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Resistance to Powdery Scab in Potato

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Introduction

Powdery scab is a serious disease of potato that is among the most damaging emerging potato pathogens throughout the world. Twenty years ago it was rare in the Columbia Basin but today it is widespread, damaging, and a threat to the profitability of the industry. Flagellated zoospores which swim in soil water constitute a part of the life cycle. The resting spore, the cystosorus, is very durable (meaning that fields maintain inoculum for up to six years) and survives passage through animal digestive tracts. Given good conditions, abundant soil moisture, and temperatures at 11-18° C, zoospores from multiple cycles continue the infection process (van de Graaf et al., 2005) throughout the growing season. Unfortunately no soil or plant treatment has an economically beneficial effect on the level of damage. Although the fungus causes damage on the skin of certain varieties, (i.e., Shepody), the tubers of russeted skin varieties are seldom damaged. Damage is caused, however, by means of root suppression and yield loss in total tonnage and tonnage of large sized tubers. The fungus is also the vector for Potato Mop-Top Virus. Resistance to the fungus could raise the profitability of the potato crop.

Figure1. Skin lesions caused by *Spongospora subterranea* on potato tubers. (Photo credit: Dr. Ueli Merz, Insitute of Plant Sciences, Zurich, Switzerland)

Genetic Resistance

Relatively little is known about resistance of potato to powdery scab. There is some indication of resistance in European varieties, including the cultivars Granola, Nicola, Ditta, and Gladiator. The Australian variety Tarago is also reported to be resistant. In the Pacific Northwest (PNW), most of the acreage is planted to varieties with russeted skin. The skin problem in the PNW occurs among the non-russeted varieties (primarily Shepody and red skinned varieties). The production problem posed by yield reduction is caused by powdery scab root damage and interactions with other soil-borne pathogens. Certain processing varieties with russeted skin typically suffer yield reductions of 2 to 5 tons/acre and considerable loss of tuber size, which can affect the contract incentive payments to a high degree. Consequently the focus in our germplasm screening has been on identifying resistance to galling in the root system.

Figure 2. Root galling caused by the Powdery scab organism. Inset shows galls on root (Photo credit of inset, Dr. Ueli Merz).

We have screened a number of germplasm lines at two locations during the last three years. In Table 1 is a summary of three field tests in Washington State and two in Idaho. The indices of root galling are shown. The indices from Washington are on a different scale than from those from Idaho. An interesting observation is that a number of lines have maintained a low level of root galling in all five trials.

All of the shaded entries appear to show stable resistance over the five tests. These entries have two ancestral factors in common: 1) they are all derived from an introgression program to incorporate resistance to Columbia root-knot nematode (*Meloidogyne chitwoodi*) from the Mexican wild species *Solanum bulbocastanum* and 2) they all have two successive backcrosses to the the newly named variety Summit Russet. Summit Russet was tested in 2002 and 2003 in Idaho and 2006 in Washington and was quite resistant to root galling and tuber lesions of powdery scab. These clues on the origin of genetic resistance will be followed up in future research.

Summarizing the data from Washington and Idaho we see in Figure 3 that several resistant clones PA95B2-4 and PA95B5-2, PO94A009-7, PO94A009-10, and PA98NM38-1 performed consistently in regard to root galling reduction compared to susceptible cultivars.

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Clone or Variety	GS 2005 (WA)	GS 2004 (WA)	GS 2003 (WA)	GS 2003 (ID)	GS 2004 (ID)
PA99N82-4	**2.9**	**2**	**1.1**	**4.1**	**18.3**
PA98NM36-16	**5.1**	**2.2**	**1.3**		**20.2**
Ranger	**5.0**	**1.7**	**2.1**	**12.0**	**24.4**
PA99N88-2	**2.7**	**1.5**	**0.7**		**12.8**
Umatilla	**4.8**	**1.3**	**2.0**		**30.3**
Russet Burb/	**5.3**	**1.3**	**2.1**	**15.0**	**18.5**
PA98NM39-1	**3.3**	**1.2**	**0.7**	**12.1**	**30.8**
PA95B1-53	**2.5**	**0.7**	**0.6**	**16.8**	**22.2**
PO94A010-3	**3.1**	**0.7**	**1.4**	**13.3**	**14.5**
POR00HG5-1	**0.6**	**0.7**	**0.1**	**15.4**	**8.0**
PA95B4-67	**3.0**	**0.6**	**1.4**	**13.0**	**27.4**
PO94A009-2	**2.5**	**0.6**	**1.1**	**5.7**	**16.9**
PA98N5-2	**1.0**	**0.5**	**0.4**	**3.9**	**6.8**
PA98NM30-11	**4.4**	**0.5**	**2.1**		**12.9**
PO94A012-2	**3.4**	**0.4**	**1.4**	**8.3**	**25.8**
PA95B2-4	**1.9**	**0.3**	**0.4**	**0.8**	**1.6**
PO94A009-10	**2.5**	**0.3**	**0.7**	**1.7**	**4.0**
PO94A009-7	**1.7**	**0.3**	**0.8**	**2.0**	**8.4**
PA98NM38-1	**0.6**	**0.2**	**0.9**	**6.4**	**4.9**

Table 1. Root galling scores (GS) on root systems of potato varieties and breedling lines tested in infested field three years in Washington and two years in Idaho. Entries with shading are considered to be resistant.

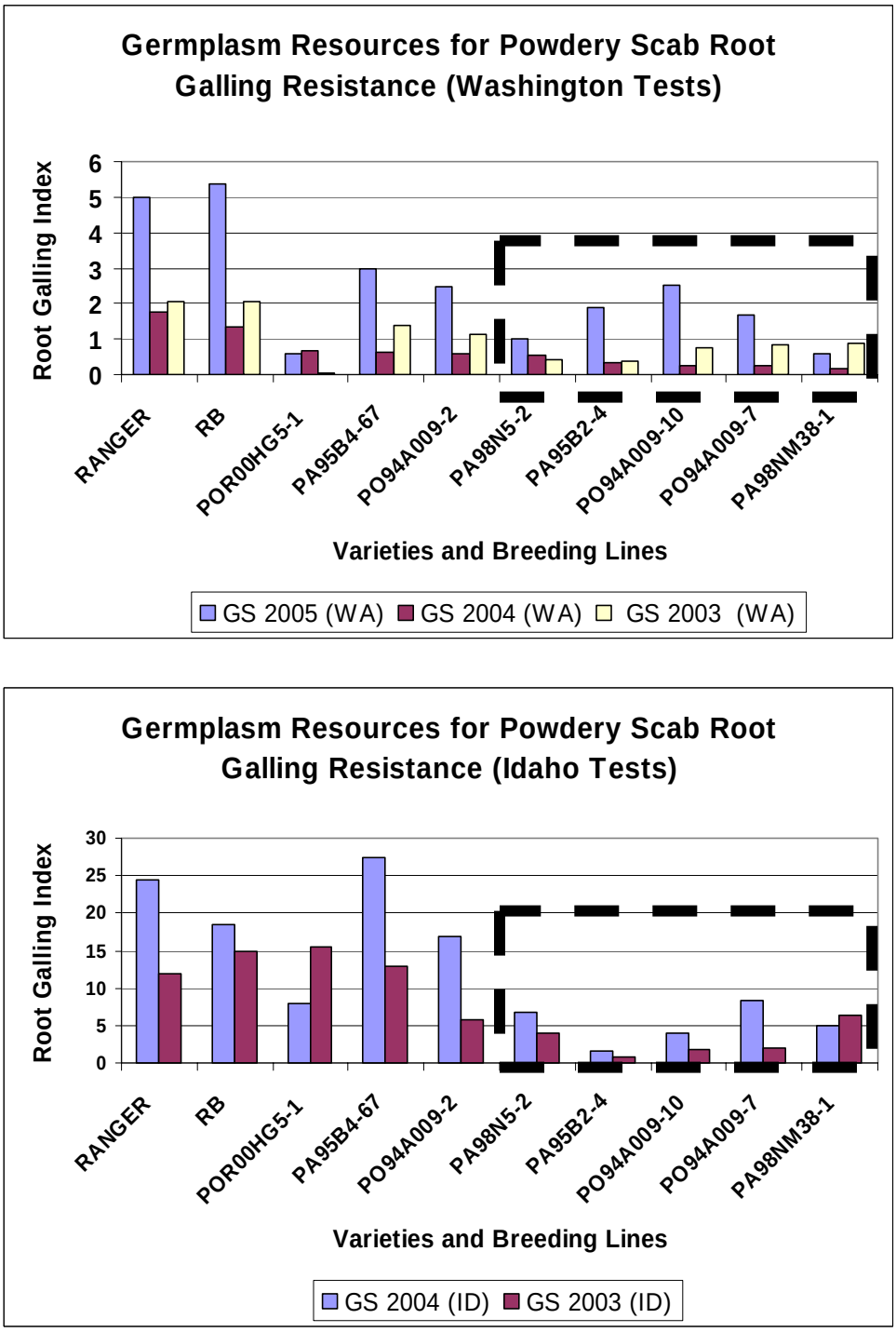

Figure 3. Summary of root galling scores in Washington and Idaho tests. Ranger Russet and Russet Burbank (RB) were consistently susceptible to root galling while five clones inside the broken rectangle showed a stable resistance.

Conclusions

We have found in five independent field tests conducted in Washington and Idaho that some breeding lines show a consistent and repeatable resistance to root galling caused by the powdery scab organism. The breeding lines that show this resistance have a wild Mexican potato and Summit Russet in their ancestry. We are examining the value of Summit Russet in the Columbia Basin, after determining that it is resistant to powdery scab. We are also looking to define the resistance better and to develop tools to more efficiently select the resistance in future germplasm. We are testing all the Tri-State and Western Regional advanced clones for resistance.

Reference

Van de Graaf, P, AK Lees, SJ Wale and JM Duncan. 2005. Effect of soil inoculum level and environmental factors on potato powdery scab caused by *Spongospora subterranea*. Plant Pathology 54:22-28.

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Insects and Other "Bugs" in Potato Tubers

Andy Jensen, WSPC Director of Research

Since the arrival of tuberworm in the Columbia Basin, I have been working to learn about all the insects that invade potato tubers. Quite a few different species of flies, beetles, and the like have already been seen and photographed, but I would like your help. Any time you find potato tubers, whether seed pieces or harvested crop, that have maggots, worms, or other "bugs" in them, I'd like to have a sample. Just give me a call at 509-760-4859 or drop me an e-mail at ajensen@potatoes.com.

Potato Association of America 91st Annual Meeting
August 12—16, 2007
Shilo Inn Conference Center Idaho Falls, Idaho

The annual meeting of the Potato Association of America (PAA) will be held this year in Idaho Falls August 12-16. The PAA is the official professional society for those interested in advancing the potato industry. There will be numerous presentations and posters during Monday through Thursday of the week covering almost every topic of potato research and extension. Attendees will be from several countries but mostly the U.S. and Canada. There will be a special industry-oriented session during the morning of Tuesday, August 14th. For more information see the meeting's website at:

http://www.conferences.uidaho.edu/PAA/default.asp

Washington Potato Acreage, Production, and Storage Data

Crop Year	Harvested Acreage	Yield Per Harvested Acre (cwt)	Tons/A	Production (000cwt)	Stocks on Hand (000 cwt) Dec. 1	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1
1966	58,000	376	18.8	21,830	18,300	7,150	5,500	3,950			
1967	64,000	345	17.3	22,090	10,660	8,800	6,600	4,400			
1968	64,000	378	18.9	24,173	10,430	8,800	7,050	5,100			
1969	71,700	415	20.8	29,796	15,300	13,100	10,300	7,800			
1970	87,000	386	19.3	33,590	18,500	16,000	12,500	9,700			
1971	78,000	386	19.3	30,110	16,450	13,500	10,350	7,500			
1972	75,000	418	20.9	31,365	15,800	13,400	10,300	7,100	4,200		
1973	82,000	430	21.5	35,260	18,600	15,600	12,600	9,100	5,500		
1974	98,000	420	21.0	41,160	22,500	20,500	16,800	12,800	8,900		
1975	105,000	460	23.0	48,300	27,900	24,100	19,900	11,500	10,000		
1976	124,000	450	22.5	55,800	33,200	29,700	25,000	20,100	15,200		
1977	110,000	460	23.0	50,600	28,400	24,700	20,800	15,900	11,300		
1978	109,000	465	23.3	50,685	32,000	28,800	24,000	19,300	14,500	9,500	
1979	103,000	475	23.8	48,450	30,800	27,300	23,300	19,000	14,400	10,500	
1980	87,000	505	25.3	43,935	24,300	22,000	18,500	14,600	10,900	7,200	
1981	108,000	490	24.5	52,920	29,200	25,100	21,000	17,000	12,600	8,200	
1982	110,000	480	24.0	52,800	29,200	25,100	21,600	17,100	13,200	8,600	
1983	103,000	520	26.0	53,560	29,500	25,600	21,800	16,500	11,000	7,100	
1984	115,000	495	24.8	56,925	29,600	25,900	20,800	16,600	11,300	7,000	
1985	127,000	505	24.3	61,100	33,500	30,000	25,700	21,000	16,200	9,700	
1986	118,000	510	25.5	60,200	32,300	28,000	24,400	20,400	14,600	8,700	
1987	124,000	540	27.0	67,000	36,600	32,900	28,300	22,800	17,500	12,400	
1988	115,000	550	27.5	63,300	36,700	32,100	27,700	22,500	16,200	10,700	
1989	118,000	545	27.3	64,310	34,500	30,400	25,100	20,000	13,100	7,100	
1990	132,000	515	25.8	67,980	35,500	29,500	24,500	19,800	15,100	10,400	
1991	141,000	535	26.8	75,440	37,000	32,200	27,000	21,200	15,000	9,600	
1992	125,000	525	26.3	69,300	31,000	26,700	24,900	19,800	13,000	8,200	
1993	150,000	590	29.5	88,500	43,500	38,500	32,000	26,500	20,000	13,500	
1994	152,000	585	29.3	88,900	47,500	43,000	37,500	30,500	23,500	17,000	
1995	147,000	550	27.5	80,850	39,500	33,000	30,500	25,000	18,000	12,500	
1996	161,000	590	29.5	94,990	48,000	42,000	36,500	30,000	23,000	16,500	
1997	152,000	580	29.0	88,060	47,000	41,500	36,500	29,500	22,500	16,000	
1998	165,000	565	28.3	93,225	49,000	43,500	36,500	29,500	21,500	14,500	7,500
1999	170,000	560	28.0	95,200	48,000	41,000	35,000	28,000	20,500	14,500	7,000
2000	175,000	600	30.0	105,000	59,000	52,000	44,500	37,500	29,500	21,500	13,000
2001	160,000	590	29.5	94,400	53,000	45,500	40,000	32,500	25,000	18,000	10,000
2002	165,000	560	28.0	92,400	53,000	46,500	40,000	33,000	25,500	19,500	12,000
2003	162,000	575	28.8	93,150	51,000	44,000	38,000	29,500	21,500	15,000	7,000
2004	159,000	590	29.5	93,810	50,000	43,000	36,500	29,000	22,000	15,500	8,000
2005	154,000	620	31.0	95,480	52,500	46,500	40,500	32,500	25,000	17,000	9,000
2006	155,000	580	29.0	89,900	49,000	42,500	36,500	28,500	21,000		

Data from National Agricultural Statistics Service