

Evaluation of short season soybean cultivars for *Rps6* resistance to *Phytophthora sojae*

T. R. Anderson¹, R. I. Buzzell¹, H. D. Voldeng², and V. Poysa¹

¹ Greenhouse and Processing Crop Research Centre, Agriculture and Agri-Food Canada, 2585 County Road #20, E, Harrow Ontario, Canada. N0R 1G0. andersont@agr.gc.ca
(Dr. R.I. Buzzell, retired)

² Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, K.W. Neatby Building, 960 Carling Avenue, Ottawa, Ontario, Canada, K1A 0C6

Abstract:

Phytophthora root rot caused by *Phytophthora sojae* (*Ps*) is an important disease of soybean on poorly drained soil. The resistance gene *Rps6*, which provides resistance to a number of races, was reported in the cultivar Altona in 1982. A line, 840-7-3 (PI 436.477) has a gene for resistance and has been used in the development of a number of short season cultivars in Canada but the gene for resistance has not been previously identified. Inoculation of the original lines and crosses derived from PI 436.477 with a limited number of *Phytophthora* races indicated that *Rps6* was present in a number of these lines and cultivars either alone or in combination with other genes for resistance to *Phytophthora* root rot. These lines may be useful sources of the resistance gene *Rps6* in future breeding programs.

Introduction:

The *Rps6* gene for resistance to *Phytophthora sojae* (*Ps*) in the soybean cultivar Altona was reported by Athow and Laviolette (1982). Altona resulted from a cross between O-52-903 (PI 194.654) (*Rps6*) and Flambeau (*rps,rps*). O-52-903 is from Sweden and another Swedish line, 840-7-3 (PI 436.477), that has been used in soybean breeding, has been resistant to hypocotyl inoculations with *Ps* in prior trials at the Greenhouse and Processing Crops Research Centre, but it was not clear if the line contained *Rps6*. Results obtained in 1994-95 from inoculations of the cross 840-7-3 (*Rps6?*)/HARO 6272 (*Rps6,Rps7*) with *Ps* race 1 did not show segregation for resistance and susceptibility so it was concluded that *Rps6* was present in 840-7-3. However, the F₂ population was small (38 plants) and limited testing was done in the F₃ and F₄. This study was conducted to identify the gene for resistance in 840-7-3 (PI436.477) and to identify cultivars that may have resistance derived from 840-7-3.

Materials and Methods:

Because the number of reported *Ps* races is increasing and the difficulty of maintaining *Ps* cultures with the correct virulence formula, it has become increasingly difficult to include all races in the characterization of putative resistance genes. As a compromise, we inoculated the Swedish lines and progeny derived from 840-7-3 with 7 races of *Ps* to compare their responses. The pedigrees of the 20 cultivars that have 840-7-3 in their parentage and genotype are listed in Table 1. The pedigree and genotype for Cabot and Zephyr is incomplete. The lines and cultivars were inoculated by the hypocotyl method (Anderson and Buzzell, 1992) with isolates B135R3.40, D45R5.10, C20R10.3, D35R17.2, C25R21.6, and B17R31.16 obtained from Dr. A. Dorrance, OARDC, OH., which correspond to *Ps* races 3, 5, 10, 17, 21, and 31, respectively (Hartman et al., 1999). *Rps7* which is found in Harosoy, HARO 1272 (Harosoy 63) and HARO 6272 is susceptible to all of the above races so the presence or absence of this gene could not be verified in any of the soybean lines screened.

Results and Conclusions:

Expected results were obtained with the control lines/cultivars containing *Rps6* (Table 2). Harosoy (*rps6, rps1*) was susceptible to all races and HARO 1272 (*Rps1a, Rps7*) was distinguishable from *Rps6* by a resistant response with Races 17 and 31. Inoculation of O-52-903 and 840-7-3 resulted in a similar response pattern suggesting both contain *Rps6*. Of the cultivars evaluated, 5 contained no resistance, 6 contained *Rps6* and *Rps1a*, 4 contained *Rps6* and two contained *Rps1a* based on responses to the *Ps* races used for screening.

Inoculation of 3 cultivars with Races 17 and 31 resulted in a variable response. Results indicate that *Rps6* is present in 840-7-3 and some of the progeny derived from this line and that these progeny could be used as a source for *Rps6* in breeding programs.

Inoculation of Commander resulted in intermediate responses to races 3, 17, 21, and 31; therefore, it was not clear if *Rps1a* or *Rps6* were present. Inoculation of Galaxy and RCAT Bobcat with race 17 resulted in a susceptible response which was not expected if *Rps1a* were present which suggests the presence of a resistant gene other than *Rps1a*. The presence of *Rps6* in these varieties is assumed but cannot be confirmed.

References:

Anderson, T. R. and Buzzell, R. I. 1992. Inheritance and linkage of the *Rps7* gene for resistance to Phytophthora rot of soybean. Plant Dis. 76:958-959.

Athow, K. L. and Laviolette, F. A. 1982. *Rps6*, a major gene for resistance to *Phytophthora megasperma* f. sp. *glycinea* in soybean. Phytopathology 72:1564-1567.

Hartman, G. L., Sinclair, J. B. and Rupe, J. C. 1999. Compendium of Soybean Diseases. 4th Ed. APS Press. Pp.39-42.

Table 1. Soybean cultivars and lines, source/pedigree, and Rps genes detectable in this study.

Cultivar/Line	Source/Pedigree	Rps genes
Harosoy		rps
Altona	O-52-903 x Flambeau	Rps6
O-52-903	PI 194.654	Rps6
HARO6272	(Harosoy [7] x Altona)	Rps6
L89-1581	(Williams [6] x Altona)	Rps6
HARO 1272 (Harosoy 63)		Rps1a
840-7-3	PI 438.477	Rps6?
Cultivars from crosses involving 840-7-3 (<i>Rsp6?</i>)		
Maple Amber	[Harosoy 63 x Altona] x 840-7-3	[Rps1-a x Rps6] x Rps6?
Maple Arrow	Harosoy 63 x 840-7-3	Rps1-a x Rps6?
Maple Presto	[Amsoy x Portage] x 840-7-3	[rps x rps] x Rps6?
Maple Belle	[Evans e3 x 840-7-3] x Evans e3	[Rps1a x Rps6?] x Rps1-a
AC 2001	[Harosoy e3//840-7-3/2*Evans] x Conrad	[[rps x Rps6?] x Rps1-a] x rps
Maple Glen	BD22115 x Premier (B216)	[Rps6?//rps x rps] rps
Zephyr	FLSL-line x Maple Glen	? x Rps6?
Cultivars from crosses involving Maple Arrow (<i>Rps6? Rps1-a</i>)		
AC Bravor	Maple Arrow x Wayne	Rps6?Rps1-a x rps
Commander	Evans x Maple Arrow	Rps1-a x Rps6?Rps1-a
KG 41	B220 x Maple Arrow	Rps1-a x Rps6?Rps1-a
Maple Donovan	Maple Arrow x Harcor	Rps6?Rps1-a x Rps1-a
Marathon	McCall x Maple Arrow	rps x Rps6?Rps1-a
KG30	McCall x Maple Arrow	rps x Rps6? Rps1-a
OAC Eclipse	Maple Arrow x Williams	Rps6?Rps1-a x rps
OAC Frontier	Pioneer 1677 x Maple Arrow	rps x Rps6?Rps1-a
Galaxy	McCall x Maple Arrow	rps x Rps6?Rps1-a
RCAT Bobcat	T8508 x OAC 86-07	rps x [Rps6? Rps1-a x rps]
Cultivars from crosses involving Maple Presto (<i>Rps6? rps1</i>)		
Alta	Amsoy 71 x Maple Presto	Rps1-a x Rps6?
Cabot	Maple Presto/Evans // I-1/M.Presto) x FLSL-line	[Rps6? x Rps1-a]x? x Rps6? x ?
AC Harmony	[Maple Presto x Williams] x Weber	[Rps6? x rps] x rps

Note:

B220 [Hark x Amsoy 71],
 BD22115 [840-7-3//Portage x Amsoy],
 OAC86-07 [Maple Arrow x Williams],
 P1677 [Corsoy x (Corsoy x Rampage)],
 T8508 [S1346 x Calland].

Table 2. Soybean cultivar summary of responses to 7 races of *P. sojae*

Cultivar	<i>P. sojae</i> race reactions*							Rps genes present**
	3	5	8	10	17	21	31	
Harosoy	S	S	S	S	S	S	S	<i>rps1-a, rps6,</i>
Harosoy 63	S	S	S	R	R	S	R	<i>Rps1-a</i>
O-52-903, Altona, 840-7-3 HARO6272, L89-1581	R	S	S	R	S	R	S	<i>Rps6</i>
AC2001, AC Harmony, KG30, Maple Glen, Zephyr	S	S	S	S	S	S	S	<i>rps1-a rps6</i>
Alta, Cabot, Maple Amber, Maple Presto	R	S	S	R	S	R	S	<i>Rps6</i>
Maple Belle, OAC Frontier	S	S	S	R	R	S	R	<i>Rps1-a</i>
AC Bravor, KG41, Maple Arrow, Maple Donovan, Marathon, OAC Eclipse	R	S	S	R	R	R	R	<i>Rps1-a, Rps6</i>
Commander	I	S	S	R	I	I	I	<i>Rps1-a? Rps6</i>
Galaxy, RCAT Bobcat	R	S	S	R	S	R	R	<i>Rps? Rps6?</i>

* R = < 30% of plants killed, S = > 70% of plants killed, I = 31-69% of plants killed.

** Based on reactions to the isolates used.