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Late Blight Tuber Resistance of Potato Cultivars Grown in the USA to the New US-24 Strain

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Late blight caused by *Phytophthora infestans* is a major annual threat to potato production in the U.S. and worldwide. Management of late blight on a worldwide scale was conservatively estimated to be 6.7 billion dollars in 2009 (Hu et al., 2012). Fungicides are used to manage late blight since most major potato cultivars lack foliar and tuber resistance (Porter et al., 2004; Miller et al., 2006). The predominant strains of *P. infestans* impacting potato production have changed over time in the Northwest and across the U.S. The newest strains of *P. infestans* include US-22, US-23 and US-24 (Danies, 2013). These strains are replacing the US-11 and US-8 strains in some locations. Due to the changing strains of *P. infestans* infecting potato, it is important for potato breeders to find potato lines with resistance to current and past strains of *P. infestans* to establish stable resistance.

Although the foliage of most major potato cultivars grown in the Pacific Northwest is susceptible to infection by *P. infestans*, that doesn't mean the tubers are susceptible. Some potato plants have resistant tubers and susceptible foliage; the reverse can also be true. When managing foliar late blight during a season, ineffective fungicide applications or poor timing of fungicide applications can result in the development of foliar infections in a field. These foliar infections, under humid conditions, can sporulate and produce spores which can be washed down the stem. Often there are openings created in the soil where stems come in contact with the soil, creating an unobstructed path to susceptible tubers below ground, resulting in infection and rot. Spores can also move through cracks in the soil, or motile spores called zoospores are capable of moving through water-filled pores of most soil types and can infect below ground tubers.

If foliar infections occur in a field during the growing season, tubers are at risk of infection. Cultivars with tuber resistance are desired under these circumstances and can be extremely important to preserve yields and reduce the likelihood of storage rot issues. The present research determined the late blight tuber resistance of 110 potato cultivars to the new US-24 strain of *P. infestans*. This study compared potato tubers grown in Wisconsin with the same cultivars grown in Washington. The purpose of this study was to determine late blight tuber resistance of clones to the US-24 strain of *P. infestans* and to see if growing location had any impact on differences in tuber resistance of the same cultivars.

The cultivars Patagonia and Yukon Gem demonstrated the best tuber resistance to *P. infestans* among the cultivars tested and were rated as resistant at both growing locations (See Table 1 for ratings). The percent incidence of late blight tuber infection of Patagonia and Yukon Gem tubers grown in

Wisconsin was 4.8 and 0%, respectively, while tubers of these cultivars grown in Washington had percent incidences of 22.2 and 15%, respectively. Long term storage of tubers with greater than a 3% incidence of infection by *P. infestans* is not recommended since secondary rots, such as bacterial soft rot or Pythium leak, that accompany infection sites can result in unacceptable storage losses. The tubers in the present study were inoculated with a high level of inoculum (10,000 spore/ml water) and concentrations associated with such high levels in the field are not likely, therefore field resistance of the aforementioned cultivars may be better under natural conditions. Research is being conducted to combine natural tuber resistance with chemical products to obtain a synergistic affect to limit tuber infection.

In addition to Patagonia and Yukon Gem, the cultivars Jacqueline Lee, Mesa Russet, Prince Hairy and Alturas were either resistant or moderately resistant at both locations, and the cultivar Hindenburg was moderately resistant at both locations. Nine cultivars were considered resistant at one location but susceptible or highly susceptible at the second location. This research supports the idea that differences in susceptibility within a potato cultivar can be affected by the location where the tubers are grown and further research needs to be conducted to understand the factors influencing resistance in different growing regions. Nutrition, virus infections, the environment, and other factors may be playing a role in the susceptibility of tubers to *P. infestans*.

Table 1 categorizes the tuber resistance of all the cultivars screened at both locations and indicates whether the cultivar is resistant (R), moderately resistant (MR), susceptible (S), or highly susceptible (HS) to the US-24 strain of *P. infestans*. The cultivars are arranged in alphabetical order. See how resistant the potato cultivars you grow stack up to this new US-24 strain of the late blight pathogen. Future research will attempt to determine the genes responsible for late blight tuber resistance to facilitate the incorporation of these genes into commercial cultivars.

Literature cited

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Table 1. Tuber resistance of 110 cultivars to infection by a new strain (US-24) of *Phytophthora infestans*, the cause of potato late blight. Multiple tubers of each cultivar harvested from field trials in Washington and Wisconsin were inoculated with spores of the pathogen on a single eye in two or more screening tests. The tuber resistance of each cultivar was categorized into four resistance levels based on the percent incidence of infection: R = resistant (0 to 30% infected tubers); MR = moderately resistant (31 to 50%), S = susceptible (51% to 75%), and HS = highly susceptible (76% to 100%). Yukon Gold was screened only in Wisconsin.

Cultivar	Resistance level (Washington)	Resistance level (Wisconsin)
AC Brador	MR	S
Adirondack Blue	HS	HS
Adirondack Red	HS	HS
All Blue	S	MR
All Red	HS	HS
Alpine Russet	R	S
Alturas	MR	R
Andover	S	MR
Atlantic	S	MR
Bannock Russet	S	S
Beacon Chipper	HS	S
Bintje	HS	S
Blazer Russet	HS	S
Boulder	S	MR
Cal White	S	MR
Canela Russet	HS	S
Carola	S	S
Cascade	S	S
Centennial Russet	S	HS
Chieftain	HS	S
Chipeta	HS	S
Chippewa	HS	S
Classic Russet	HS	S
Clearwater Russet	S	S
Dakota Crisp	HS	S
Dakota Diamond	S	S
Dakota Jewel	HS	HS
Dakota Pearl	HS	HS
Dark Red Norland	S	HS
Defender	R	HS
Denali	S	S
Early Rose	S	R
Elba	HS	S
Eramosa	S	S
Eva	HS	S
Exploits	HS	MR
Freedom Russet	S	MR
Garnet Chile	HS	R

GemStar Russet	HS	R
Grand Falls	S	S
Green Mountain	HS	MR
Harley Blackwell	S	S
Highland Russet	S	MR
Hindenburg	MR	MR
Ida Rose	HS	S
Inca Gold	S	MR
Irish Cobbler	HS	MR
Ivory Crisp	S	HS
Jacqueline Lee	MR	R
Kalkaska	HS	MR
Katahdin	HS	HS
Kennebec	HS	S
Keuka Gold	HS	S
Klamath Russet	HS	S
Langlade	HS	S
Lehigh	S	S
Liberator	S	S
MaineChip	S	HS
Marcy	S	R
MegaChip (W1201)	S	MR
Mesa Russet	R	MR
Michigan Purple	HS	HS
Modoc	HS	S
Monona	HS	MR
Monticello	S	MR
Mountain Rose	HS	S
Norchip	HS	S
NorDonna	S	S
Northstar	S	S
NorValley	S	S
Norwis (FL 657)	HS	S
Prince Hairy	MR	R
Ontario	R	S
Patagonia (NDSU 2)	R	R
Peter Wilcox	HS	S
Pike	S	MR
Premier Russet	S	S
Purple Majesty	MR	S
Ranger Russet	HS	S
Reba	S	S
Reeves Kingpin	S	HS
Rideau	HS	HS
Rio Grande Russet	HS	S
Rochdale Gold- Doree	HS	HS
ROND95249-Russ	S	S

Rosa	S	HS
Russet Burbank	S	S
Russet Norkotah-S3	HS	S
Russet Norkotah-S8	HS	S
Russet Nugget	HS	MR
Salem	S	S
Sangre	HS	HS
Satina	S	S
Sebago	HS	S
Shepody	S	MR
Sierra Gold	S	S
Silverton Russet	HS	R
Snowden	S	MR
Superior	S	MR
Umatilla Russet	S	R
Villetta Rose	HS	HS
W2324-1 (Megachip)	S	S
Wallowa Russet	S	S
Western russet	HS	S
White Pearl	S	MR
Willamette	S	HS
Winema	HS	S
Yankee Chipper	S	HS
Yukon Gem	R	R
Yukon Gold	Not Tested	S

Figure 1. Picture of tubers of various potato cultivars screened for late blight resistance.

Volunteer Potato Outlook - 2014

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Winter soil temperatures are being recorded at four depths (2 ¾", 4 ¾", 6 ¾", and 8 ¾") at the USDA-ARS Research Farm at Paterson, WA. Data have been collected since the first week of November beneath 2013 wheat ground that was mowed and chisel-plowed after harvest. Soil temperatures during the period from November 18 to December 16 were sufficiently low to kill potato tubers at all depths monitored.

Potato tubers are normally killed when they reach temperatures ≤ 28° F. Air temperature reached a low of about -4° F on December 8 and soil temperature at 8 ¾" deep reached 27.5° F on December 9, which would kill all potato tubers to that depth. Cold conditions returned to the Lower Basin on January 5, 2014 but soil temperatures did not kill tubers beyond 2 ¾" deep.

The vast majority of potato tubers left in the field are in the upper 8 inches of the soil profile unless deep post-harvest tillage, such as mold board plowing, was done. Based on previous research on post-harvest tuber depth (Newberry and Thornton, 2004) we estimate that 94% or more of the tubers left in the field last fall at the USDA Research Farm were killed by the low temperatures in December. Volunteer potato plants will likely not be a common occurrence in areas of the Columbia Basin that experienced similar air temperatures in the absence of snow or vegetative cover.