# 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 rarity 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 lifecycle. The resting spore, the cystosorus, is very durable, meaning that fields maintain inoculum for up to six years and survive 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, a quarantine virus in the United States. 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 the 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 a summary of three field tests in Washington State and two in Idaho is summarized. 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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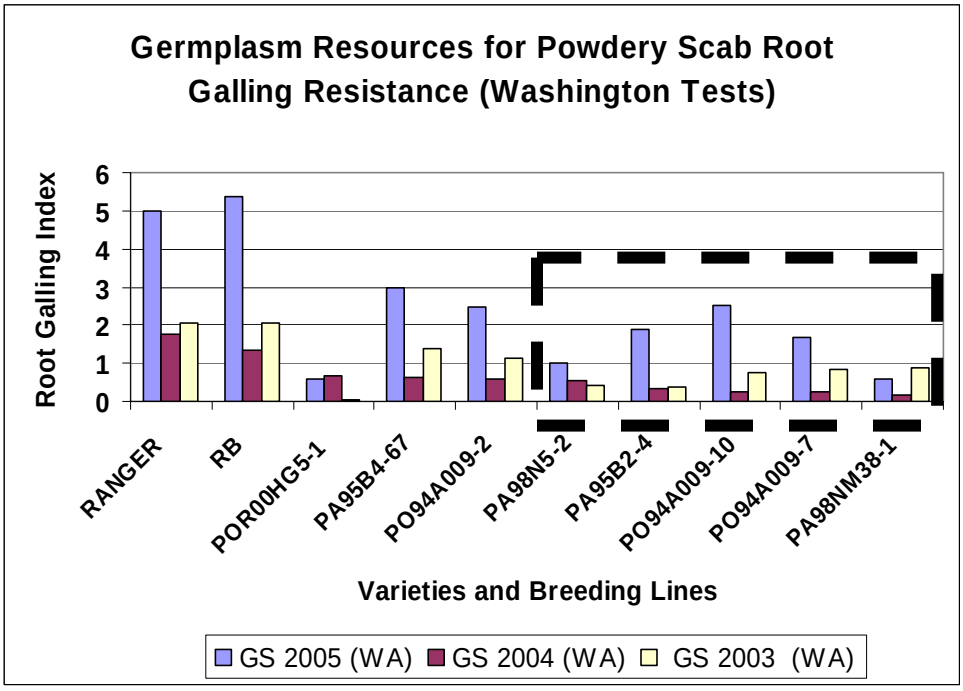
Table 1. Root galling scores (GS) on root systems of potato varieties and breedling lines tested in infested field three years in Washington and two years in Idaho. Entries with shading are considered to be resistant.

| 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** |



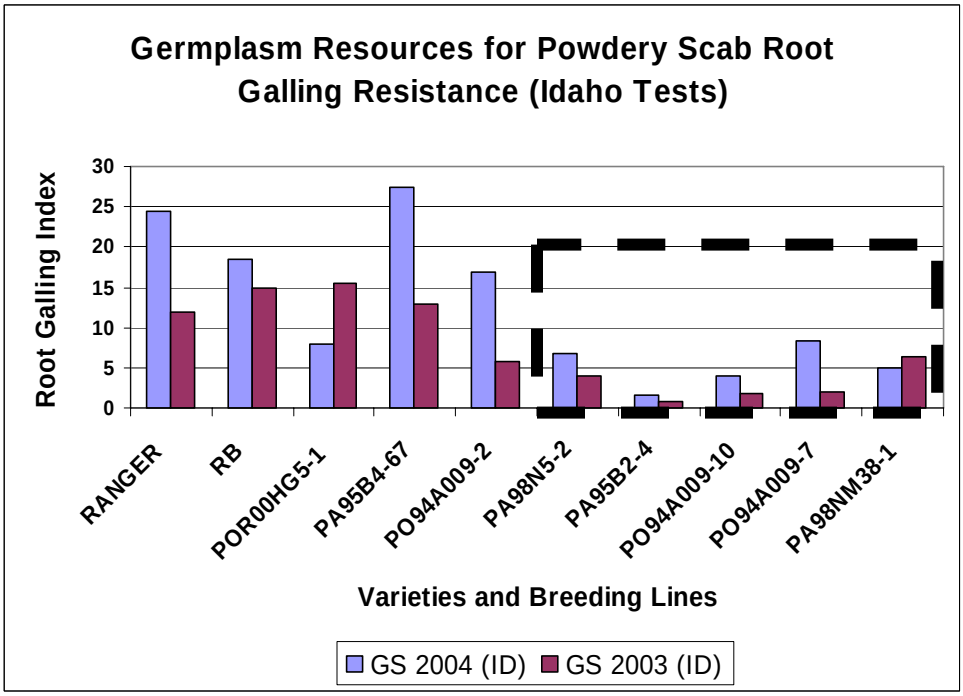




Figure 3. Summary of root galling scores in Washington and Idaho tests. Ranger Russet and Russet Burbank (RB) were consistently susceptible to root galling while five clones inside the broken rectangle showed a stable resistance.

## 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, 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.

***This research has been funded by the USDA-ARS base funds and a grant from the Washington State Potato Commission. We also appreciate the Industry support, particularly by Lynn and Chris Olsen. Without their support and collaboration this study would not have been possible.***