# FACTORS INFLUENCING THE INCIDENCE OF PLRV IN THE COLUMBIA BASIN OF WASHIGTON STATE

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Information from industry sources has confirmed that the incidence of tuber net necrosis resulting from Potato Leaf Roll Virus (PLRV) was considerably higher in 1999 than has been experienced over the past several years. A major source of PLRV that is spread by the Green Peach Aphid (GPA) is acknowledged to be infected seed tubers. Beginning in the early 1960's Washington State University established what is known as the potato seed lot trial. One objective of this trial is to evaluate the amount of PLRV present in seed tubers used to plant commercial acreages of potatoes in Washington State. The Washington State Potato Commission as a part of their ongoing support of potato research and education has funded this effort. Potato producers in Washington State submit samples of potato tubers from the seed lots they receive. PLRV content is based on plant symptoms observed during two field readings. The data from the 36 years of this trial provides a historical profile of the incidence of seed borne PLRV in the seed lots represented by the samples and thus in the seed potatoes used by the potato industry of Washington State during this period. The incidence of seed borne PLRV over the most recent 18 years, expressed as percent of samples that have one or more PLRV plants is profiled in Figure 1.

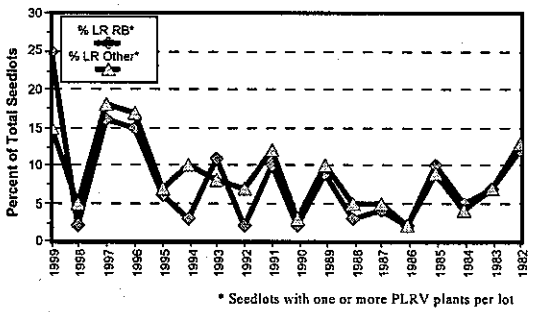


Fig. 1 The incidence of seed borne PLRV over the most recent 18 years, expressed as percent of samples that have one or more PLRV plants.

Incidence of PLRV in cultivars other than Russet Burbank and for the cultivar Russet Burbank is shown. The percent of lots with one or more PLRV plants is similar for Russet Burbank and those grouped as other clones. Percent PLRV was variable but consistently relatively low through 1995. In 1996 the percent of infected lots increased and continued to increase over the following years reaching the highest level in 1999. An exception to the recent increase is 1998 which had an exceptionally low incidence of seed borne PLRV.

The percent of samples with one or more plants showing PLRV symptoms does not provide an indication of the severity of infection within a given sample nor the potential impact this amount of infection will have on the potatoes grown throughout the Washington potato industry any given year. In an attempt to represent the overall PLRV threat present from the seed borne sources an estimate of SEVERITY was derived from the trial results. Severity was

estimated by dividing the total number of PLRV plants in the trial by the number of lots that had one or more PLRV plants.

## Leafroll Severity

$$\frac{\text{Total number leafroll plants}}{\text{\# of lots with one or more leafroll plants}}$$

Example $\frac{\text{20 leafroll plants}}{\text{10 lots with leafroll plants}}$

Severity = **2**

This provides an estimate of the severity that exists any given year but it is doubtful that the potential impact that PLRV from seed borne sources is adequately represented. To estimate the POTENTIAL overall threat the presence of PLRV in the seed tubers represented in the seed lot samples the percent of seed lots with one or more plants with PLRV symptoms was multiplied by the severity value generated above.

## Leafroll Potential

Percent of lots with one or more Leafroll plants x
Severity (average leafroll plants/lot)

Example 15% of lots with leafroll x **2** (severity)

Leafroll Potential = **30**

The profile of PLRV SEVERITY and POTENTIAL values (Figure 2) is similar to the profile of the percent of samples with one or more PLRV plants (Figure 1). This similarity is especially notable from 1994 thru 1999.

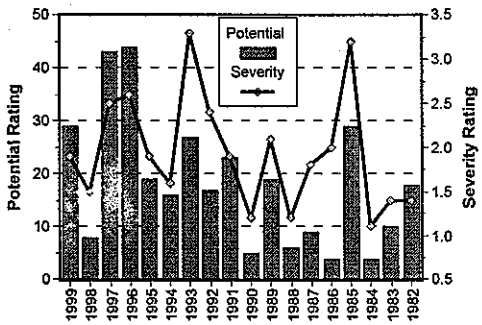


Fig. 2 The profile of PLRV SEVERITY and POTENTIAL values.

Percent of lots with one or more plants with symptoms of PLRV, severity and potential all increase from 1994 through 1997. The significant drop in PLRV in 1998 shown in the percent graph (Figure 1) is also shown in the severity and potential values (Figure 2) as is the rebound to a higher incidence in 1999. An unanswered question resulting from these profiles is why

was the net necrosis experienced in 1999 apparently higher than in either 1996 or 1997. Both 1996 and 1997 had higher severity and potential values (Figure 2) than 1999. One theory proposed for this apparent anomaly is that there has been a substantial change in cultivar make up within the industry (this issue to be addressed later in this article).

An obvious question that needs to be addressed concerning the use of seed lot trial data to represent the presence of seed borne PLRV in the seed potatoes being planted in commercial fields in a given year or any other factor of the seed lot trial is "Do the entries in the seed lot trial sufficiently represent the seed tubers being planted by the industry?" Information on the cultivar make up of the seed lot trial any given year compared to the cultivar make up for the Washington potato industry as reported by the National Potato Council (NPC) may provide sufficient information to answer this question.

Cultivar makeup based on percent of each cultivar in the seed lot trial (Figure 3) or as percent of acreage planted to the 4 major cultivars as reported by the NPC (Figure 4) for the recent 18 years show remarkably similar profiles. Cultivar make up is presented as percent of both Russet Burbank and Norkotah Russet as well as cultivars in three distinct use groupings. This method is used because not all cultivars are present in the seed lot trial or in the NPC data over the entire time.

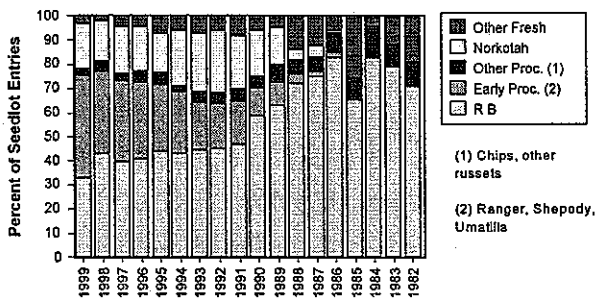


Fig. 3 Historical Seed Lot Variety Make Up

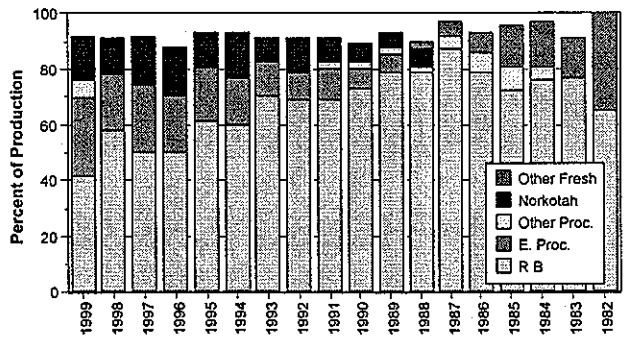


Fig. 4 Historical National Potato Council Washington Variety Make Up

Two dominant trends are seen in the cultivar make up of the seed lot trials and the NPC data. The first is the rapid and constant decline in the percent of the Russet Burbank cultivar from 1986 onward, the second is the rapid increase in percent Norkotah Russet and cultivars in

the Early processing group (Figures 3 and 4). The similarity in the seed lot and NPC data supports the idea that the PLRV values generated using the seed lot trial data reasonably represent the seed potatoes used by the Washington potato industry.

The change in cultivar makeup shown in the two sets of data may also have relevance in terms of the PLRV issue. A factor of interest is that many of the new cultivars are being grown to be harvested early in the growing season rather than for full season growth and eventual storage. These cultivars are used either for fresh packing as is the Norkotah Russet cultivar or for direct delivery for out of the field processing as are most of the Shepody and a large percent of the Ranger Russet and Umatilla Russet. A number of these early harvest cultivars are resistant to or at least not as susceptible to PLRV net necrosis as is Russet Burbank (Figure 5) even though some of these cultivars may be a host of the PLRV virus.

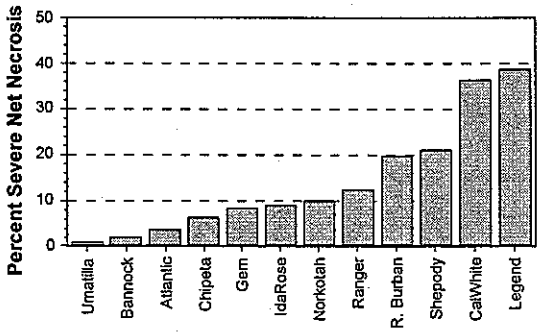


Fig. 5 Response of varieties to PLRV Net Necrosis (Corsini – unpublished)

The combination of early harvest and less threat of net necrosis provide the opportunity to reduce or eliminate GPA control programs on the acreage of these cultivars. Since these cultivars are hosts for the GPA they can serve as a source of GPA and in some cases PLRV. As a host for the GPA fields of these cultivars can provide a place for the build up of large populations of the GPA which can ultimately move in great numbers into the fields of PLRV susceptible cultivars. Some of these aphids could be carrying PLRV. The high GPA population with or without PLRV provides the opportunity for extensive spread of PLRV. Green peach aphids may also come from other host plants but since these alternate host plants rarely harbor the PLRV they do not pose the same threat as do GPA's originating from the early harvest potato fields.

The make up of crops that are found in rotation with potatoes throughout the potato production areas of Washington's Columbia Basin has also changed during the past ten years. A major characteristic of this cropping pattern change is in the acres of row crop involved (Figure 6).

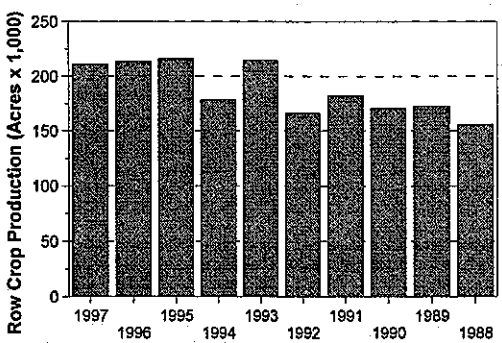

Fig. 6 10 year Columbia Basin Row Crop History (Wash. Ag. Statistics An. Report)

The relationship between crop makeup and the potential PLRV incidence is based on the volunteer plants that are produced from the after harvest tuber leavings in row crops vs. broadcast crops (Figure 7).

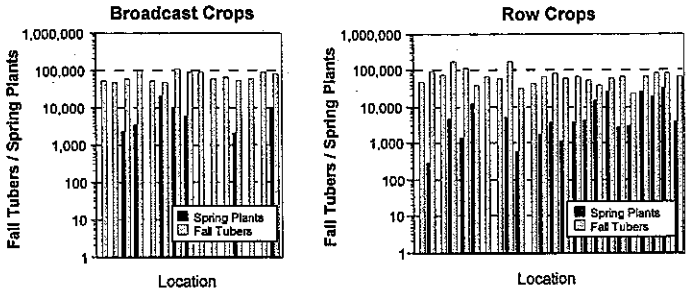


Fig. 7 Impact of Rotation Crop on Volunteer Potato Plant Population

Although the number of after harvest tubers in broadcast and row crops is similar (approaching 100,000 tubers per acre in many fields) a higher percentage of row crop fields (75%) have a high number of volunteer plants the following spring compared to broadcast crops (47%). Volunteer plant population also tends to be higher in row crops than in broadcast crops. Thomas (1983)* has shown that these volunteer plants have essentially the same percent of PLRV (60% in his study) as was present in the tubers from the commercial potato field (68%) the previous year (Figure 8). He also found that there were 1.7 GPA's per sample in fields with wheat cover crop while in fields without a cover crop they were 12.3 GPA per sample. The combination of a high number of PLRV carrying volunteer plants and high population of GPA in row crops provides increased potential for high disease occurrence.

The influence of these factors on PLRV incidence can be summarized as follows:

1. Seed borne virus
   a. Number of lots
   b. Infection severity
   c. Size of infected lots
   d. Distribution of infected lots
2. Use pattern of potato acreage
   a. Disease management practices
   b. Disease symptom expression
3. Makeup of rotation crops
   a. Presence of volunteer plants following potato crop
   b. PLRV overwintering in volunteers in rotation crops

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• Source: Thomas, P. 1983 Pl. Disease