Heterodera glycines*, rotations

The soybean cyst nematode (SCN) (*Heterodera glycines* Ichinohe) has been identified in nearly all states where soybeans (*Glycine max* (L.) Merr.) are grown. Four races of the nematode have been described on the basis of differential reproduction on five soybean lines (3). Cultivars resistant to SCN have been grown as the primary control measure. When SCN race 4-resistant cultivar Bedford was released to soybean growers in 1979, there were differences in the recommended usage of this cultivar. Some scientists suggested that Bedford could be grown continuously for several years; others recommended that an SCN nonhost crop or an SCN-susceptible cultivar be grown after 1 yr of Bedford. There was great concern that a new SCN race would develop if Bedford were grown too frequently.

In several greenhouse tests, rapid increases in the ability of SCN populations to reproduce on resistant cultivars occurred when the nematodes were cultured continuously on the cultivars (1,7,8,11,12); few long-term field studies have been reported showing the effects of continuous cropping of resistant or susceptible soybeans in soil infested with SCN. Hartwig et al (5) reported that in a field infested with SCN race 3 in Mississippi, no treatment was superior to growing the SCN race 3-resistant cultivar Centennial continuously for 5 yr. Seed yield of SCN susceptible cultivar Tracy grown after 2 yr of Centennial was often significantly less than that of Centennial grown continuously. The SCN populations decreased after the third year of the study and appeared to stabilize below damaging levels. Riggs et al (9) reported that in a rotation study in SCN race 3-infested soil, nematode populations were relatively high at the beginning of the test but declined over 4 yr even under continuous susceptible soybeans. Increased ability of SCN populations to reproduce on resistant cultivars was reported in a survey of fields planted to race 4-resistant cultivars for 3–6 yr (13). However, reduced seed yields were not evident in these fields.

The objectives of these studies were to test 1) the productivity of resistant soybeans grown continuously in the same soil and nematode reproduction on these cultivars, 2) the effect of differing levels of SCN race 4 resistance on seed yield, 3) the effect of rotating a resistant cultivar with susceptible cultivars on seed yield and changes in nematode reproduction, 4) the effect of blending resistant and susceptible cultivars on seed yield and nematode reproduction, and 5) the effect of rotating a nonhost crop with a resistant cultivar.

MATERIALS AND METHODS

Nine cropping treatments (Table 1) were compared at three locations (Jonesboro, AR; Portageville, MO; and Woodland Mills, TN) in fields infested with SCN in 1979 through 1984. Six treatments were continuous culture of six

Table 1. Soybean cropping treatments grown in soil infested with soybean cyst nematodes at Jonesboro, AR; Portageville, MO; and Woodland Mills, TN, 1979–1984

	Soybean lines grown[a]					
Treatment	1979	1980	1981	1982	1983	1984
A	Forrest	Forrest	Forrest	Forrest	Forrest	Forrest
B	Bedford	Bedford	Bedford	Bedford	Bedford	Bedford
C	Nathan	Nathan	Nathan	Nathan[b]	Nathan	Nathan
D	D75-10710	D75-10710	D75-10710	D75-10710	D75-10710	D75-10710[c]
E	Peking	PC[d]	PC	PC	PC	PC
F	D72-8927	D72-8927	D72-8927	D72-8927	D72-8927	D72-8927[e]
G	Corn[f]	Bedford	Corn	Bedford	Corn	Bedford
H	Bedford	Corn	Bedford	Corn	Bedford	Corn
I	Blend[g]	Blend	Blend	Blend	Blend	Blend
J	Bedford[h]	Forrest	Essex	Bedford	Forrest	Essex
K	Forrest	Essex	Bedford	Forrest	Essex	Bedford
L	Essex	Bedford	Forrest	Essex	Bedford	Forrest

[a]PC = Peking × Centennial breeding line.
[b]Epps soybean was substituted in Tennessee in 1982–1984.
[c]D83-3319, Bedford × [Forrest × (Peking × Centennial)], was substituted in Tennessee in 1984.
[d]Peking was grown in Missouri, 1980–1984; a selection from Forrest (2) × (Peking × Centennial) was substituted in Tennessee in 1983–1984.
[e]J82-21, Forrest × D72-8927, was substituted in Tennessee in 1984.
[f]Treatments G and H were not grown in Missouri, and grain sorghum was grown instead of corn in Arkansas.
[g]Blend composed of 70% Bedford and 30% Forrest.
[h]In Missouri, the sequence was Bedford, Essex, and Forrest.

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soybean cultivars or breeding lines with varying degrees of resistance to SCN race 4. Included were D75-10710, with parentage similar to Bedford but highly resistant; Bedford, resistant; Nathan, a sister line of Bedford but slightly less resistant; derivatives of Peking, moderately resistant (Peking has at least one gene for SCN resistance to race 4 that was not transmitted to Centennial and Forrest [4]); D72-8927, moderately resistant; and Forrest, susceptible. The six soybean lines were resistant to SCN race 3. The seventh treatment was a rotation of corn (Tennessee) or grain sorghum (Arkansas) and Bedford; two sets of plots were included to permit growing each entry each year. This treatment was not grown in Missouri. The eighth treatment included a blend of 70% Bedford and 30% Forrest. The ninth treatment included a 3-yr rotation of Bedford, Forrest, and Essex soybeans in three sets of plots to permit growing each cultivar each year. Essex, susceptible to the four races of SCN, is equal to Forrest in productivity when grown in the absence of SCN.

The Arkansas study was initiated in 1979 in a field of Collins silt loam infested with SCN. In yield trials in 1977 and 1978, Bedford had a seed yield 64% greater than those of Forrest and Mack (SCN race 3-resistant and race 4-susceptible cultivars). Plots were 12 rows 76 cm apart and 12 m long with a 6-m alley between ranges. Three replicates of each treatment were grown. Nine meters of each of the center eight rows were harvested for seed yield. One hundred soil probes (2 cm in diameter and 15 cm deep) collected near harvest from the middle four rows of each plot were composited each year. Cysts in 250-cm^3 samples were collected on a 60-mesh sieve and counted. In the fall of 1984, soil was collected from the center of each plot and the soil of each treatment was mixed together. Essex, Forrest, Bedford, Peking, PI 88788, and PI 90763 were grown for 30 days in the soil. White or yellow SCN females on the roots of each plant were counted to evaluate for races.

The Missouri study was initiated in 1980 in a field of Dundee-Forestdale loam infested with SCN. In 1978, SCN was observed on the roots of Forrest soybeans in this field, and cotton was grown in 1979. Plots were eight rows 76 cm apart and 9 m long with a 3-m alley between ranges. Each treatment was replicated four times. Five meters of the four center rows of each plot were harvested for seed yield. The plots were irrigated twice each year with sprinkler irrigation. Near harvest, 16 soil cores were collected from four harvest rows of each plot and two 100-g subsamples of composited soil were processed by elutriation. Cysts were collected on a 60-mesh sieve and counted. In the fall of 1984, soil was collected from about 10 places in the harvest rows of each plot. Six pots each of Lee 74, Pickett 71, Peking, PI 88788, and PI 90763 were grown for 30 days in the soil. White and yellow SCN females washed from the roots and soil were counted to evaluate for races.

The Tennessee study was initiated in 1979 in a field of Center silt loam and Routon-Bonn silt loam soils. In 1978, Centennial soybean (resistant to SCN race 3 and susceptible to race 4) had shown severe SCN injury. The field was planted to Forrest soybeans in 1977 and was in alfalfa in several previous years. Plots were 16 rows 90 cm apart and 24 m long with a 6-m alley between ranges. Treatments were replicated three times. The four center rows of each plot were harvested each year except in 1979 and 1980, when four 4.9-m row segments were harvested from the center rows. Seed yield was not determined for Peking in 1979. Only two replicates were included in the 1983 analysis for seed yield because of severe drought stress in one replicate. Twelve soil cores were collected from the four center rows of each plot near harvest to determine cyst densities. Cysts were extracted from 450-cm^3 soil samples by elutriation, collected on a 60-mesh sieve, and counted. Soil was collected from about 15 places in the harvest rows of each plot in September of 1980 through 1984. Essex, Bedford, Peking, PI 89772, and PI 90763 were grown for 30 days in the soil. White and yellow females washed from the roots and soil were counted to evaluate for races.

Seed yield and cyst densities at harvest were subjected to analysis of variance each year at each location. Cyst densities were converted to cysts per 450 cm^3 of soil at the Arkansas and Missouri locations. Analysis of variance by year was performed on the race determination data after it was transformed to an index of parasitism (IP) for the Missouri and Tennessee locations with a split-plot design with field treatments as main plots. The IP was the number of nematodes on each soybean line expressed as a percentage of the number developing on Essex for each plot. A combined analysis over years was also done for the Tennessee location.

Table 2. Mean cyst densities of soybean cyst nematode at harvest and soybean seed yield for soybean cropping treatments at Jonesboro, AR

	Cysts per 450 cm^3 of soil						Yield (kg/ha)					
Treatment	1979	1980	1981	1982	1983	1984	1979	1980	1981	1982	1983	1984
A[a]	68	369	117	52	19	172	1,082	457	1,680	2,238	813	1,740
B	22	155	72	48	4	50	1,250	343	1,593	2,171	585	1,667
C	30	220	39	36	17	37	1,035	296	1,243	2,036	450	1,660
D	20	215	83	11	4	65	847	504	1,263	1,297	551	1,189
E	45	464	117	30	13	72	719	296	464	981	323	1,458
F	42	284	155	33	7	58	652	464	1,122	1,539	470	1,492
G	5	367	45	6	4	16	···	329	···	2,218	···	1,707
H	30	120	144	29	11	52	1,028	···	1,720	···	571	···
I	50	365	97	29	8	83	1,142	329	1,599	2,271	497	1,673
J	36†	249	139*	18†	17	92*	981†	450	1,613*	2,265†	645	1,284*
K	210	563*	108†	59	17*	13	1,042	181*	1,579†	2,218	417*	1,902†
L	182*	468†	91	22*	4†	64	1,055*	275†	1,714	1,693*	585†	2,016
LSD (0.05)	79	152	NS	38	7	15	309	NS	558	376	222	282
C.V. (%)	75.2	28.0	20.3	54.3	32.9	25.7	18.6	38.0	23.5	12.7	24.3	10.2

[a] Treatment A = Forrest; B = Bedford; C = Nathan; D = D75-10710; E = selection of Peking × Centennial (Peking in 1979); F = D72-8927; G and H = rotation of grain sorghum and Bedford (yield of grain sorghum not given); I = blend of 70% Bedford and 30% Forrest; and J, K, and L = Bedford, Forrest, and Essex grown in sequence; † = values for Bedford and * = values for Essex.

Table 3. Mean cyst densities of soybean cyst nematode at harvest and soybean seed yield for soybean cropping treatments at Portageville, MO

	Cysts per 450 cm^3 of soil					Yield (kg/ha)				
Treatment	1980	1981	1982	1983	1984	1980	1981	1982	1983	1984
A[a]	396	468	297	198	585	2,339	2,231	1,727	2,016	2,997
B	135	212	216	144	414	1,956	2,486	2,171	2,076	2,910
C	230	252	230	189	396	1,935	2,359	1,969	1,418	2,318
D	112	117	122	117	225	1,693	2,325	2,244	1,821	2,708
E	153	387	158	189	288	2,097	2,043	1,620	1,452	2,681
F	338	243	184	166	364	1,586	1,989	2,224	2,211	2,540
I	243	284	158	158	306	2,056	2,258	2,177	2,144	2,896
J	162†	567*	234	176†	324*	1,996†	2,345*	2,144	2,446†	2,937*
K	446	270†	252*	189	166†	2,258	2,439†	1,861*	2,164	3,071†
L	788*	472	158†	140*	598	1,761*	2,244	2,244†	1,351*	2,648
LSD (0.05)	202	297	90	63	284	336	390	511	262	396
C.V. (%)	83.2	67.8	30.7	45.7	54.1	11.8	10.1	17.7	9.5	9.8

[a] Treatment A = Forrest; B = Bedford; C = Nathan; D = D75-10710; E = Peking; F = D72-8927; I = blend of 70% Bedford and 30% Forrest; and J, K, and L = Bedford, Essex, and Forrest grown in sequence; † = values for Bedford and * = values for Essex.

RESULTS AND DISCUSSION

At the Arkansas and Missouri locations, the seed yields of continuous Forrest and continuous Bedford were not significantly different in most years (Tables 2 and 3). None of the other treatments were superior to continuous Bedford in most years. Only in 1983 at Missouri was

Bedford (treatment J) in rotation with Forrest and Essex superior in seed yield to continuous Bedford. Cyst densities apparently were not great enough at these locations to cause yield reductions in these soils. Irrigation at the Missouri location may have allowed the higher cyst densities to develop without noticeable seed yield reductions. Higher cyst densities can develop in soil with high soil matrix potentials than in soil with lower matrix potentials (6); however, in a microplot test, soybean seed yield was reduced in SCN-infested soil with high matrix potential compared with uninfested soil with the same matrix potential (14). However, the cyst densities at Missouri were greater than or equal to those at the Tennessee location, where significant differences in seed yield between continuous Forrest (treatment A) and Bedford (treatment B) occurred in four of the six years (Table 4). When there was a seed yield difference between these two treatments (A and B) at the Tennessee location, cyst densities at harvest in the Forrest plots were greater than 330/450 cm^3 compared with fewer than 200 cysts when there was no seed yield difference. In Tennessee, seed yields and cyst densities for the Nathan/Epps treatment (C) were similar to the continuous Bedford treatment (B) (Table 4). The low seed yield of D75-10710 (treatment D) in 1982 was probably due to stem canker caused by *Diaporthe phaseolorum* var. *caulivora*; none of the other cultivars were affected. Although the cyst densities in Bedford after corn (treatments G and H) and Bedford after Forrest and Essex treatments (J, K, and L) were one-half or less of those in continuous Bedford treatment (B), there were no significant differences in seed yield between these treatments. Seed yield of Forrest after Bedford (J, K, and L) was not significantly less than yield of continuous Bedford (B). Seed yield of Essex after Forrest (treatments J, K, and L) was significantly less than seed yield of Bedford (treatment B) in 1980, 1982, and 1984. Significant seed yield differences occurred between continuous Forrest (treatment A) and Bedford (treatment B). Seed yield for the Bedford/Forrest blend (treatment I) was not significantly different from that of continuous Bedford (treatment B).

Data obtained in the race determination tests are presented in Tables 5–7. Abilities of the nematode populations in each field treatment to reproduce (IP) on either Bedford or PI 88788 are the data of interest for discussion. IP on Bedford or PI 88788 grown in soil from the continuous susceptible cultivar (Forrest [treatment A]) plots was less than 10 at the three locations (except IP on Bedford was 12.3 in 1982 at the Tennessee location). If one assumes that the IP on Bedford for the continuous Forrest treatment (A) is indicative of the IP on Bedford for the SCN populations at the three locations when the studies were initiated, then one can conclude that IP on Bedford or PI 88788 increased for the continuous Bedford (B) and Nathan (C) treatments at the three locations. This assumption appears valid for the Tennessee location, because SCN taken from Forrest plots in another area of the field in 1979 had an IP on Bedford of 3.1 (12). The IPs on Bedford (PI 88788 at

Table 4. Mean cyst densities of soybean cyst nematode at harvest and soybean seed yield for soybean cropping treatments at Woodland Mills, TN

	Cysts per 450 cm^3 of soil						Yield (kg/ha)					
Treatment	1979	1980	1981	1982	1983	1984	1979	1980	1981	1982	1983	1984
A[a]	364	330	190	383	132	395	1,662	1,718	2,424	2,379	1,398	2,209
B	94	84	103	130	98	192	2,779	2,256	2,566	2,862	1,866	2,554
C	172	24	32	153	85	263	2,389	2,045	2,856	2,773	2,084	2,179
D	26	16	12	107	25	242	2,423	2,136	2,251	1,097	1,492	2,388
E	330	328	100	255	155	357	···	1,680	1,565	1,956	1,761	1,834
F	284	122	120	170	90	292	1,936	1,995	2,094	2,375	1,583	2,255
G	20	28	2	43	12	157	···	2,439	···	3,171	···	2,787
H	48	10	45	23	8	2	2,612	···	2,704	···	2,203	···
I	152	54	118	137	73	125	2,663	2,530	2,729	2,947	1,885	2,613
J	48†	276	138*	100†	80	443*	2,635†	2,069	2,582*	2,912†	1,921	1,902*
K	454	102*	12†	437	178*	23†	1,698	1,625*	2,704†	2,798	1,794*	2,583†
L	636*	20†	302	402*	25†	595	1,427*	2,509†	2,556	2,350*	2,188†	2,383
LSD (0.05)	312	147	102	204	74	128	452	476	366	398	NS	255
C.V. (%)	84.0	87.0	61.8	61.8	42.0	29.4	11.8	13.4	8.7	9.3	13.3	6.4

[a] Treatment A = Forrest; B = Bedford; C = Nathan (Epps in 1982–1984); D = D75-10710 (selection of Bedford × [Forrest × (Peking × Centennial)] in 1984); E = selection of Peking × Centennial (Peking in 1979, yield not determined); F = D72-8927 (selection of Forrest × D72-8927 in 1984); G and H = rotation of corn and Bedford (yield of corn not determined); I = blend of 70% Bedford and 30% Forrest; and J, K, and L = Bedford, Forrest, and Essex grown in sequence; † = values for Bedford and * = values for Essex.

Table 5. Mean indices of parasitism on two soybean lines when grown in a greenhouse in soil from field plots infested with soybean cyst nematode at Woodland Mills, TN

	Index of parasitism[a]									
	1980		1981		1982		1983		1984	
Treatment	Bed[b]	907	Bed	907	Bed	907	Bed	907	Bed	907
A[c]	8.1	37.6	7.4	29.9	12.3	29.2	5.8	13.1	4.0	34.9
B	29.5	34.6	50.1	21.6	86.1	9.0	51.1	7.0	51.7	2.5
C	22.7	19.5	29.0	17.2	38.6	9.6	59.8	8.1	50.0	4.4
D	39.0	66.2	21.1	11.3	71.2	7.4	126.9	13.7	25.4	2.6
E	6.8	24.1	6.4	8.3	6.6	33.2	8.1	38.7	4.5	15.7
F	9.5	89.1	7.2	18.4	6.1	60.3	8.4	41.1	6.3	17.3
G	100.6†	50.5†	20.6	74.0	53.8†	6.4†	35.1	18.3	28.1†	11.2†
H	11.7	28.3	106.1†	57.8†	52.3	21.5	23.3†	26.2†	19.1	4.7
I	9.5	22.1	5.8	16.2	16.4	22.6†	16.0	14.8	15.2	16.3
J	6.3	22.0	5.7*	33.1*	28.1†	13.6†	8.1	12.4	8.1*	21.4*
K	11.4*	21.7*	11.2†	25.4†	8.2	18.0	7.7*	15.1*	7.5†	9.4†
L	35.9†	35.0†	4.0	30.8	31.1*	24.4*	4.9†	16.7†	5.3	10.3
LSD (0.05)[d]	68.9	68.9	62.9	62.9	34.2	34.2	39.2	39.2	29.6	29.6

[a] Index of parasitism equals the number of soybean cyst females (cysts) developing on a soybean line expressed as percentage of the number developing on Essex soybeans. Means of three replicates.
[b] Bed = Bedford and 907 = PI 90763 soybeans.
[c] Treatment A = Forrest; B = Bedford; C = Nathan (Epps in 1982–1984); D = D75-10710 (D83-3319 in 1984); E = selection of Peking × Centennial; F = D72-8927; G and H = rotation of corn and Bedford († = values for Bedford); I = blend of 70% Bedford and 30% Forrest; and J, K, and L = Bedford, Forrest, and Essex grown in sequence; † = values for Bedford and * = values for Essex.
[d] LSD (0.05) for comparing indices of parasitism on Bedford and PI 90763 for the same treatment are 39.8 for 1980, 56.0 for 1981, 32.8 for 1982, 35.0 for 1983, and 26.6 for 1984. LSD (0.05) for comparing indices of parasitism for Bedford or PI 90763 over years is 43.4.

Table 6. Mean indices of parasitism on four soybean lines in 1984 when grown in a greenhouse in soil from field plots infested with soybean cyst nematode at Portageville, MO

	Index of parasitism[a]			
Treatment	Pickett 71	Peking	PI 88788	PI 90763
A[b]	86.7	17.2	5.9	11.3
B	65.4	16.2	25.3	2.3
C	69.4	11.7	21.4	1.4
D	71.4	11.2	29.6	1.2
E	87.2	30.9	7.0	15.5
F	76.6	11.7	17.0	1.8
I	81.4	18.2	16.2	3.1
J	82.5	23.4	17.6	5.9
K	93.4	25.8	17.6	5.9
L	74.3	21.2	8.4	8.6
LSD (0.05)[c]	11.0	11.0	11.0	11.0

[a] Index of parasitism equals the number of soybean cyst females (cysts) developing on a soybean line expressed as a percentage of the number developing on Lee 74 soybeans. Means of three replicates.
[b] Treatment A = Forrest; B = Bedford; C = Nathan; D = D75-10710; E = Peking; F = D72-8927; I = blend of 70% Bedford and 30% Forrest; and J, K, and L = Essex, Bedford, and Forrest grown in sequence since 1980. All treatments were grown in the field, 1980–1984.
[c] LSD (0.05) = 17.4 for comparing differences between soybean lines within the same treatment.

Missouri) for the continuous Bedford treatment (B) were 97.7, 25.3, and 51.7, respectively, at the Arkansas, Missouri, and Tennessee locations in 1984. These IPs were greater than that on Bedford (3.2, 5.9, and 4.0, respectively, for the Arkansas, Missouri, and Tennessee locations) for the continuous Forrest treatment (A). Nematologists have theorized that if a soybean cultivar or genotype susceptible to the original SCN population is grown at regular intervals, the likelihood of an increase in the ability of the nematode population to reproduce on resistant cultivars is minimized (10). SCN that cannot reproduce on resistant cultivars are believed to have greater fecundity than SCN that can reproduce on resistant cultivars. Thus growing a susceptible cultivar would maintain a field population with a greater percentage of SCN that cannot reproduce on resistant cultivars than would occur if the susceptible cultivar were not grown. Data (Table 7) from the Arkansas test suggest that such an increase did not occur in the Bedford-Forrest-Essex (treatments J, K, and L) rotation and an increase did occur in the continuous Bedford treatment (B). However, there was no seed yield advantage for the rotation treatment. In the Missouri test, the IP on PI 88788 (Table 6) for Essex and Bedford (J, K, and L) in the rotation was not significantly different from the IP on PI 88788 for continuous Bedford (B), and these IPs were significantly greater than that on PI 88788 for Forrest (A). At the Tennessee location, IP on Bedford in the rotation treatment (J, K, and L) was similar to that on Bedford for continuous Forrest treatment (A) in most years. There was no seed yield advantage for the rotation even though IP on Bedford in the rotation was significantly lower than for continuous Bedford. Seed yield of Essex was significantly reduced in 1980, 1982, and 1984; thus growing susceptible cultivars for 2 yr in rotation with 1 yr of a resistant cultivar may not be economical. Nematicide treatment for the susceptible cultivar has been shown ineffective in these soils (2).

In summary, the following general conclusions were drawn in reference to the objectives outlined for these studies.

1. Only one treatment in one year produced seed yield superior to continued production of the SCN race 4-resistant cultivar Bedford (treatment B). There was an increase in the ability of SCN to reproduce on Bedford, but this increase did not result in seed yield depression. Apparently, SCN race 4-resistant culivars can support substantial SCN densities without detectable seed yield reduction.

2. Cultivars Bedford, Nathan, and D75-10710 were chosen because they showed slightly different levels of SCN race 4 reproduction in greenhouse and field evaluations. These differences in SCN reproduction had little if any effect on SCN densities or seed yields in these tests. D72-8927 and Peking (and substitutes) had moderate levels of resistance to SCN race 4 in some tests (4), and they generally yielded less than Bedford and Forrest in uninfested soil. It was not determined in these tests what effect the moderate level of resistance had on seed yield. D72-8927 and Peking maintained SCN with IP on Bedford similar to that on Bedford observed in the continuous Forrest treatment (A).

3. IP on Bedford for the rotation of Bedford, Forrest, and Essex (treatments J, K, and L) was similar to that on Bedford for continuous Forrest (treatment A) at the Missouri and Tennessee locations. Seed yield of Essex was depressed (Bedford, Forrest, and Essex have equal seed yield in the absence of SCN) in 1979, 1980, 1982, and 1984 for this treatment in Tennessee. Seed yield of Forrest after Bedford was not depressed significantly. The effects of rotating a resistant cultivar with a susceptible cultivar on seed yield and IP was not clearly defined.

4. If growing a susceptible cultivar is beneficial in preventing increased ability of SCN populations to reproduce on resistant cultivars, growing a blend of resistant and susceptible cultivars could prevent seed yield depression and increases of SCN reproduction on resistant cultivars. At the Missouri and Tennessee locations, seed yield was not depressed and IP on Bedford for a blend of Bedford and Forrest (treatment I) was not significantly different from that on Bedford for continuous susceptible cultivar (A). At the Arkansas location, the IP on Bedford was significantly greater than that for the continuous susceptible cultivar. However, seed yield was not depressed.

5. Rotating Bedford with a nonhost crop resulted in low SCN densities, but seed yield was not greater than that of continuous Bedford, where SCN densities were greater. This rotation did not prevent increased ability of SCN to reproduce on resistant cultivars. Even though increased ability of SCN to reproduce on Bedford was measured in continuous Bedford, Bedford/Forrest blend, and Bedford-corn rotation, there were no significant increases in cyst densities for these treatments. This may be the reason seed yields were not depressed for these treatments.

Table 7. Indices of parasitism on five soybean lines in 1984 when grown in a greenhouse in soil from field plots infested with soybean cyst nematode at Jonesboro, AR

	Index of parasitism[a]				
Treatment	Forrest	Peking	Bedford	PI 88788	PI 90763
A[b]	78.9	49.2	3.2	4.7	44.5
B	124.1	115.8	97.7	147.4	14.3
C	66.2	50.7	70.3	64.7	7.6
D	100.8	67.2	41.9	52.5	20.2
E	102.9	68.3	9.1	8.2	45.2
F	109.9	102.1	9.9	4.2	63.1
G	161.3	114.2	103.8	96.2	15.1
H	138.4	80.8	74.7	72.7	24.2
I	81.2	85.0	52.9	60.2	10.3
J	100.5	73.7	6.9	6.9	65.0
K	109.4	117.6	27.1	22.4	107.2
L	121.6	127.5	6.5	11.8	75.8

[a] Index of parasitism equals the number of soybean cyst nematode females (cysts) developing on a soybean line expressed as a percentage of the number developing on Essex soybeans. These indices were the mean of eight plants. Infested soil used to determine indices was bulked from three replicates of each treatment.

[b] Treatment A = Forrest; B = Bedford; C = Nathan; D = D75-10710; E = selection of Peking × Centennial; F = D72-8927: G and H = rotation of grain sorghum and Bedford (grain sorghum in H in 1984); I = blend of 70% Bedford and 30% Forrest; and J, K, and L = Essex, Bedford, and Forrest grown in sequence since 1979. All treatments were grown in the field since 1979.

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