Two New Physiologic Races of *Phytophthora megasperma* f. sp. *glycinea*

F. A. LAVIOLETTE and K. L. ATHOW, Department of Botany and Plant Pathology, Purdue University, West Lafayette, IN 47907

ABSTRACT

Laviolette, F. A., and Athow, K. L. 1983. Two new physiologic races of *Phytophthora megasperma* f. sp. *glycinea*. Plant Disease 67:497-498.

Two new physiologic races of *Phytophthora megasperma* f. sp. *glycinea* have been identified after hypocotyl inoculation of the differential soybean (*Glycine max*) cultivars Harosoy, Harosoy 63, Sanga, Mack, Altona, PI 171442, and PI 103091. The new races are proposed as races 21 and 22. The effect of the new races on cultivars now being developed with more than one major gene resistant to Phytophthora root rot is discussed.

Twenty physiologic races of *Phytophthora megasperma* Drechs. f. sp. *glycinea* Kuan & Erwin (7) (syn. *P. megasperma* Drechs. var. *sojae* Hildeb.), the causal fungus of Phytophthora root rot of soybean (*Glycine max* (L.) Merr.), have been identified since the disease was first reported in 1955 (14). Race 2 was reported in 1965 (10), race 3 in 1972 (12), race 4 in 1974 (13), races 5 and 6 in 1976 (4), races 7–9 in 1977 (8), races 10–16 in 1979 (5), and races 17–20 in 1982 (6).

From 1973 through 1981, race determinations were made on 1,341 isolates of *P. megasperma* f. sp. *glycinea* collected in Indiana. Forty-eight percent of the isolates were race 3, 18% race 1, 17% race 7, 10% race 9, 4% race 4, 3% race 8, and two isolates each were races 5 and 13. The reactions of two isolates, 78-42-5 from Allen County in northeastern Indiana in 1978 and 80-23-1 from Jay County in the extreme east central part of the state in 1980, differed from the reactions of races 1–20 on the differential soybean cultivars Harosoy, Harosoy 63, Sanga, Mack, Altona, PI 171442, and PI 103091. The reactions of the differentials to these isolates are reported and the isolates are proposed as physiologic races 21 and 22, respectively.

MATERIALS AND METHODS

Dying plants symptomatic of Phytophthora root rot caused by *P. megasperma* f. sp. *glycinea* were collected throughout Indiana, but mainly in the central and northern parts of the state, where the disease is most severe. A portion of the basal stem, 10–12 cm long, consisting of diseased and healthy tissue was placed in a plastic bag and kept on ice until sectioned. Four or five cross sections were made at the transition area between diseased and healthy tissue and were aseptically transferred to a selective

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Table 1. Reaction of differential soybean cultivars to physiologic races 1–22 of *Phytophthora megasperma* f. sp. *glycinea*

Differential cultivar	Reaction[a] to physiologic race																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21[b]	22[c]
Harosoy	S	S	S	S	S	S	S	S	S	S	S	R	S	S	S	R	S	R	R	S	S	S
Harosoy 63	R	R	S	S	S	S	S	S	S	R	R	R	R	R	R	R	R	R	R	S	S	S
Sanga	R	S	R	R	R	R	R	R	R	S	S	S	R	R	R	S	R	R	S	S	R	R
Mack	R	R	R	S	S	R	R	R	R	R	R	S	R	S	R	S	R	S	S	S	R	S
Altona	R	R	R	R	S	S	S	S	S	R	S	R	S	R	R	R	S	R	R	R	R	S
PI 171442	R	R	R	R	R	S	S	R	R	S	R	S	R	R	S	R	S	R	S	S	S	S
PI 103091	R	R	R	R	R	S	R	S	R	R	R	R	R	R	R	R	S	R	S	R	R	R

[a] R = resistant, S = susceptible to *P. megasperma* f. sp. *glycinea*.
[b] Isolate 78-42-5 collected from Allen County, IN, in 1978 is proposed as race 21.
[c] Isolate 80-23-1 collected from Jay County in 1980 is proposed as race 22.

medium in petri plates. The medium consisted of 0.6 g of calcium carbonate, 0.2 g of Bacto yeast extract, 1 g of sucrose, 0.01 g of cholesterol, 0.001 g of benomyl, 0.027 g of pentachloronitrobenzene, 0.2 g of vancomycin (hydrochloride), 20 g of agar, 40 ml of V-8 juice, and 1,000 ml of water. Generally, one isolate from each plate was transferred and maintained on potato-dextrose agar slants at 20–24 C in an unlighted cabinet.

Inoculum was prepared by growing the isolates on oatmeal agar in petri plates in an unlighted cabinet for 2–3 wk at 24 C. Inoculations were made by the hypocotyl method, which consists of inserting a piece of mycelium (2 × 2 mm) into a longitudinal slit in the hypocotyl and covering the wound with petrolatum to prevent desiccation of the inoculum and host tissue. Ten 10-day-old seedlings of the seven differential cultivars were inoculated with each isolate and grown in the greenhouse at 24–27 C with supplemental fluorescent and incandescent light. Six days after inoculation the seedlings were classified as susceptible (dead) or resistant (no external symptoms) to the isolates.

RESULTS AND DISCUSSION

The reactions of races 1 through 20 and isolates 78-42-5 and 80-23-1 were obtained on the seven differential cultivars (Table 1). Race 21 (isolate 78-42-5) most closely resembled races 3, 7, 15, and 20 but differed from these races by its reaction on PI 171442, Altona, Harosoy 63, and Sanga, respectively. Race 22 (isolate 80-23-1) differed from race 7 only by its reaction on Mack.

Each of the differential cultivars except PI 103091 has a single major gene that controls resistance or susceptibility to the various races (1,9,11). Harosoy 63 has the gene Rps_1, Sanga has $Rps_1{}^b$, Mack has $Rps_1{}^c$, Altona has Rps_6, (1), and PI 171442 has Rps_3. In addition, the soybean cultivars Kingwa and Williams 82 have the gene $Rps_1{}^k$ (3), which gives resistance to all races but 12, 16, 19, and 20. The Rps_4 gene from PI 86050 (2) gives resistance to all races except 5–9, 17, and 22. Thus, although 22 physiologic races of *P. megasperma* f. sp. *glycinea* have been described in the past 27 yr, resistance to all races is still possible with several two-gene combinations. The combinations $Rps_1{}^b Rps_4$, $Rps_1{}^b Rps_6$, $Rps_1{}^k Rps_4$, and $Rps_1{}^k Rps_6$ that we have incorporated into several soybean cultivars provide resistance to races 1–22. Cultivars now being multiplied for release with the combination $Rps_1{}^b Rps_3$ are susceptible to races 10, 12, 19, and 20, whereas those with $Rps_1{}^c Rps_3$ are susceptible to races 12, 19, and 22. Of these, only race 22 has been found in the area where the cultivars are adapted.

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