

Responses of Soybean Cultivars and Breeding Lines to Races of *Heterodera glycines*¹

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Abstract: Many new cultivars of soybean (*Glycine max*) are released each year. Knowledge of their relative susceptibility to soybean cyst nematode (*Heterodera glycines*) is of interest to soybean breeders and those making nematode management recommendations. Two-hundred-eighty-one cultivars and breeding lines of soybean were screened for resistance to isolates of *H. glycines* races 1, 2, 3, 4, 5, 6, 9, and 14. No cultivar or line (except possibly PI 437654 or cultivars developed from this PI line) had resistance to all of the races tested. Twenty-one cultivars and lines were resistant to race 1, 5 to race 2, 146 to race 3, 2 to race 4, 4 to race 5, 24 to race 6, and 24 to race 14; some had resistance to more than one race. In addition, several cultivars and lines had moderate resistance to each of the race isolates tested.

Key words: breeding, cultivar, *Glycine max*, *Heterodera glycines*, soybean, soybean cyst nematode, race, resistance.

Soybean cyst nematode, *Heterodera glycines*, is known to occur in 26 of 28 states in the United States in which soybean (*Glycine max*) is grown (16). This nematode has long been recognized as a major cause of yield losses in the southeastern United States; however, a recent report (4) indicated that 48.6% of soybean disease losses in the north-central states were attributed to *H. glycines*. Many soybean breeders in the public and private sectors are developing cultivars with resistance to *H. glycines*. In most cases, cultivars are tested against one or more isolates of races 1, 2, 3, 4, 5, 6, 9, and 14—some because they occur commonly, others because few cultivars have resistance. The purpose of our study was to test all of the cultivars of soybean that were included in the University of Arkansas yield tests for cultivars and new strains each year against as many isolates representing different races of *H. glycines* as possible.

MATERIALS AND METHODS

The methods used in these tests were similar to those used in earlier studies (13,15). Seeds of the test cultivars and lines (hereafter referred to as "lines" in the text) were germinated in vermiculite, transplanted at the cotyledon stage into 7.5-cm-d clay pots containing sterilized fine sandy soil (91% sand, 5% silt, 4% clay; 0.1% organic matter; pH 6.1) that was infested with 4,000 eggs and second-stage juveniles (J2) of a selected isolate of *H. glycines* 24 hours after transplanting. Plants were kept in a greenhouse at a minimum of 26.5 C. After 28–35 days, females were dislodged from roots with a strong spray of water and enumerated. A total of 281 lines were tested; 196 were tested for resistance to race 1, 199 for race 2, 281 for race 3, 146 for race 4, 281 for race 5, 83 for race 6, and 280 for race 14 resistance. Some cultivars were tested 3 years (1991–93), whereas others were tested only 1 year.

The race differential soybean cultivars and Plant Introduction (PI) lines Pickett, Peking, PI 88788, and PI 90763 (hereafter referred to as differentials) (5,14) were included in each test (Table 1). Because of large variations in the reproduction of race 3 of *H. glycines* on the cultivar Lee (14), Lee 74 was used as the standard susceptible

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TABLE 1. Isolates of *Heterodera glycines* used in testing host responses of soybean cultivars and lines in greenhouse tests in Arkansas, 1991-93.

Cultivar or plant introduction	Female indices ^a							
	Race 1	Race 2A	Race 2B	Race 3	Race 4	Race 5	Race 6	Race 14
	1991							
Lee	— ^b	100	100	100	—	100	—	100
Pickett	—	101	68	<1	—	40	—	56
Peking	—	10	30	0	—	1	—	20
PI 88788	—	13	27	<1	—	50	—	3
PI 90763	—	2	6	<1	—	0	—	11
	1992							
Lee	100	100	—	100	—	100	100	100
Pickett	1	172	—	<1	—	67	23	88
Peking	<1	15	—	<1	—	1	1	35
PI 88788	29	12	—	<1	—	43	1	2
PI 90763	0	3	—	0	—	<1	<1	41
	1993							
Lee	100	—	—	100	100	100	—	100
Pickett	2	—	—	<1	107	60	—	86
Peking	0	—	—	0	47	2	—	34
PI 88788	22	—	—	<1	26	50	—	7
PI 90763	<1	—	—	0	15	0	—	29

^a Female index = (average number of females and cysts on test cultivar + average number of females and cysts on Lee 74 soybean cultivars) × 100. An FI of <10 = resistant, 10 to 30 = moderately resistant, 31 to 60 = moderately susceptible, and >60 = susceptible.

^b — = isolate not used in indicated year.

cultivar for race testing. The test lines were replicated five times except in a few cases where seed germination was poor or where one or more plants died during the test. Each race differential was replicated 10 times.

Host response was categorized on the basis of a female index (FI) calculated for each soybean line as a percentage of the number of females produced on Lee 74, as follows: FI = (average number of females on test line ÷ the average number of females on Lee 74) × 100. Female indices were rounded to the nearest whole number. Soybean lines were categorized according to their FI as follows: <10 indicated resistance; 10 to 30, moderate resistance; 31 to 60, moderate susceptibility; and >60, susceptibility (17).

RESULTS

Eighty-one lines were susceptible to race 3 (Table 2), and those lines varied in their susceptibility to other races. Thirty-eight

lines were moderately susceptible to race 3 (Table 3), but were not equally susceptible to other races. The nine lines that were moderately resistant to race 3 (Table 4) and the 134 lines that were resistant to race 3 (Table 5) also had variable susceptibility to the other races.

Two *H. glycines* race 2 isolates were used for testing (Table 1). Of the 141 soybean subjected to both race 2 isolates, 58 were in similar response categories whereas 83 were in different response categories (Tables 2-5). In fact, six lines were categorized as susceptible to one isolate and resistant to the other. Fifteen other lines differed by two categories (susceptible and moderately resistant, or moderately susceptible and resistant) to the two race 2 isolates.

During the last 10 years, 611 lines have been tested for resistance to race 3 and fewer to other races (Table 6). Forty-five percent of those tested have been resistant to race 3, whereas no more than 12% of those tested with any other race were resistant.

TABLE 2. Female indices^a of eight isolates of *Heterodera glycines* on soybean cultivars and breeding lines that were susceptible to race 3 of *H. glycines*.

Cultivar or breeding line	Race							
	1	2A	2B	3	4	5	6	14
A6785	69	100	94	65	93	61	— ^b	134
A7258	106	202	86	72	—	128	174	100
AgraTech 575	69	157	65	67	60	81	—	—
BioDelt 2146	94	113	—	67	83	79	93	90
Braxton	—	125	102	77	—	170	—	52
Brim	67	117	49	101	60	77	18	113
Buckshot 603	69	99	48	65	—	92	68	49
Buckshot 62	24	—	—	128	126	37	—	67
Buckshot 68	90	—	—	153	101	81	—	75
Buckshot 703	85	164	116	64	—	51	45	145
Buckshot 723	64	—	—	123	99	77	—	89
Capehart Stone	77	86	56	73	78	152	—	151
Crawford	94	10	64	96	66	90	—	79
Davis	82	105	—	73	—	127	37	76
Deltapine DP 3456	—	120	83	80	—	101	—	213
Deltapine DPX 3553	93	—	—	95	56	50	—	172
Deltapine DPX 3606	56	—	—	222	34	61	—	148
Deltapine DP 3627	91	81	59	96	78	89	11	136
Deltapine 417	—	88	127	101	—	65	—	344
Deltapine 506	—	127	130	64	—	118	—	60
Douglas	—	4	42	118	—	161	—	224
Dyna-Gro 3495	97	—	—	125	90	67	—	73
Dyna-Gro 3576	79	—	—	79	27	97	—	88
E.H.J.U. 13	—	90	21	69	—	137	—	40
Flyer	126	—	—	129	102	81	—	93
Hartz HX1039	—	76	1	85	—	38	—	32
Hartz HX307	90	74	49	63	—	62	7	37
Hartz H4242	121	—	—	68	99	119	—	76
Hartz H5070	61	—	—	121	56	49	—	100
Hartz HX5191	59	204	—	71	—	104	147	87
Hartz HX5258	60	202	—	71	—	190	73	128
Hartz HX5403	—	90	39	104	—	38	—	3
Hartz H6500	22	—	—	70	30	23	—	100
Hartz 6686	96	89	79	76	105	94	—	60
HB 90-400	—	79	124	80	—	87	—	233
HB 90-472	—	106	67	75	—	30	—	95
HBK 49	104	—	—	91	111	95	—	97
HBK 65	128	—	—	85	30	107	—	161
HSC 401 Brand	82	—	—	65	79	71	—	84
HSC 579	—	16	15	93	—	58	—	2
Hyperformer HB2-X484	70	—	—	128	66	78	—	112
Hyperformer HY 498	90	—	—	103	53	131	—	95
Wilstar 550	—	101	43	127	—	18	—	224
Hutcheson	20	134	53	145	119	101	—	114
Lee 74	—	133	68	86	—	178	—	85
M89-577321	71	167	140	76	—	86	151	230
M89-685724	108	95	132	82	—	55	51	120
MECO 799	38	—	—	70	64	63	—	64
Mitchell 410	90	—	—	74	62	104	—	89
Mitchell 450	90	—	—	134	54	102	—	116
Northrup King C6847	—	108	164	77	—	94	—	109
Northrup King RA452	85	151	—	69	76	93	96	82
Pershing	—	4	75	94	—	50	—	13
Pioneer 9391	—	11	61	72	—	103	—	129
Pioneer 9501	75	82	—	95	—	167	162	102
Pioneer 9581	—	44	147	88	—	117	—	179

TABLE 2. Continued

Pioneer 9641	—	56	114	81	—	108	—	99
Pioneer 9791	—	68	124	92	—	172	—	15
Riverside 499	103	163	42	76	110	104	—	79
Riverside 699	98	109	40	84	108	83	—	61
Riverside 77	93	—	—	92	85	70	—	133
Riverside 90-94	37	—	—	118	53	62	—	112
Riverside 91-46	111	—	—	110	81	92	—	56
Stafford	114	—	—	91	118	116	—	90
Stoneville FFR 464	86	132	—	117	120	83	240	116
Stoneville FFR 561	48	156	22	131	59	93	—	127
Stoneville FFR 562	92	117	56	77	—	126	135	76
Stoneville FFR 671	26	—	—	101	111	47	—	129
Stoneville FFR 695	147	93	36	99	23	61	—	61
Terra-Vig 505	—	93	111	100	—	51	—	448
Terra-Vig 5693	—	98	92	85	—	40	—	77
Terra-Vig 6653	87	90	156	128	27	103	44	134
Toano	92	—	—	67	104	69	—	83
Tracy M	32	120	98	111	105	72	—	237
UAPX 36	92	193	—	82	48	89	196	106
Underwood 509A	101	124	—	76	—	107	151	108
Underwood 605	45	134	—	81	—	128	21	90
Vernal	54	—	—	107	138	47	—	79
Union	112	—	—	62	81	90	—	90
Victory	—	67	163	80	—	116	—	425
Young	69	129	—	97	102	49	—	78
Total no. tested	59	54	43	81	46	81	20	80
No. susceptible	46	47	26	81	31	64	12	68
No. mod. susceptible	9	1	13	0	10	14	4	8
No. mod. resistant	4	3	3	0	5	3	3	2
No. resistant	0	2	1	0	0	0	1	2

^a Female index (FI) = (average number of females and cysts on test cultivar ÷ average number of females and cysts on Lee 74 soybean cultivar) × 100. An FI of <10 = resistant, 10 to 30 = moderately resistant, 31 to 60 = moderately susceptible, and >60 = susceptible.

^b — = not tested.

DISCUSSION

Because *H. glycines* race 3 does not have an FI ≥ 10 on any of the differentials (Table 1), the assumption was made that any cultivar susceptible to race 3 would also be susceptible to the other races. In our previous tests, no cultivar that was susceptible to race 3 was resistant to any other race (13,15). However, in 1990, Young (19) reported that PI 399061, PI 424595, and PI 438342 were susceptible to race 3 but resistant to race 5. In our test, most of the 281 lines were resistant to race 3, and a few lines that were resistant to other races were susceptible to race 3. In tests in Georgia, no cultivar that was susceptible to race 3 was resistant to race 9 (10–12). Cultivars observed to be susceptible to race 3 and resistant to another race (in our case, two

resistant to race 2, one to race 6, and three to race 14) should be retested to determine whether they are truly resistant or were escapes. However, because multiple genes are involved in resistance and susceptibility to various races of *H. glycines* (2,3,5–9,18), different genes may combine such that a soybean line could have resistance to another race even though susceptible to race 3. In addition, the differentials do not encompass the entire spectrum of resistance genes found in *Glycine max* (1).

Resistance ratings for 77 of the cultivars in these studies were included in the 1988 and/or the 1991 report of Arkansas tests (13,15), and 66 were reported in Georgia tests (10–12,14). They were included in more than one report because we test them for 3 years. When the other papers were published they had not been tested three

TABLE 3. Female indices^a of eight isolates of *Heterodera glycines* on soybean cultivars and breeding lines that were moderately susceptible to race 3 of *H. glycines*.

Cultivar or breeding line	Race							
	1	2A	2B	3	4	5	6	14
BioDelt 2449	80	— ^b	—	56	102	104	—	43
Bragg	—	57	67	69	—	106	—	4
Buckshot 67	57	—	—	38	65	61	—	65
CSIM 9461	—	63	28	47	—	84	—	176
Delta King 5430	35	202	—	35	55	43	141	116
Deltapine 105	94	148	167	49	159	79	—	196
Deltapine DP 3456	84	92	—	55	107	116	72	72
Deltapine DPX3484	86	165	—	49	—	73	66	136
Deltapine 566	—	113	30	47	—	30	—	216
Dyna-Gro 3501	86	29	—	37	—	114	149	124
E.H.J.U. 5	—	121	44	41	—	171	—	80
Hartz H4242	42	95	—	57	—	77	171	171
Hartz H4464	1	51	26	50	—	17	14	71
Hartz HX5070	37	111	—	57	—	109	63	90
Hartz HX5258	—	92	29	56	—	136	—	81
Hartz HX5403	46	63	—	41	—	146	57	58
Hartz H5668	—	121	58	40	—	165	—	80
Hartz 6200	1	78	5	44	81	75	—	137
Hartz H6464	61	95	—	41	20	66	25	66
Hartz H7190	90	113	45	32	—	86	205	187
Z-1357	—	73	94	35	—	79	—	161
HB 89-147B	—	48	50	56	—	76	—	29
HSC 623	—	95	82	55	—	82	—	12
HSC 682	64	55	—	35	—	96	17	79
HSC 401	56	111	—	39	—	56	70	140
Lamar	95	114	74	61	—	87	35	102
M89-467126	71	99	136	38	—	100	126	174
Pioneer 9461	58	44	84	61	—	80	86	39
Pioneer 9591	—	97	191	49	—	90	—	330
Pioneer 9592	149	122	38	33	70	113	—	105
Riverside 677	—	115	78	58	—	201	—	118
Terra-Vig 5693	96	116	—	53	58	95	55	81
Terra-Vig 616	91	113	22	42	—	124	13	85
UAPX 29	24	110	—	46	124	51	126	78
UAPX 34	91	72	—	44	—	97	5	81
UAPX 41	17	98	—	53	—	78	33	53
UAPX 96	107	—	—	45	102	91	—	93
Underwood 609	96	160	—	41	—	116	100	130
Total no. tested	27	35	20	38	11	38	21	38
No. susceptible	16	28	9	0	8	33	12	31
No. mod. susceptible	7	5	5	38	2	3	4	4
No. mod. resistant	2	1	5	0	1	2	4	2
No. resistant	2	0	1	0	0	0	1	1

^a Female index (FI) = (average number of females and cysts on test cultivar ÷ average number of females and cysts on Lee 74 soybean cultivar) × 100. An FI of <10 = resistant, 10 to 30 = moderately resistant, 31 to 60 = moderately susceptible, and >60 = susceptible.

^b — = not tested.

times. Of those reported previously in Arkansas tests, 73 had the same responses to race 3 as in our current studies, 27 susceptible and 46 resistant. Two lines previously reported as moderately resistant were

rated susceptible in the tests reported herein, and one that was previously reported as susceptible was rated resistant herein. Of the eight previously tested that are currently rated moderately susceptible,

TABLE 4. Female indices^a of eight isolates of *Heterodera glycines* on soybean cultivars and breeding lines that were moderately resistant to race 3 of *H. glycines*.

Cultivar or breeding line	Race							
	1	2A	2B	3	4	5	6	14
87243	— ^b	94	73	13	—	128	—	94
BG 50600	81	68	46	24	70	98	23	31
DeKalb CX458	89	—	—	21	113	115	—	64
Hartz HX5442	—	42	26	18	—	45	—	11
HB2-X490	124	—	—	26	100	79	—	85
KS 5292	46	—	—	10	77	57	—	115
Northrup King S48-84	42	85	22	25	88	41	22	45
Underwood 611	38	68	—	17	—	66	14	25
Winner	—	38	16	23	—	69	—	4
Total no. tested	6	6	5	9	5	9	3	9
No. susceptible	3	4	1	0	5	6	0	4
No. mod. susceptible	3	2	1	0	0	3	0	2
No. mod. resistant	0	0	3	9	0	0	3	2
No. resistant	0	0	0	0	0	0	0	1

^a Female index (FI) = (average number of females and cysts on test cultivar ÷ average number of females and cysts on Lee 74 soybean cultivar) × 100. An FI of <10 = resistant, 10 to 30 = moderately resistant, 31 to 60 = moderately susceptible, and >60 = susceptible.

^b — = not tested.

seven were reported as susceptible and one as resistant; of two rated previously as moderately resistant, both are reported as R.

Of the eight cultivars previously tested in Arkansas for race 1, one has the same rating, seven have different ratings; of the 36 tested for race 2, 23 are the same, 13 are different; of the 22 tested for race 4, 11 are the same, 11 are different; of the 59 tested for race 5, 33 are the same, 26 are different; of the three tested for race 6, two are the same, one is different; and of the 74 tested for race 14, 41 are the same, 33 are different. Of the 64 cultivars tested for race 3 resistance in Arkansas and Georgia, 52 cultivars had the same ratings and 12 had different ratings.

Discrepancies in ratings such as those listed in the previous paragraph, may be explained by the fact that races of *H. glycines* are not homogeneous. A field population of *H. glycines* is a mixture of genotypes for parasitic capabilities. A race test is an average measure of the genotypes for parasitism that are included in a given population. The test is limited by the genes for resistance present in the differentials. The isolates designated as the same race

may vary considerably in FI on a given differential, as was true in our tests (Table 1). At the same time, soybean lines may not be homozygous for resistance, and whereas a particular combination of genes (alleles) confers resistance to a particular combination of genotypes in the *H. glycines* population, the same combination of soybean genes may not confer resistance to another combination of genotypes in another *H. glycines* population. Thus, reports of resistance of soybean lines to a given race may vary, particularly if FI are borderline on any differential. If a race is negative on a given differential, such as for race 14 on PI 88788, the nearer the FI is to 0, the stronger the race, theoretically, and the more reliable the test of soybean lines when that isolate is used.

Resistance to race 3 appears to be most closely correlated with resistance to race 6. Of those soybean lines resistant to race 3 that were tested against race 6, 60% were resistant. In previous tests (13,15) all cultivars resistant to race 14 were also resistant to race 3, but not in the present tests. Two cultivars that were susceptible and moderately resistant to race 3 were resistant to race 14. The tests confirm previous obser-

TABLE 5. Female indices^a of eight isolates of *Heterodera glycines* on soybean cultivars and breeding lines that were resistant to race 3 of *H. glycines*.

Cultivar or breeding line	Race							
	1	2A	2B	3	4	5	6	14
88500	— ^b	45	29	2	—	41	—	34
A4715	32	50	—	2	42	72	8	14
A5403	36	50	76	3	28	110	—	15
A5560	73	—	—	1	51	53	—	27
A5885	73	—	—	3	58	86	—	29
A5979	42	50	26	5	—	95	4	25
A6291	—	26	111	4	—	133	—	1
A6297	26	—	—	4	20	48	—	33
A6961	65	50	—	8	21	52	9	41
AgraTech 495	—	26	80	2	—	14	—	0
AgraTech 520	41	—	—	<1	42	51	—	132
AgraTech 550	69	35	170	1	36	55	—	23
AgraTech 555	43	—	—	3	19	51	—	32
AgraTech 695	—	39	23	1	—	116	—	37
Avery	35	—	—	1	39	40	—	24
Bedford	—	53	36	1	—	50	—	1
BioDelt 2157	74	—	—	3	46	52	—	26
BG 60400	77	—	—	6	39	85	—	11
BG 88501	—	29	165	1	—	111	—	74
Bryan	—	119	84	<1	—	36	—	79
Buckshot 507	82	41	133	2	—	92	4	49
Buckshot 55	44	—	—	7	16	85	—	30
Buckshot 66	67	—	—	4	20	58	—	9
Centennial	—	78	125	1	—	42	—	72
Cordell	—	22	34	0	—	19	—	24
Crowley	136	60	15	6	32	72	—	47
DeKalb CX469c	73	41	—	8	20	99	5	18
Delsoy 4500	4	—	—	<1	65	36	—	41
Delsoy 4710	41	—	—	1	31	80	—	16
Delsoy 4900	88	—	—	<1	125	84	—	110
Delta King 521	38	—	—	5	29	46	—	36
Delta King 551	48	—	—	8	25	131	—	17
Deltapine X3541	48	—	—	8	28	45	—	60
Deltapine DPX 3589	101	—	—	1	61	108	—	99
Deltapine DPX 3680	1	168	—	<1	—	37	54	55
Deltapine DP 3682	1	—	—	<1	45	21	—	100
Deltapine 415	51	102	111	1	52	72	—	73
Deltapine 726	—	87	134	6	—	44	—	44
E.H.J.U. 7	—	63	73	0	—	5	—	209
E.H.J.U. 11	—	55	39	9	66	196	—	136
Emery	—	33	53	2	—	26	—	2
Epps	—	41	96	1	—	73	—	6
Forrest	—	92	50	1	—	131	—	313
Gordon	—	141	2	4	—	60	—	28
Hartwig	0	<1	—	0	0	<1	0	<1
Hartz H5088	30	113	—	2	—	136	38	70
Hartz 5164	81	41	5	4	44	87	—	29
Hartz H5240	1	71	76	<1	—	125	20	104
Hartz H5350	78	—	—	1	40	31	—	17
Hartz 5370	—	58	7	1	—	197	—	2
Hartz HX5566	52	48	126	3	27	92	—	81
Hartz HX5650	—	80	61	7	—	3	—	197
Hartz 5810	49	45	—	2	20	91	16	17
Hartz 6130	—	35	26	0	—	99	—	158
Hartz HX6797	—	37	48	3	—	34	—	2
Hartz 7126	—	30	149	8	—	60	—	14

TABLE 5. Continued

HBK 79	42	—	—	0	70	65	—	70
Hyperformer HSC B2J	1	38	87	1	58	50	—	103
Hyperformer HSC 501								
Brand	77	—	—	3	35	20	—	33
Hyperformer HSC 557	32	37	—	3	29	54	2	19
Hyperformer HSC 591	56	37	135	3	24	89	19	329
Hyperformer HB 90-5	68	9	—	3	—	174	9	28
Hyperformer HSC 623	70	76	52	5	71	79	3	33
Hyperformer HSC 721	33	106	104	2	—	85	8	160
Hyperformer HSC 741	57	89	29	3	—	68	6	12
Leflore	—	33	83	1	—	24	—	42
Lloyd	—	54	29	2	—	69	—	97
Manokin	40	—	—	<1	108	24	—	98
MECO 678	1	—	—	<1	79	12	—	71
MECO 679	56	—	—	7	23	62	—	44
Narrow	—	153	6	3	—	88	—	23
Narrow M	58	112	—	2	64	96	9	126
Northrup King Coker 485	1	60	100	<1	85	79	—	111
Northrup King Coker 6727	29	—	—	1	43	40	—	115
Northrup King Coker 6955	—	73	66	0	—	49	—	83
Northrup King Coker 6995	—	26	20	1	—	111	—	112
Northrup King RA 606	—	81	33	3	—	29	—	113
Northrup King S59-60	109	—	—	3	37	68	—	24
Northrup King S61-89	68	73	44	3	10	66	21	16
Northrup King S64-23	—	40	47	1	—	90	—	193
Northrup King S59-60	119	31	60	1	—	54	3	150
Northrup King S62-66	64	—	—	4	59	38	—	11
Northrup King X9165	—	26	58	2	—	48	—	6
Northrup King X9256	46	—	—	3	17	57	—	17
Northrup King X9275	42	—	—	6	114	67	—	32
Pharoah	—	3	38	1	—	100	—	144
PI 437654	0	—	—	0	0	<1	—	2
Pioneer 9521	<1	69	—	<1	31	31	7	107
Pioneer 9531	45	60	73	3	—	100	9	9
Pioneer 9551	55	109	—	7	31	68	5	25
Pioneer 9584	92	—	—	1	100	69	—	87
Pioneer 9593	50	197	—	2	88	83	47	98
Pioneer 9681	—	115	70	1	—	46	—	104
Pioneer 9692	31	—	—	2	148	66	—	71
Pioneer 9711	1	148	74	4	65	95	47	95
Pioneer 9751	—	94	142	0	—	128	—	63
Pioneer 9761	54	130	—	1	88	80	5	90
Rally	—	72	55	3	—	150	—	120
Rhodes	4	95	76	<1	42	62	—	162
Riverside 577	0	54	87	1	40	64	—	121
Riverside 696	—	100	64	<1	—	116	—	13
Riverside 757	28	43	61	6	38	147	—	137
RJ 85-9116	47	18	16	1	17	32	—	171
RVSL 91-42	22	—	—	<1	89	29	—	51
RVSL 91-75	1	—	—	<1	45	57	—	81
RVSL 91-85	21	—	—	0	127	38	—	67
Sampson	—	68	45	5	—	95	—	5
Sharkey	3	85	40	<1	33	38	—	171
Stoneville FFR 3809	47	23	—	5	—	72	12	22
Stoneville FFR 3810	88	—	—	3	45	71	—	54
Stoneville FFR 565	—	73	33	7	—	174	—	17
Stoneville FFR 595	54	35	—	3	20	97	5	14
Stoneville FFR 606	—	37	162	3	—	58	—	51
Stoneville FFR 646	57	35	61	6	16	107	—	126
Stoneville FFR X36578	—	34	46	2	—	38	—	325
Stonewall	1	151	144	<1	158	45	22	189

TABLE 5. *Continued*

Terra-Vig 515	9	57	91	<1	84	114	—	121
Terra-Vig 5452	76	84	155	2	58	55	11	97
Terra-Vig 5555	57	100	—	7	33	74	12	33
Terra-Vig 5652	40	—	—	2	—	131	—	3
Terra-Vig 5676	44	—	—	4	18	43	—	23
Terra-Vig 626	20	51	58	4	—	88	—	33
Terra-Vig X6670	93	82	—	3	17	111	5	35
Terra-Vig 6792	31	—	—	5	35	48	—	33
Thomas	—	103	14	1	—	64	—	2
TN 4-86	50	1	111	1	31	48	—	35
TN 5-85	—	75	103	<1	—	93	—	162
Twiggs	—	77	140	<1	—	26	—	197
UAPX 40	71	176	—	4	—	97	26	91
UAPX 42	53	32	—	3	26	97	9	20
Underwood 607	0	147	—	1	—	21	24	155
Underwood 701W	46	154	—	9	—	55	7	17
Walters	—	10	3	1	—	57	—	143
Total no. tested	91	94	73	134	76	134	35	134
No. susceptible	26	42	39	0	20	73	0	58
No. mod. susceptible	40	38	20	0	31	45	4	25
No. mod. resistant	7	10	10	0	23	12	10	35
No. resistant	18	4	4	134	2	4	21	16

^a Female index (FI) = (average number of females and cysts on test cultivar ÷ average number of females and cysts on Lee 74 soybean cultivar) × 100. An FI of <10 = resistant, 10 to 30 = moderately resistant, 31 to 60 = moderately susceptible, and >60 = susceptible.

^b — = not tested.

TABLE 6. Numbers of cultivars and breeding lines tested and percentage of cultivars tested that were in each host response category.

Cultivar or breeding line	Race 1		Race 2		Race 3		Race 4		Race 5		Race 6		Race 9		Race 14	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1988																
Total tested	— ^a	—	114	—	171	—	87	—	106	—	95	—	—	—	82	—
Susceptible	—	—	77	68	71	42	33	39	68	64	42	44	—	—	67	82
Mod. sus.	—	—	22	19	24	14	31	36	28	26	11	12	—	—	2	2
Mod. res.	—	—	14	12	19	11	22	25	9	8	31	33	—	—	11	13
Resistant	—	—	1	1	57	33	1	1	1	1	11	12	—	—	2	2
1991																
Total tested	38	—	94	—	178	—	97	—	96	—	120	—	97	—	178	—
Susceptible	16	42	34	36	70	39	78	80	72	75	47	39	48	49	92	58
Mod. sus.	9	24	36	38	18	10	15	15	18	19	23	19	29	30	46	26
Mod. res.	7	18	23	24	9	5	3	3	4	4	49	41	17	17	23	13
Resistant	6	16	1	1	81	45	1	1	2	2	1	1	3	3	17	10
1994																
Total tested	183	—	189	—	262	—	138	—	262	—	79	—	—	—	261	—
Susceptible	91	50	122	65	81	31	64	46	176	67	24	30	—	—	161	62
Mod. sus.	59	32	47	25	38	14	43	31	65	25	12	15	—	—	39	15
Mod. res.	13	7	14	7	9	3	29	21	17	6	20	25	—	—	41	16
Resistant	20	11	6	3	134	51	2	1	4	1	23	29	—	—	20	8
All																
Total tested	221	—	397	—	611	—	322	—	464	—	294	—	97	—	521	—
Susceptible	107	48	233	59	222	36	175	54	316	68	113	38	48	49	320	61
Mod. sus.	68	31	105	26	80	13	89	28	111	24	46	16	29	30	87	17
Mod. res.	20	9	51	13	37	6	54	17	30	6	100	34	17	17	75	14
Resistant	26	12	8	2	272	45	4	1	7	2	35	12	3	3	39	7

^a — = not tested or not applicable.

vations that, in most cases, resistance to one race is not related to resistance to any other race. Logically, soybean lines that derive resistance from Peking should be resistant to races 1, 3, 5, 6, and 9, but that is not true. Similarly, lines that derive their resistance from PI 88788 should be resistant to races 3, 6, and 14, but again that is not the case. The picture is further complicated by the fact that many lines have resistance from both Peking and PI 88788, a combination that should impart resistance to races 1, 3, 5, 6, 9, and 14 but does not.

Results of these studies emphasize the need for a new scheme for race determination in *H. glycines*. However, until a new scheme is available, the present scheme must be used as judiciously as possible in the determination of resistance of soybean lines to races of *H. glycines*.

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