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1) Genotype-race interactions in relation to phytophthora rot of soybean.

Many of the widely grown soybean cultivars in the Mid-Atlantic region are susceptible to phytophthora rot caused by *Phytophthora megasperma* f. sp. *glycinea* Kuan and Erwin (Pmg). There is limited information available on tolerance to Pmg in these popular soybean cultivars. Tolerance or field resistance to Pmg in soybean is characterized as race nonspecific resistance involving root resistance to Pmg infection, whereas resistance to Pmg in soybeans is characterized as race specific resistance (Schmitthenner, 1985). The objective of this study was to evaluate race-specific resistance and levels of tolerance to phytophthora rot in soybean cultivars grown in Maryland.

Materials and methods: Greenhouse screening tests were performed on public and private soybean cultivars entered in the state variety trials. The greenhouse evaluations used 14-day-old lima bean agar cultures of Pmg grown at 25 C. Race-specific resistance to Pmg was determined by placing mycelia in a hypocotyl slit approximately 1 cm below the cotyledonary node of 10-day-old seedlings. Inoculated plants (5 plants per 10-cm pot) were kept in a moist chamber for 24 hrs. Root resistance (tolerance) was determined by transplanting 4-day-old seedlings into 10-cm plastic pots (5 plants per pot) filled with steam-pasteurized compost media infested with a mycelial Pmg suspension. Soil was infested 24 hours before transplanting with one petri plate culture per pot. Culture medium was placed on wet soil surface and chopped into pieces approximately 0.5 cm square, then worked into the top 5 cm of soil. Cultivars were compared and rated for number of live plants 2 to 3 weeks after transplanting. The transplant technique has produced tolerance ratings among cultivars which are comparable to those obtained using a greenhouse mycelium inoculum layer technique similar to that described by Walker and Schmitthenner (1984). The transplant procedure ensured selection of uniform seedlings and reduced potential complications caused by abnormal, diseased seedlings. To account for both plant kill and plant stunting caused by phytophthora rot, cultivars grown with and without Pmg were compared for number of live plants, and for average plant height (i.e., growth above the cotyledons) at 21 days after planting (equation - Table 3). A virulent isolate of race 1 of Pmg from Maryland was used to determine hypocotyl and root resistance. Cultivars exhibiting root resistance to race 1 from Maryland were subsequently evaluated for root resistance against isolates of races 3, 4, 5, 7, 10, 12, 13, 14, 15, 16, and 24 and additional isolates of race 1 obtained from Dr. B. J. Keeling, USDA-ARS, Stoneville, MS, and J. D. Paxton, Univ. of Illinois, Urbana.

Results: Many of the early (group III) and mid-maturity (group IV) cultivars entered in the variety trials showed race-specific resistance to isolates of Pmg race 1 (race 1 is currently the only race reported in Maryland). However, there was little race-specific hypocotyl resistance to Pmg found in late maturity (group V) soybean cultivars with only two of the 15 public and private lines tested showing resistance to race 1 isolates from Maryland (Table 1). Eight of the 13 group V cultivars without race-specific

Table 1. Hypocotyl and root resistance reactions to race 1 (Maryland isolate) in Maturity Group V cultivars entered in the state soybean variety trials<sup>a</sup>

Group V	Cultivars	Hypocotyl resistance	Root resistance
Public	Essex	S	S
	Bay	S	S
	York	S	R
	Forrest	S	R
	Epps	S	R
	Toano	S	R
Private	Asgrow 5149	S	MR
	Coker 425	S	MS
	Coker 575	S	MR
	Coker 485	S	MR
	Jacques X-83140	S	MR
	Pioneer 5482	S	S
	Pioneer 9531	R	NA
	S. S. FFR-561	S	MS
Stanford HT 5203	R	NA	

<sup>a</sup>S = all plants dead (5 plants per pot);

MS = 3-4 dead;

MR = 3-4 alive;

R = no dead;

NA = unable to evaluate root resistance because of hypocotyl resistance for race 1.

Table 2. Root resistance reaction to different races of Pmg<sup>a</sup>

Races	Cultivars				
	Verde	Essex	York	Ware	Forrest
1 (MD)	S	S	R	R	R
3	-	S	R	R	R
4	S	S	R	R	R
7	MS	MR	R	R	R
10	S	S	S	MR	MR
14	-	S	R	R	R
16	MS	MR	R	R	R
24	S	S	S	R	MR

<sup>a</sup>S = all plants dead (5 plants per pot);

MS = 3-4 plants dead;

MR = 3-4 plants alive;

R = no dead.



Table 3. Root resistance ratings of four soybean cultivars to different races of Pmg<sup>a</sup>

Isolate/Race <sup>b</sup>	Cultivars			
	Essex	Williams	York	Ware
<u>Test 1</u>	%			
MD-1	3 <sup>c</sup>	0	98	100
IL-1	75	76	95	97
IL-5	14	26	87	92
K-10	0	2	9	65
K-24	7	32	23	85
LSD (0.05)	15	25	27	22
<u>Test 2</u>				
MD-1	4	1	92	96
IL-1	81	83	96	102
IL-5	43	56	109	97
K-10	0	1	3	87
K-24	22	29	54	99
LSD (0.05)	20	22	34	30

$${}^a\text{Rating} = \frac{(\text{no. of live plants}) [\bar{x} \text{ height (Pmg)}]}{(\text{no. of live plants}) [\bar{x} \text{ height (w/o Pmg)}]} \times 100\%.$$

<sup>b</sup>MD-1 = isolate of race 1 from Maryland; IL-1 and IL-5 = isolates of race 1 and 5, respectively, from Illinois; K-10 and K-24 = isolates of race 10 and 24, respectively, from Mississippi.

<sup>c</sup>Values shown are the means of four replications; 5 plants per replication.

resistance to race 1 exhibited high levels of root resistance to race 1 isolates of Pmg. However, 'Essex', the most widely planted late-maturing cultivar in Maryland, showed little or no root resistance (Table 1).

The results in Tables 2 and 3 indicate that there are different levels of root resistance in soybean to Pmg. The genotype race interactions were highly significant. The isolates of race 1 from Illinois and Maryland showed marked differences in virulence (Table 3). The race 1 isolate from Illinois may have lost virulence; however, cultures of race 1 from Maryland have shown no loss in virulence over an 18-month period. The isolates of races 10 and 24 from Mississippi also appeared to differ in virulence. The reactions of 'York', Essex and 'Williams' to Maryland race 1 isolates compared to their

reactions to either the race 10 or 24 isolates would indicate a difference in pathogenicity rather than virulence. 'Ware' and 'Forrest' showed tolerance to all isolates.

In future breeding efforts, soybean cultivars should be selected for the highest levels of Pmg tolerance available. Preliminary findings indicate that selecting for tolerance to a limited number of Pmg isolates may not necessarily ensure the highest levels of root resistance.

### References

- Schmitthenner, A. F. 1985. Problems and progress in control of phytophthora root rot of soybean. *Plant Dis.* 69:362-368.
- Walker, A. K. and A. F. Schmitthenner. 1984. Comparison of field and greenhouse evaluations for tolerance to phytophthora rot in soybeans. *Crop Sci.* 24:487-489.

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