

Inheritance of Resistance in Soybeans to Physiologic Races 5, 6, 7, 8, and 9 of *Phytophthora megasperma* var. *sojae*

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ABSTRACT

LAVIOLETTE, F. A., K. L. ATHOW, E. H. MUELLER, and J. R. WILCOX. 1979. Inheritance of resistance in soybeans to physiologic races 5, 6, 7, 8, and 9 of *Phytophthora megasperma* var. *sojae*. *Phytopathology* 69:270-271.

The F₂ populations from nine soybean crosses were tested with physiologic races 5, 6, 7, 8, and 9 of *Phytophthora megasperma* var. *sojae*. The gene *Rps^a* in the soybean cultivar Mukden, which gives resistance to races 1 and 2 and susceptibility to races 3 and 4, gave susceptibility to races 5, 6, 7, 8, and 9. The gene *Rps^b*, which conditions resistance to races 1, 3, and 4 but susceptibility to race 2 in PI 84637, gave resistance to races 5, 6, 7, 8, and 9. The gene *Rps^c* in PI 54615-1, which gives resistance to races 1, 2, and

3 and susceptibility to race 4, gave susceptibility to race 5 and resistance to races 6, 7, 8, and 9. These three genes are located at the same locus. The independent gene *Rps3* in PI 86972-1, which conditions resistance to races 1, 2, 3, and 4, gave resistance to races 5, 8, and 9 but susceptibility to races 6 and 7. Lines with the genotypes *Rps^b Rps^b Rps3 Rps3* and *Rps^c Rps^c Rps3 Rps3* have been selected which are resistant to the nine reported physiologic races of the fungus.

Additional key words: soybean disease, soybean genetics.

Recently, Mueller et al (3) reported results of a study of the inheritance of resistance to physiologic races 1, 2, 3, and 4 of *Phytophthora megasperma* Drechs. var. *sojae* A. A. Hildeb. in four soybean cultivars. The gene *Rps^a* in Mukden gave resistance to races 1 and 2. The gene *Rps^b* in PI 84637 gave resistance to races 1, 3, and 4. The gene *Rps^c* in PI 54615-1 gave resistance to races 1, 2, and 3. The gene *Rps3* in PI 86972-1 gave resistance to races 1, 2, 3, and 4. The genes *Rps^a*, *Rps^b*, and *Rps^c* were at the same locus, whereas *Rps3* was at a different locus and segregated independently of the other three genes. While that work was in progress, Haas and Buzzell (1) reported physiologic races 5 and 6 of the fungus and Laviolette and Athow (2) reported races 7, 8, and 9. The results reported here extend the knowledge of the genetics of resistance in the above four soybean cultivars to the five new physiologic races.

MATERIALS AND METHODS

Soybean cultivars Harosoy and Mukden, and plant introductions PI 54615-1, PI 84637, and PI 86972-1, and F₂ populations from crosses between them, were inoculated with races 5, 6, 7, 8, and 9 of *P. megasperma* var. *sojae*. Inoculum was prepared by growing the isolates of the physiologic races on oatmeal agar in petri dishes for 2-3 wk at 24 C. The same isolate of each race was used throughout the study. Inoculations were made by the hypocotyl method which consists of inserting a 2 × 2 - mm piece of mycelium into a longitudinal slit in the hypocotyl and covering the wound with petrolatum to prevent desiccation of the inoculum and host tissues. Ten-day-old F₂ seedlings of each cross and appropriate parental checks were inoculated with each race and grown in the greenhouse at 24-27 C. Six days after inoculation the seedlings were classified as resistant (no external symptoms) or susceptible (dead). The data were analyzed by the chi-square test for goodness of fit.

RESULTS AND DISCUSSION

The reactions of the parental cultivars to the nine physiologic races are shown in Table 1. Harosoy was susceptible to all nine races, Mukden was resistant to only races 1 and 2, PI 84637 was resistant to all but race 2, PI 54615-1 was susceptible to only races 4 and 5, and PI 86972-1 was resistant to all but races 6 and 7.

The segregation of the F₂ populations of the nine soybean crosses to physiologic races 5, 6, 7, 8, and 9 is given in Table 2. The data from the Harosoy × Mukden cross are not included because both parents and the F₂ population were susceptible to the five races. The F₂ populations from the crosses of Harosoy or Mukden with PI 54615-1, PI 84637, and PI 86972-1 each segregated in a ratio of 3 resistant:1 susceptible to those races to which the three PI's were resistant. When inoculated with races to which both parents were susceptible (race 5 with PI 54615-1, and races 6 and 7 with PI 86972-1), the F₂ populations were uniformly susceptible except for a few apparent escapes (Table 2). These data indicate that the gene *Rps^b* in PI 84637 which was reported by Mueller et al (3) to confer resistance to races 1, 3, and 4, also gives resistance to races 5, 6, 7, 8, and 9. The gene *Rps^c* in PI 54615-1 reported to control resistance to races 1, 2, and 3, also controls resistance to races 6, 7, 8, and 9. The

TABLE 1. Reaction of parental soybean cultivars or plant introduction lines to physiologic races 1 through 9 of *Phytophthora megasperma* var. *sojae*

Cultivar	Host reaction ^a to physiologic races								
	1	2	3	4	5	6	7	8	9
Harosoy	S	S	S	S	S	S	S	S	S
Mukden	R	R	S	S	S	S	S	S	S
PI 54615-1	R	R	R	S	S	R	R	R	R
PI 84637	R	S	R	R	R	R	R	R	R
PI 86972-1	R	R	R	R	R	S	S	R	R

^aAbbreviations: R = resistant, and S = susceptible.

TABLE 2. Segregation of the F₂ populations of nine soybean crosses to physiologic races 5, 6, 7, 8, and 9 of *Phytophthora megasperma* var. *sojae*

Parentage	Plants resistant (R) or susceptible (S) to race									
	5		6		7		8		9	
	(No. R)	(No. S)	(No. R)	(No. S)	(No. R)	(No. S)	(No. R)	(No. S)	(No. R)	(No. S)
Harosoy × PI 84637	159	50	150	55	119	43	130	38	152	36
Harosoy × PI 54615-1	0	208	182	73	91	29	115	42	102	38
Harosoy × PI 86972-1	164	58	1	203	0	170	159	57	127	50
Mukden × PI 54615-1	1	222	105	27	122	37	91	27	95	35
PI 54615-1 × PI 84637	157	56	203	0	150	0	127	0	114	0
Mukden × PI 84637	160	50	155	44	151	47	148	53	158	52
Mukden × PI 86972-1	156	44	4	216	0	194	122	47	151	47
PI 86972-1 × PI 54615-1	157	56	156	50	68	25	146 ^a	10	101 ^a	8
PI 86972-1 × PI 84637	194 ^a	10	163	47	133	49	162 ^a	8	150 ^a	12

^aAll segregation was in a ratio of 3 resistant:1 susceptible ($P = > 0.05$) except these which segregated in a ratio of 15 resistant:1 susceptible ($P = > 0.30$).

gene *Rps3* in PI 86972-1, reported to give resistance to races 1, 2, 3, and 4, also gives resistance to races 5, 8, and 9.

The F₂ population from the cross PI 54615-1 × PI 84637 was resistant to races 6, 7, 8, and 9, to which both parents were resistant, and segregated in a ratio of 3 resistant:1 susceptible to race 5, to which PI 84637 was resistant and PI 54615-1 was susceptible. This indicates that *Rps^b* and *Rps^c* are allelomorphic for resistance to races 6, 7, 8, and 9, in addition to races 1 and 3 previously reported (3).

The F₂ populations from crosses of PI 54615-1 and PI 84637 with PI 86972-1 each segregated in a ratio of 15 resistant:1 susceptible to those races to which both parents were resistance. The F₂ populations from these crosses segregated 3 resistant:1 susceptible to those races to which only one parent was susceptible. These data confirm that the gene *Rps3* in PI 86972-1 which controls resistance to races 5, 8, and 9, in addition to races 1, 2, 3, and 4 previously reported (3), is not at the same locus as the allelomorphic series *Rps^a*, *Rps^b*, *Rps^c* represented by the soybean cultivars Mukden, PI 84637, and PI 54615-1, respectively.

The gene *Rps^a* gives resistance to only races 1 and 2, but the resistance conferred by *Rps^b*, *Rps^c*, and *Rps3* has been extended as

follows: *Rps^b* gives resistance to races 1, 3, 4, 5, 6, 7, 8, and 9; *Rps^c* gives resistance to races 1, 2, 3, 6, 7, 8, and 9; and *Rps3* gives resistance to races 1, 2, 3, 4, 5, 8, and 9. The significance of these findings is the selection of lines with the genotypes *Rps^b* *Rps^b* *Rps3* *Rps3* and *Rps^c* *Rps^c* *Rps3* *Rps3* which are resistant to the nine reported physiologic races of the fungus. Lines with the former genotype have two genes for resistance to all but races 2, 6, and 7, whereas lines with the latter genotype have two genes for resistance to all but races 4, 5, 6, and 7.

LITERATURE CITED

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