Resistance of Potential Potato Cultivars for the Columbia Basin

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Late blight of potato, caused by *Phytophthora infestans*, is currently the most damaging disease of potato in North America. Direct losses are from reduced yields due to blighted foliage and tuber breakdown in storage associated with tuber infection. Direct losses also include fungicide costs, estimated for late harvested potatoes in the Columbia Basin at $150 to $230 per acre in 1995 and at $130 to $190 per acre in 1998. Losses in storage due to tuber rot were estimated at $1.4 million in the Columbia Basin in 1998. The insensitivity of *P. infestans* to metalaxyl has increased the importance of developing cultivars resistant to the disease. The purpose of this research was to evaluate and characterize late blight resistance of new potato clones.

P. infestans infects plant tissue by sporangia and zoospores under mild and wet conditions. After infection, lesions can develop and sporulate producing further sporangia and zoospores. Rain or overhead sprinklers can wash these spores into the soil where they can infect below ground tubers through eyes, lenticels, or wounds. Resistant potato clones can: reduce lesion spread on tubers and foliage, reduce the number of sporangia produced, require fewer fungicide applications, and provide better control of *P. infestans* in a growers field resulting in lower management costs.

Potato breeding programs are currently using a number of species of *Solanum* to develop late blight resistance in both tubers and potato foliage. Some of these species include *S. bulbocastanum*, *S. demissum*, *S. stoloniferum*, and *S. hougasii*. When testing potato clones for resistance it is important to test all the plant parts. Ranking the plant parts from more to less susceptible, flowers are by far the most susceptible followed by lower canopy leaflets, upper canopy leaflets, and last of all the stems. Tubers most likely fit between upper leaflets and stems in susceptibility.

Thirty-eight clones were grown in the field at the WSU Mount. Vernon Experimental Station during the 2000 growing season. No fungicides were applied to the potato canopy and the field plots were infected by naturally occurring inoculum of *P. infestans*. In the field trial many of the cultivars currently grown in the Columbia Basin had severity values of 93% or higher (Table 1). There were several new clones that did show effective resistance to late blight. One clone of interest is A90586-11 which had a moderately high level of resistance with only 32% of the foliage infected. According to Dennis Corsini, a plant pathologist for the USDA, this variety will probably be released in 2-3 years. There are some problems that will detract from it being accepted by the french fry processors and it isn't a russet, so it will be difficult for it to enter the fresh market. However, this selection has outstanding yields, high specific gravity, and good tuber shape and size for french fries. This is more than any

current late blight resistant tuber on the market. It will most likely be useful in areas favoring late blight. Nine other clones tested in the field trial showed moderately high to high resistance to late blight. These clones ranged from 32 to .3% severity (Table 1).

The flowering of all the clones grown in the field at Mt. Vernon coincided with the peak of the late blight epidemic. The percentage of late blight infected flowers for each clone was calculated. Flowers of cultivars commonly grown in the Columbia Basin were once again extremely susceptible to late blight infection through flowers (Table 2). Of considerable interest was the fact that the only infection sites on several of the resistant clones were by way of the flower, the stem and foliage had almost no symptoms to small traces of infection. The weather conditions at the time were conducive for sporulation. The infected flowers, regardless of the clone, also sporulated.

Leaflet lesion expansion and sporulation is an effective way to determine foliage resistance. Leaflets located in the upper canopy were found to be more resistant to lesion formation and spread than were leaflets in the lower canopy in separate greenhouse experiments (Fig. 1). This shows the importance of obtaining thorough fungicide coverage at all levels in the potato canopy especially the lower regions. Although leaflets in the lower canopy tend to be more susceptible to infection and lesion spread, the leaflets in the upper canopy tend to produce more sporangia than those in the lower canopy (Fig. 2). This may be due to the nutritional contents of older vs. newer leaflets with newer leaflets providing a better substrate for sporulation. Due to the position, an increased production of sporangia in the upper canopy would also facilitate the spread of the sporangia. Sporulation levels of nine clones were compared in a greenhouse experiment in two separate experiments. Gem Russet and Russet Burbank both had high sporulation rates compared to other potato clones (Fig. 3). A90586-11 had no detectable sporulation for the two *P. infestans* isolates used in the two experiments. Since these two experiments, other isolates have been used to infect this clone and limited sporulation has been observed.

Percent tuber infection and area under the lesion expansion curve for both leaflets and stems using two isolates of *P. infestans*, an US-8 and US-11, were measured under greenhouse conditions (Figs. 4 & 5). Percent severity values for the late blight field trial conducted at Mt. Vernon were also included in the figures. Eight clones demonstrated moderately high to high levels of late blight resistance for all categories tested (Fig. 5). The clone A9512-3 demonstrates the importance of testing all plant parts when testing for resistance. For this selection, it has good foliage resistance but tuber infection is high. Greenhouse methods used for testing resistance in this study were effective in determining level of resistance found in the field.

In conclusion, current cultivars in the Columbia Basin are extremely susceptible to late blight and it is important to look at all plant parts when determining resistance. Several new clones tested in the greenhouse and the field have moderately high to high levels of resistance to late blight, and at least one

selection is likely to be released as a cultivar. Our greenhouse methods testing for late blight resistance directly correlated with the field performance of these selections. Hopefully more of these resistant selections will be released as cultivars for use in the Columbia Basin to easy disease pressure due to late blight.

Table 1. Late blight severity of 18 potato cultivars and lines grown in Mount Vernon, WA during the 2000 growing season.

Cultivar	% Severity
Norkotah	100
Ranger	99
Russet Burbank	98
Shepody	98
Bannock	97
Umatilla	96
Gem	95
Legend	93
A9540-84	32
A9538-14	30
A9538-27	20
A9583-56	4
A9553-68	2
A95020-17	0.5
A95053-61	0.5
A9512-3	0.4
A95020-70	0.3
Lst. Sig. Diff.	8

Table 2. Percentage of flowers infected with late blight of nine cultivars and lines at Mt. Vernon, WA during the 2000 growing season.

Cultivar	% Inf. Flwrs.
Norkotah	100
Ranger	100
Shepody	100
Bannock	100
Gem	97
Legend	96
Umatilla	89
Russet Burbank	75
A90586-11	26
Lst. Sig. Diff.	19

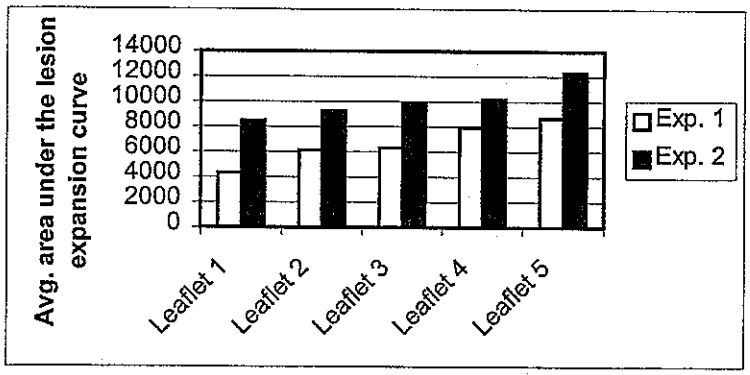

Figure 1. Lesion expansion on leaflets at five canopy levels inoculated with *P. infestans* (leaflet 1= top of plant, leaflet 5=bottom).

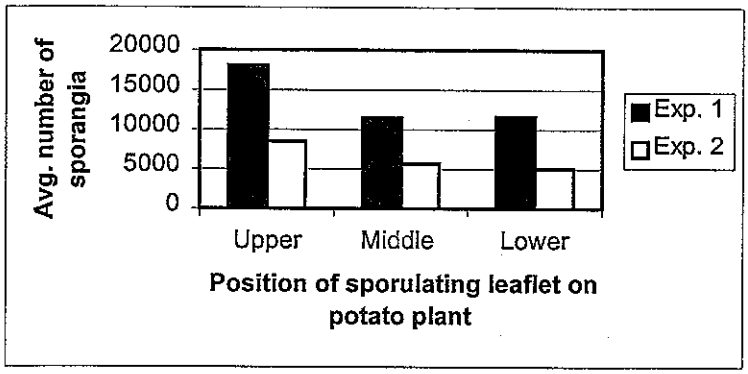

Figure 2. Mean number of *P. infestans* sporangia at three canopy levels on nine cultivars.

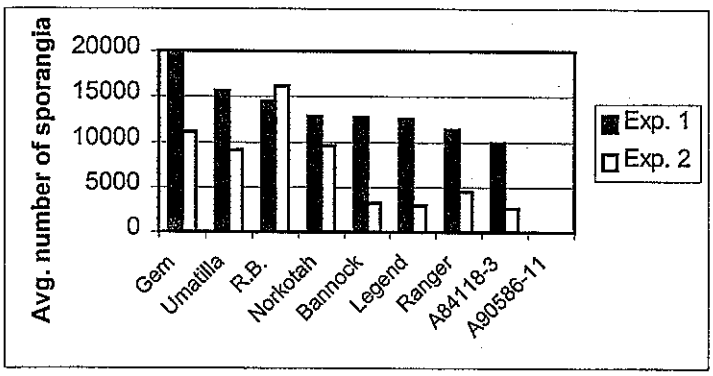

Figure 3. Mean number of *P. infestans* sporangia produced on leaflets of nine cultivars.

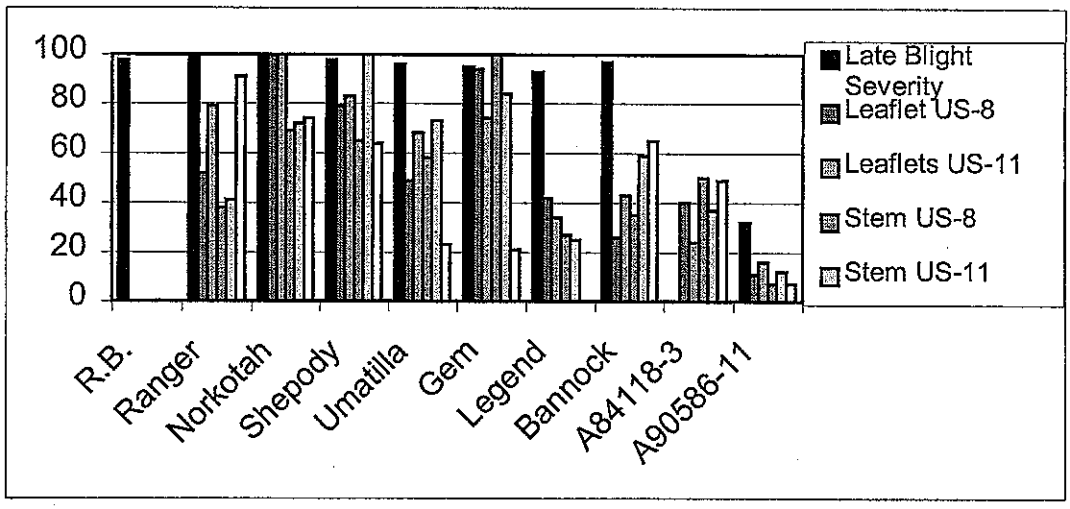

Figure 4. Late blight severity on plants in the field at Mt. Vernon and on leaflets, stems, and tubers in the greenhouse of 10 cultivars. (The values for each respective leaflet and stem assay for each cultivar was calculated by taking the area under the lesion expansion curve (AULEC) of a given cultivar and dividing it by the highest AULEC of the cultivars X 100.)

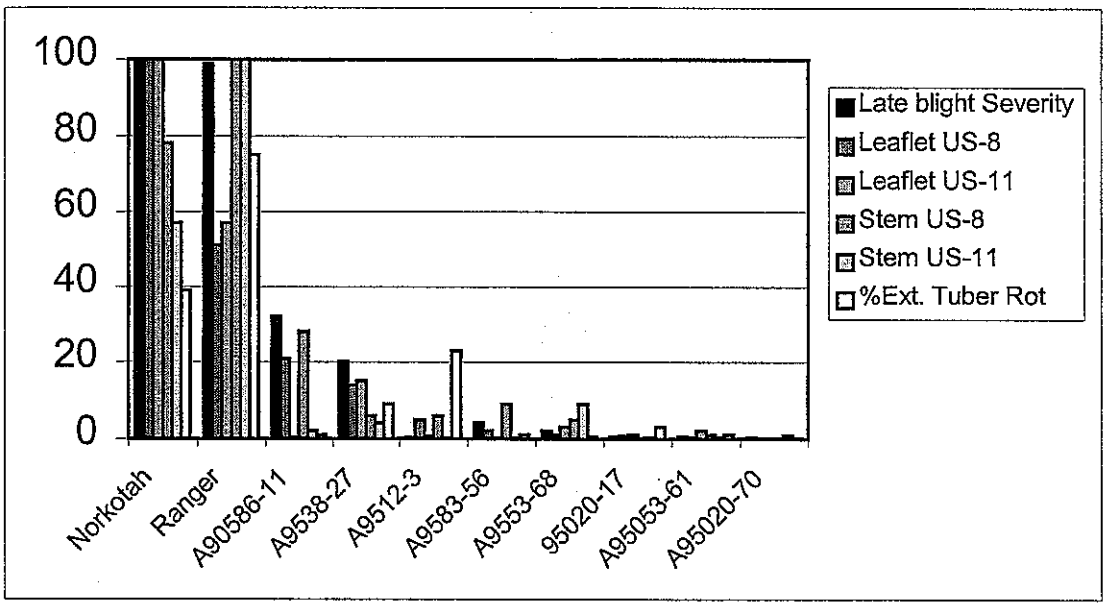

Figure 5. Late blight severity on plants in the field at Mt. Vernon and on leaflets, stems, and tubers in the greenhouse of eight advanced lines. (The values for each respective leaflet and stem assay for each line was calculated by taking the area under the lesion expansion curve (AULEC) of a given line and dividing it by the highest AULEC for the controls (Norkotah or Ranger) X 100.)