

Identification of Additional Soybean Germ Plasm with Resistance to Race 3 of the Soybean Cyst Nematode

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ABSTRACT

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A total of 9,153 soybean (*Glycine max*) germ plasm lines through PI 458024A were evaluated for their resistance to race 3 of soybean cyst nematode (*Heterodera glycines*) by growing them in infested soil and counting the number of white females infecting the roots 30 days after planting. Nineteen additional highly resistant and 15 moderately resistant lines were identified. Most of these lines are in maturity group II, III, or IV and have a black seed coat.

Soybean cyst nematode (*Heterodera glycines* Ichinohe) is a major disease pathogen of soybeans (*Glycine max* (L.) Merr.) in the United States. Extensive screening has been performed to identify

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sources of resistance. Ross and Brim (5) found PI 90763, PI 84751, Ilsoy, and Peking to be resistant to the field populations of soybean cyst nematode (SCN) in North Carolina. Golden et al (3) described the determination of races of SCN. Epps and Hartwig (2) tested more than 3,000 soybean cultivars and lines against race 4 of SCN and reported PI 88788, PI 89772, PI 87631-1, Cloud, Columbia, Peking, PI 84751, and PI 90763 to have a high level of resistance. Anand (1) screened more than 2,000 additional soybean PIs and observed PI 416762 to be resistant to races 3 and 4. Several thousand new lines have been

added to the U.S. soybean collection that have never been evaluated for cyst nematode resistance. The object of this study was to screen the entire U.S. collection against race 3 of SCN.

MATERIALS AND METHODS

The soybean germ plasm collection in maturity groups 000 through IV was obtained from R. L. Bernard, Department of Agronomy, University of Illinois, Urbana, and the collection in groups V through X from E. E. Hartwig, Delta Branch Experiment Station, P.O. Box 196, Stoneville, MS. It included a total of 9,153 lines ending at PI 458024A. The initial race 3 culture was collected from the Ames Plantation near Grand Junction, TN, and was tested against check soybean lines Peking, Forrest, PI 88788, and PI 90763 and the susceptible cultivar Essex to confirm its race status. Fresh inoculum of SCN was prepared each month by increasing it on Essex. Ten plants of each PI line were screened. Two seeds were sown in an 8-cm pot containing about 20 cysts per 100 g of soil

(equivalent to 32 eggs per gram of soil). Ten pots of the check lines were also planted each time a new soil lot was prepared in order to verify inoculum

purity and viability. The plants were grown in the greenhouse at 26.5 ± 2 C.

Thirty days after planting, the roots were exposed by gently shaking them free

of soil. The white cysts on the roots of each plant were counted to rate the lines for resistance. Lines with zero to five white cysts were classified as highly resistant, whereas those with as many as 10 white cysts were considered moderately resistant. Susceptible lines had 30 or more white cysts per plant. The screening process was repeated for all lines classified as resistant.

Table 1. Description of soybean lines identified as resistant to race 3 of the soybean cyst nematode

Soybean line	Maturity group		Name	Seed color	Received from	Year received
	Group	Number				
Highly resistant						
Ilsoy	III	13-9	...	Brown	Korea	1901
PI 16790	III	...	Cloud	Black	China	1905
PI 17852B	IV	...	Peking	Black	China	1906
PI 22897	III	...	Columbia	Green	China	1908
PI 79609	II	N247/1250	...	Black	China	1928
PI 84751	IV	2305	LG-59	Black	Japan	1930
PI 87631-1	III	5640	Kindaizu	Yellow	Japan	1930
PI 88788	III	5913	...	Black	China	1930
PI 89772	IV	7193	...	Black	China	1930
PI 90763	IV	7570	...	Black	China	1930
PI 92720	III	7915	...	Black	China	1931
PI 209332	IV	2	...	Black	Japan	1953
PI 303652	V	CPI 34069	Liam-zia-tno	Black	Australia	1965
PI 339868B	IV	6	Yuwoltae	Black	Korea	1969
PI 398680	IV	320-1(1)	Jochiweon, Chungcheong	Green	Korea	1974
PI 404166	III	K-5222	Krasnoarmejskaja	Black	Russia	1975
PI 404198A	IV	K-5518	Sun-huan-do	Black	Russia	1975
PI 404198B	IV	K-5518	Sun-huan-do	Black	Russia	1975
PI 407729	IV	Black	China	1976
PI 416762	II	H-020157	Akanida	Black	Japan	1977
PI 437654	III	5268	Er-hej-jan'	Black	Russia	1980
PI 437655	III	5269	Er-huan-jan'	Black	Russia	1980
PI 437679	IV	4895	Nan-cou	Black	Russia	1980
PI 437690	III	5283	Pin-din-guan'	Black	Russia	1980
PI 437725	IV	5430	Te-zu-gan	Black	Russia	1980
PI 438489B	IV	27	Chiquita	Black	Russia	1980
PI 438496B	III	195	Peking	Black	Russia	1980
PI 438497	III	206	Peking	Black	Russia	1980
PI 438498	IV	28	Sable	Black	Russia	1980
PI 438503A	III	60	Wu dow	Black	Russia	1980
Moderately resistant						
PI 54591	III	31	...	Yellow	China	1921
PI 70218-2-19-3	IV	...	Patoka	Yellow	China	1926
PI 79693	III	Brown	China	1929
PI 89008	II	5953	...	Yellow	China	1930
PI 89014	II	5959	...	Yellow	China	1930
PI 91138	II	6593	...	Yellow	China	1930
PI 200495	IV	46	Kuro-daizu	Black	Japan	1952
PI 398682	IV	320-3(2)	Kaeri-GNT	Black	Korea	1974
PI 407944	V	581-2	Jeonju Gun	Yellow	Korea	1976
PI 408192-2	V	681-7	Gyeongju Gun	Green	Korea	1978
PI 417091	II	H-040095	Kuro mame	Black	Japan	1977
PI 417094	III	H-110025	Kuro Masshokutou	Black	Japan	1977
PI 437488	II	1070	...	Black	Russia	1980
PI 437770	II	1278	...	Black	Russia	1980
PI 438183	II	4447	...	Brown	Russia	1980

Table 2. Total number of soybean lines evaluated and lines resistant to the soybean cyst nematode in different maturity groups

Maturity group	Number of lines		Number of resistant lines	
	Total	Percent of total	Total	Percent of total
000	86	0.94	0	0.0
00	326	3.56	0	0.0
0	801	8.75	0	0.0
I	1,054	11.52	0	0.0
II	1,111	12.14	9	20.0
II	1,030	11.25	16	35.5
IV	2,126	23.23	17	37.8
V	1,369	14.96	3	6.7
VI	421	4.60	0	0.0
VII	314	3.43	0	0.0
VIII	266	2.91	0	0.0
IX	109	1.19	0	0.0
X	140	1.53	0	0.0
Total	9,153		45	

RESULTS AND DISCUSSION

Descriptions of the resistant lines are presented in Table 1. The 30 lines found highly resistant include 11 that were previously reported resistant to one or more races of SCN (1,2,5). Nineteen additional highly resistant lines and 15 moderately resistant lines were isolated. Two of the lines, PI 438496 and PI 438497, received from Russia in 1980, were designated as Peking in their record. PI 438496 is highly variable because three distinct sublines were isolated. PI 438496B was resistant, whereas PI 438496A and PI 438496C were susceptible. Both PI 438496B and PI 438497 are in maturity group III, whereas Peking from the U.S. collection is in group IV. The seed coat of PI 438496B is black with brown mottling, whereas Peking is completely black. These lines might be traced to natural crosses with Peking.

The U.S. soybean collection includes lines received from different countries on various occasions; however, it is difficult in some cases to locate the primary seed source of several of the SCN-resistant lines. Most of the resistant lines are in maturity group II, III, or IV (Table 2). This may be attributed to the place of their origin, because the maximum infestation of SCN has been reported from the northeastern provinces of China, where maturity groups II, III, and IV are adapted.

The numbers of black, yellow, brown, and green-seeded resistant lines were 32, 7, 3, and 3, respectively. More than 50% of the U.S. collection lines are yellow seeded, whereas 71% of the cyst-resistant lines are black seeded. The remainder are yellow (15%), brown (7%), and green (7%) seeded. This may indicate a common background for the resistant lines. Close linkage has been reported between genes for seed coat color and reaction to cyst nematodes (4).

All of our soybean varieties grown at present acquired resistance from Peking for race 3 and from PI 88788 for race 4. Use of new sources of resistance may provide additional genes to broaden the genetic base contributing to resistance.

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