

Evaluation of Soybean Varieties for Resistance to the Soybean Cyst Nematode

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Use of soybean varieties resistant to the soybean cyst nematode (SCN), *Heterodera glycines*, is the most effective method of SCN management. There are a number of SCN-resistant varieties available for the southern and central zones in Minnesota. Most of the resistant varieties in Minnesota are derived from the resistance source 'PI 88788', and a small percentage (about 5%) is from 'Peking'. Recently a few varieties derived from CystX (resistance source 'PI 437654') are also available on the market. Effectiveness of using resistant varieties depends on the interaction of the varieties with local SCN populations. A previous study revealed that most SCN populations in Minnesota were race 3 (HG Type 0, or 7) which is not virulent (having ability to reproduce on resistant varieties) to the common resistance source soybean PI 88788, Peking, and PI 437654, and the levels of virulence of populations did not change significantly from 1997 to 2002 in the state. However, it is expected that the level of virulence will increase and the diverse types of virulent populations will emerge with the use of the resistant varieties in the state. In field plot experiments, after 5 years of the resistant variety Freeborn (PI 88788 source of resistance), SCN population changed from avirulent (HG Type 0 = race 3) to virulent (HG Type 2 = race 1) on PI 88788 and varieties carrying PI 88788 resistance genes. For effective management of SCN, it is important to use appropriate SCN-resistant varieties based on HG Type in a field. For example, if a field is infested with HG Type 0 (race 3), a variety carrying SCN-resistant genes from any of the three sources of resistance is fine. In fields infested with HG Type 2 (race 1), varieties with Peking or PI 437654 (if yield potential is good) source of resistance should be used. In contrast, in field infested with HG Type 1.3 (race 14), PI 88788 varieties should perform well, but varieties developed from Peking should not be used. In this study, resistance of soybean varieties was evaluated against SCN race 3, race 1, and race 14 in the greenhouse and fields.

METHODS

Greenhouse test: A total of 64 varieties with Maturity for southern zone, and 33 varieties with Maturity for central zone in Minnesota were evaluated in the greenhouse on SCN race 1, 3, and 14 originally collected from Minnesota fields. The soybeans were grown in soil infested with 10,000 – 16,000 SCN eggs/100 cm³ soil. Five replicated plants were used. After one month, females formed on the soybean varieties were counted, and the number was compared with that from the standard susceptible 'Lee 74': Female Index (FI) = number of females on a variety × 100 / number of females on Lee 74. Level of SCN resistance was estimated based on the FI (Tables 1 and 2).

Field trial: The field evaluation was based on the egg counts from one of the three fields in each zone of the University Minnesota Varietal Trials in 2007 (Minnesota Varietal Trials Results, January 2008, Minnesota Agricultural Experiment Station, University of Minnesota). The fields in Waseca in southern zone and in Rosemount in central zone were sampled. Average egg population density was determined from three replicated plots for each variety. The level of SCN

resistance was estimated based on the Egg Index: $EI = \text{number of eggs on a variety} \times 100 / \text{number of eggs on the known susceptible varieties}$ (Tables 1 and 2).

RESULTS

Most varieties are moderately resistant (MR) to race 3 and race 14, and susceptible to race 1 (Tables 1 and 2). Among the 91 varieties that were originally classified as SCN-resistant varieties, only eight varieties are rated as R to race 3, and 10 varieties are R to race 14. Sixteen varieties have low level of resistance (MS) on race 3, and 12 varieties are MS to race 14. Two varieties originally rated as R are susceptible to all three races. Only two varieties, 92M21 and M-194NRR, are identified as resistant to race 1, but the result of M-194NRR needs to be confirmed. A few varieties carrying PI 88788 also have low level of resistance (MS) to race 1 (Tables 1 and 2).

SELECTING SCN RESISTANT VARIETIES

SCN populations in most fields in Minnesota are probably HG Type 0 (race 3), which have low level of virulence on the resistant varieties. However, if a field showed low yield of a resistant variety or a field has been planted with the same resistant variety or varieties with the same resistance source (PI 88788) for a number of years (e.g., more than 5 years), the reproduction potential of the nematode population in the field should be evaluated on the resistant varieties and/or their resistance-source soybean. This can be done by scouting females (cysts) on the soybean roots in the field, having egg population density determined, or having the HG Type of the population tested by a professional lab.

The source of resistance should be considered when selecting an SCN-resistant variety. Several genes confer the SCN-resistance traits, and different varieties can contain different resistant genes. If the same resistant variety or resistant varieties derived from the same source are planted in the same field year after year, the SCN will eventually overcome the resistance. Rotation of varieties with different sources of resistance may slow the occurrence of genetic changes of SCN populations. Unfortunately in maturity groups 0, I and II, there are limited options in choosing varieties with different sources of resistance. However, it is still useful to include different varieties even from the same resistance source in rotation since different resistance genes may be included in the varieties. More information on biology and management of the soybean cyst nematode can be found at: <http://www.soybeans.umn.edu/pdfs/DC3935.pdf>.

This study provided the data of SCN resistance of soybean to three HG Types (races). Information for other factors including yield potential, protein and oil contents, maturity rating, Phytophthora-resistance, and chlorosis tolerance can be found in the Bulletin “Minnesota Varietal Trials Results” and the webpages:

http://www.soybeans.umn.edu/pdfs/2007/variety/2007_scn_s.pdf and
http://www.soybeans.umn.edu/pdfs/2007/variety/2007_scn_c.pdf.

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Table 1. Resistance of soybean varieties of southern zone to the soybean cyst nematode in greenhouse and field tests in Minnesota.

Variety	Company	SCN Res. Com†	SCN-resistance source‡	Greenhouse test						Field test		
				Race 3		Race 14		Race 1		Eggs/100 cm ³ soil	EI	Res. §
				FI	Res. §	FI	Res. §	FI	Res. §			
0906N	Bluestem	R	PI 88788	37	MS	30	MR	91	S	2525	45	MS
152CNR	Anderson Seeds	R	PI 88788	27	MR	27	MR	69	S	2425	44	MS
1798NRR	Viking	R	PI 88788	31	MR	14	MR	77	S	550	10	R
1808RR/SCN	Agsources	R	PI 88788	23	MR	15	MR	76	S	3100	56	MS
181CNR	Anderson Seeds	R	PI 88788			16	MR	112	S	3625	65	S
1832-4	Stine	R	PI 88788	29	MR	21	MR	58	MS	750	14	MR
191CNR	Anderson Seeds	R	PI 88788	31	MR	17	MR	106	S	775	14	MR
1932-4	Stine	R	PI 88788	37	MR	16	MR	64	S	113	2	R
1978CBR	Viking	R	PI 88788	18	MR	13	MR	82	S	138	2	R
201CNR	Anderson Seeds	R	PI 88788	24	MR	14	MR	69	S	1525	27	MR
2062-4	Stine	R	PI 88788	30	MR	25	MR	67	S	588	11	MR
2165	Trelay	R	PI 88788	26	MR	21	MR	86	S	350	6	R
2203RR	Trelay	R	PI 88788	22	MR	16	MR	67	S	325	6	R
2324+RR/SCN	Agsources	R	PI 88788					64	S	1450	26	MR
31D20	Dyna-Gro	R	PI 88788	7	R	21	MR	55	MS	650	12	MR
37Y21S	Dyna-Gro	R	PI 88788	15	MR	13	MR	63	S	125	2	R
7193RR/SCN	Agsources	R	PI 88788	34	MS	20	MR	76	S	1850	33	MS
7222	Agsources	R	ND	23	MR	21	MR	73	S	3275	59	MS
91M80	Pioneer Brand	R	PI 88788	25	MR	7	R	60	S	588	11	MR
92M01	Pioneer Brand	R	PI 88788	19	MR	25	MR	60	S	575	10	MR
92M21	Pioneer Brand	R	Peking	7	R	67	S	17	MR	175	3	R
92M40	Pioneer Brand	R	PI 88788	35	MR	22	MR	71	S	1325	24	MR
ADV1740CR	Advantage	R	PI 88788	23	MR	17	MR	93	S	2800	50	MS
ADV1881CR	Advantage	R	PI 88788	15	MR	6	R	73	S	2550	46	MS
AG1802	Asgrow	R	ND	44	MS	19	MR	67	S	1675	30	MS
AG2002	Asgrow	R	ND	36	MS	26	MR	71	S	1725	31	MS
AG2107	Asgrow	R	ND	33	MS	22	MR	62	S	1700	31	MS
AG2108	Asgrow	R	ND					67	S	2500	45	MS
Freeborn	Minnesota AES	R	PI 88788	15	MR	12	MR	82	S	400	7	R
IA1022	Iowa AES	R	PI 88788	14	MR	9	R	44	MS	650	12	MR
IA2068	Iowa AES	R	PI 88788 &/or PI 437654	6	R	6	R	64	S	200	4	R
K-201RR/SCN	Kruger	R	PI 88788	35	MR	27	MR	104	S	975	18	MR
K-222RR/SCN	KSC/Challenger	R	PI 88788	35	MS	31	MS	72	S	925	17	MR
KX1707RN	Kruger	R	PI 88788	24	MR	22	MR	77	S	3000	54	MS
KX2017RN	Kruger	R	PI 88788	26	MR	20	MR	59	MS	775	14	MR
KX2207RNV	KSC/Challenger	R	PI 88788	45	MS	43	MS	135	S	1200	22	MR
KX2417RNV	KSC/Challenger	R	PI 88788	32	MR	26	MR	84	S	550	10	R
KX2427RN	Kruger	R	PI 88788	39	MS	33	MS	85	S	1425	26	MR
KY2027RN	KSC/Challenger	R	PI 88788	55	MS	29	MR	60	S	650	12	MR
L2085R												
BRAND	Latham	R	PI 88788	26	MR	23	MR	120	S	475	9	R
L2158R												
BRAND	Latham	R	PI 88788	40	MR	28	MR	89	S	525	9	R
M-194NRR	Mustang Seeds	R	ND					3	R?	950	17	MR

Table 1 - continued. Resistance of soybean varieties of southern zone to the soybean cyst nematode in greenhouse and field tests in Minnesota.

Variety	Company	SCN Res. Com†	SCN-resistance source‡	Greenhouse test						Field test		
				Race 3		Race 14		Race 1		Eggs/100 cm ³ soil	EI	Res. §
				FI	Res. §	FI	Res. §	FI	Res. §			
M-194NRR	Mustang Seeds	R	ND					3	R?	950	17	MR
M-217NRR	Mustang Seeds	R	ND	44	MS	23	MR	77	S	375	7	R
M-228NRR	Mustang Seeds	R	ND	20	MR	15	MR	62	S	1050	19	MR
M-238NRR	Mustang Seeds	R	ND	28	MR	15	MR	77	S	225	4	R
MN1011CN	Minnesota AES	R	PI 88788	10	R	2	R	58	MS	313	6	R
MN1410	Minnesota AES	S	S	61	S	54	MS	112	S	5550	0	S
MN1701CN	Minnesota AES	R	PI 88788	8	R	6	R	48	MS	350	6	R
NT-2219RR											10	
/SCN	Nutech	R	PI 88788	29	MR	25	MR	105	S	1050	19	MR
NT-7201	Nutech	R	PI 88788	18	MR	17	MR	79	S	663	12	MR
NT-7222	Nutech	R	PI 88788	34	MR	23	MR	71	S	725	13	MR
NT-7242	Nutech	R	PI 88788	19	MR	14	MR	45	MS	613	11	MR
PB-1885NRR	Prairie Brand	R	PI 88788	9	R	29	MR	65	S	1050	19	MR
PB-1887NRR	PBR	R	PI 88788	8	R	2	R	97	S	1650	30	MR
PB-2007NRR	Prairie Brand	R	PI 88788	21	MR	16	MR	53	MS	950	17	MR
PB-2056NRR	PBR	R	PI 88788	26	MR	24	MR	89	S	1050	19	MR
PB-2117NRR	PBR	R	PI 88788	18	MR	19	MR	66	S	675	12	MR
PB-2183NRR	Prairie Brand	R	PI 88788	25	MR	13	MR	62	S	625	11	MR
PB-2207NRR	PBR	R	PI 88788	25	MR	12	MR	83	S	450	8	R
PB-2297NRR	Prairie Brand	R	PI 88788	33	MS	39	MS	54	MS	438	8	R
S19-L7	NK Brand	R	ND	16	MR	22	MR	75	S	1475	27	MR
SX07323	Dyna-Gro	R	PI 88788	19	MR	26	MR	59	MS	25	0	R
XR2373	NK Brand	R	PI 88788					94	S	663	12	MR
XR2374	NK Brand	R	PI 88788	29	MR	53	MS	61	S	1775	32	MS

† The information of resistance was provided by companies.

‡ The information of source of resistance was provided by companies. ND = no data provided.

§ SCN resistance rating: R = resistant at FI or EI 10% or less; MR = moderate resistant at FI or EI 11-30%; MS = moderate susceptible (low resistance) at FI or EI 31-60%; and S = susceptible at FI or EI more than 60%. There are no data for a few varieties due to poor plant growth. Experiments are under way to re-evaluate these varieties.

Table 2. Resistance of soybean varieties of central zone to the soybean cyst nematode in greenhouse and field tests in Minnesota.

Variety	Company	SCN Res. Com†	SCN-resistance source‡	Greenhouse test						Field test		
				Race 3		Race 14		Race 1		Eggs/100 cm ³ soil	EI	Res. §
				FI	Res. §	FI	Res. §	FI	Res. §			
1432-4	Stine	R	PI 88788					84	S	3525	34	MS
39D11	Dyna-Gro Seeds	R	PI 88788	63	S	85	S	134	S	10650	102	S
90M80	Pioneer Brand	R	ND	27	MR	54	MS	71	S	1750	17	MR
91M61	Pioneer Brand	R	PI 88788	19	MR	12	MR	97	S	1225	12	MR
AG0803	Asgrow	R	ND	25	MR	26	MR	98	S	5700	55	MS
AG1402	Asgrow	R	ND	60	MS	34	MS	101	S	4000	38	MS
KX1417RN	Kruger	R	PI 88788			32	MS	100	S	4500	43	MS
KX1617RN	Kruger	R	PI 88788	36	MR	21	MR	117	S	913	9	R
KX1707RN	Kruger	R	PI 88788	30	MR	23	MR	105	S	6275	60	S
KY1507RN	Kruger	R	PI 88788	28	MR	44	MS	108	S	2225	21	MR
Lambert	Minnesota AES	S	S	93	S			110	S	8025	77	S
M-177NRR	Mustang Seeds	R	ND	30	MR	25	MR	85	S	2900	28	MR
MN0308CN	Minnesota AES	R	PI 88788					109	S	2525	24	MR
MN0602CN	Minnesota AES	R	PI 88788	117	S	62	S	115	S	10975	105	S
MN0606CN	Minnesota AES	R	PI 88788	16	MR	12	MR	75	S	2175	21	MR
MN0806CN	Minnesota AES	R	PI 88788	6	R	7	R	94	S	2325	22	MR
MN0902CN	Minnesota AES	R	PI 88788	13	MR	8	R	113	S	2250	22	MR
MN1005	Minnesota AES	S	S	108	S	86	S	100	S	9450	91	S
MN1011CN	Minnesota AES	R	PI 88788	25	MR	8	R	76	S	7025	67	S
MN1410	Minnesota AES	S	S	115	S	33	MS	101	S	11600	111	S
NT-1808RR /SCN	Nutech	R	ND	35	MR	28	MR	110	S	1900	18	MR
NT-7155	Nutech	R	PI 88788	17	MR	14	MR	71	S	2400	23	MR
NT-7167	Nutech	R	PI 88788	17	MR			84	S	4325	41	MS
NT-7193RR /SCN	Nutech	R	PI 88788	22	MR	18	MR	111	S	4150	40	MS
PB-1557NRR	Prairie Brand	R	PI 88788	39	MS	29	MR	83	S	4200	40	MS
PB-1585NRR	Prairie Brand	R	PI 88788					108	S	2850	27	MR
PB-1737NRR	Prairie Brand	R	PI 88788	50	MS	13	MR	39	MS	3775	36	MS
PB-1885NRR	Prairie Brand	R	PI 88788	30	MS	31	MS	58	MS	3450	33	MS
S08-M8	NK Brand	R	PI 88788	36	MS	27	MR	125	S	3850	37	MS
S13-K2	NK Brand	R	PI 88788			14	MR	108	S	2800	27	MR
S19-L7	NK Brand	R	PI 88788			16	MR	92	S	3025	29	MR
SHEYENNE	No. Dakota AES	S	S	136	S	82	S	92	S	12100	116	S
SX07814	Dyna-Gro Seeds	R	PI 88788					41	MS	2750	26	MR

† The information of resistance was provided by companies.

‡ The information of source of resistance was provided by companies. ND = no data provided.

§ SCN resistance rating: R = resistant at FI or EI 10% or less; MR = moderate resistant at FI or EI 11-30%; MS = moderate susceptible (low resistance) at FI or EI 31-60%; and S = susceptible at FI or EI more than 60%. There are no data for a few varieties due to poor plant growth or not enough replicates. Experiments are under way to re-evaluate these varieties.