

## Potato Virus Y and Purple Top, Two Important Diseases of Potato

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### INTRODUCTION

Viruses and virus like organisms that infect potatoes continue to plague the industry, whether one grows potatoes for seed or for commercial production. Potato Virus Y (PVY) has been an important virus in potatoes for many years. While strains of this virus have been known for many years, the common strain or PVY<sup>o</sup> was the only one found in North America, and hence the only one that was a concern to potato growers. Relatively recently, PVY<sup>n</sup> was reported in Canada. The difference between PVY<sup>o</sup> and PVY<sup>n</sup> is primarily their pathogenicity toward tobacco; PVY<sup>o</sup> causes a mild mosaic reaction whereas PVY<sup>n</sup> leads to mortality. Their impact in potato is very similar. Due to the potential damage that PVY<sup>n</sup> would cause in tobacco growing regions, the occurrence of this strain led to the establishment of the PVY<sup>n</sup> management plan between the United States and Canada. Following this set of developed rules allowed for the shipment of potatoes between these two countries. Another PVY strain, PVY<sup>ntn</sup>, previously found primarily in Europe, has also recently been confirmed in North America. The significance of this strain is the further reduction of useable tubers due to internal tuber issues.

Purple top is a disease caused by a group of organisms once called mycoplasma-like-organisms or MLO's. Most recently their name was changed to phytoplasmas, to distinguish those that attack plants (phyto=plants). Phytoplasmas are organisms that resemble bacteria in many ways but may be the least understood group of plant pathogens. This is due to the fact they are sometimes difficult to confirm in the plant, difficult to transmit in greenhouse studies, and hence, difficult to study. While there are many kinds of phytoplasmas, in potato there are likely only two that cause the purple top symptoms, "aster yellows" and "BLTVA" or Beet Leafhopper Transmitted Virulence Agent. Aster yellows has been the one considered the most important in potato though the evidence from the 2002 season seems to point to BLTVA as the agent responsible for much of the problem in the Columbia Basin. More research needs to be done to further look at the kinds of phytoplasmas involved with purple top. Purple top will reduce overall yield and reduce quality by causing high sugar areas in tubers and hence create difficulty in processing.

Both these organisms require another organism, a vector, to move them from an infected plant to a healthy plant. In the case of PVY, an aphid that probes an infected plant with its stylet can easily move the virus to the next plant probed. In the case of purple top, a leafhopper is the vector, but transmission is not as readily accomplished as PVY. In both diseases, controlling the vector of the organism is an important means of control.

The purpose of this discussion is to provide a basic understanding of these pathogens, what they are, what symptoms they cause, what impact they have on yield and/or quality, and finally how they can be managed. The reader is encouraged to seek out additional information for a complete understanding.

## **PVY STRAINS**

Potato Virus Y has been part of potato production for a long time in the Pacific Northwest. While seldom further characterized, what virologists really were saying was this virus was PVY<sup>o</sup>, or the “common strain.” There was no need to differentiate the virus as strain since none of the other strains of this virus were found in North America. However, other strains of PVY recently have been found (Table 1).

As with many viruses, this group requires an insect vector, in this case almost any aphid that probes the plant with its stylet. Transmission occurs “non-persistently,” meaning that once an aphid feeds or probes any infected plant with its stylet, the aphid can transmit the virus when probing the next plant. After several probes in uninfected plants, that aphid will no longer be able to transmit the virus. Many aphid species are involved.

Since this virus is so easily transmitted, seed growers of some cultivars have an extremely difficult time keeping seed lots free of this virus. Cultivars that are particularly difficult to see symptoms in are Russet Norkotah and Shepody. Late flights of aphids in seed areas have been known to transmit this virus, and even though field observations show little virus infection, winter grow-out tests have confirmed high virus infection levels.

## **SYMPTOMS**

Symptom development by PVY<sup>o</sup> is somewhat dependent on the potato cultivar, time of infection, and likely the growing region. Generally this virus causes a mosaic (light and dark areas) symptom in the leaves, which can be difficult to see, particularly in bright light. In some cultivars this virus will cause vein burning on the underside of the leaves and even necrotic “ringlets” on the leaves. Among the most common cultivars in the Pacific Northwest, this virus is difficult to see in Russet Burbank, and particularly difficult in Shepody and Russet Norkotah. Infection by PVY in these last two cultivars is termed “latent” because of this difficulty with visible foliar symptoms. In Ranger Russet PVY causes an extreme leaf drop, even mortality. Other symptoms include stunting and yellowing. See Table 2 below.

Symptoms due to PVY<sup>n</sup> and PVY<sup>nm</sup> are similar to that described for PVY<sup>o</sup>. However, in Ranger Russet leaf symptoms are not as severe as with PVY<sup>o</sup>. One important difference between PVY<sup>o</sup> and PVY<sup>nm</sup> is the development of tuber

symptoms. PVY<sup>ntn</sup> can cause severe internal necrotic “circles” in tubers making them unusable in most markets. Symptoms like these have been found in Umatilla, Alturas, and Yukon Gold, and other necrotic symptoms in German Butterball and Ranger Russet. Much more information is needed regarding symptom development in tubers by PVY<sup>ntn</sup>.

## YIELD LOSS

Yield loss due to PVY<sup>o</sup> has been extensively studied in the Pacific Northwest in recent years, primarily in Russet Norkotah and Shepody, two cultivars not thought to be highly impacted due to little symptom development. Results of these studies indicate where the potatoes are grown has much to do with the amount of yield loss that occurs. In other words, impact due to PVY<sup>o</sup> is much reduced if grown in shorter season areas of Idaho and Oregon compared to if grown in the long season and high yielding areas of the Columbia Basin (Table 2).

PVY<sup>n</sup> likely causes the same kind of reductions. Little data are available about these strains of PVY but work this past summer in the Columbia Basin showed an average reduction of about 50% in Ranger, Alturas, Norkotah, and Umatilla hills grown from infected seed. However, further yield reduction occurred in the infected Alturas samples due to internal necrotic areas caused by PVY<sup>ntn</sup>. If these tubers had not been grown for flakes, the complete plantings in a number of fields would have been culled. Much more research needs to be completed to get a better understanding of what impact these strains of PVY have in potato production in the West.

## MANAGEMENT

The first step in disease management is buying seed free of PVY. This means having visual in-season readings accompanied by a winter grow-out test supported by ELISA analysis. A seed grower should never purchase seed with a little amount of virus thinking that field rouging will bring a lot into certification standards. Likewise, a commercial grower should not buy a seed lot at a bargain price when the lot has a high reading (above 2-3%). The value of seed is not what ones pays for it but rather the potential it has to produce a quality crop with good yield.

PVY strains are most likely moved in a field by aphids -- any aphid that might pass through a field and “probe” while determining if potato is a suitable host. Aphids can transmit the virus faster than pesticides can kill them, making control of PVY spread into a field very difficult or impossible. Insecticides can only stop the aphids from colonizing a field. Also, since aphids are attracted to the off-color of plants grown from virus infected seed, such plants become reservoirs of the virus. These reservoirs are more important in spread of the virus in a field than is spread from outside sources.

The best practice is to plant only virus free seed and maintain an insecticide program that prevents aphids colonizing the field.

## **PURPLE TOP**

Purple top, a disease caused by a phytoplasma, seems to be of minor importance to the Pacific Northwest, at least in most years. During the past 10-12 years outbreaks of this disease have appeared maybe 4 times, and may have caused significant widespread damage only in 2002. Damage is most likely due to population variations of the leafhopper vector(s). During 2002 large numbers of leafhoppers were reported in the Columbia Basin, though potato plants with purple top symptoms were reported in other locations of Eastern Oregon, Washington, and parts of Idaho. Leafhopper populations may have been higher than normal in those areas as well.

Due to the complications that exist regarding an easy and reliable laboratory test to confirm this disease, little work has been done over the years to get a better understanding of the vector, yield loss potential, and confirmation of the specific phytoplasma involved. However, these kinds of issues need to be worked out to prevent the kind of large yield and quality losses that occurred in the Columbia Basin this past year. For more information about purple top, see *Potato Progress* (Volume 3 #1 and #3, 2003).

## **SYMPTOMS**

This disease produces symptoms that are much like those produced by Potato Leafroll Virus (PLRV). These include leathery rolling leaves that turn yellow and oftentimes a reddish color that develops with time, swollen nodes, aerial tubers, stunting, and elongation of axillary buds. This later symptom makes the plant appear to be “bushy.” Early symptoms look much like PLRV, but soon symptoms like aerial tubers develop which clearly are not due to PLRV.

## **YIELD LOSS**

Few hard data exist regarding yield loss. Yield loss does occur but is likely based on time of infection -- the earlier the infection the greater the chance of complete loss of that hill. In other words, if infection occurs before tuber development, none will develop. Infections that occur later, after tubers have formed, can cause substantial problems during processing due to the production of sugar areas in the tubers.

## **MANAGEMENT**

Management of purple top in many ways is much easier than PVY. First of all, seed is not a likely source of purple top in a potato field. This disease is

considered “self limiting,” meaning that infected plants will not produce daughter tubers so the disease will not carry over to the next generation. However, if plants become infected after tubers have been produced, these daughter tubers can be infected and show up in the next generation. Secondly, this disease differs from PVY by the fact that plants arising from infected tubers are not a source of spread of this disease in the field. Though the leafhopper can infect potatoes while feeding after acquiring the phytoplasma from weed hosts, it cannot acquire the phytoplasma when feeding on infected potatoes. Lastly, this disease can be prevented from damaging potato fields by maintaining a good insecticide program. While PVY can be easily spread by the quick and simple probing by the aphid, a much longer time period of feeding is required to spread purple top. Due to this important difference, well timed applications of insecticides quickly kill the leafhopper before transmission occurs. This last fact was clearly indicated by the control that resulted in most fields where insecticides were used in early June, which was later determined to be the time of an extensive flight of leafhoppers in the Columbia Basin.

Table 1. Strains of PVY and where they are found.

<b>Strain</b>	<b>Symptom</b>	<b>Potential Yield Losses</b>
PVY <sup>o</sup>	Mild to severe mottling, chlorosis, leaf drop death; no tuber symptoms	10 - 80% loss
PVY <sup>n</sup>	Mild mottling; (except Ranger and Liberty); no tuber symptoms	Up to 50%?
PVY <sup>ntn</sup>	Mild mottling; tuber necrosis	Up to 50 %? + tuber Loss
PVY <sup>c</sup>	Stipple-streak, stunting, death; no tuber symptoms	like PVY <sup>o</sup>

Table 2. Symptoms caused by and yield reductions due to strains of PVY

<b>Strain</b>	<b>Common Name(s)</b>	<b>Where Found</b>
PVY <sup>o</sup>	Common strain	Worldwide
PVY <sup>n</sup>	Tobacco Veinal Necrosis Strain	Europe, USSR, Africa, South America (1950's South America), North America (1990 Canada), Japan, Taiwan {PVY <sup>n</sup> management plan established due to the finding in Canada}, Montana 1999, other states 2000
	Tobacco Necrotic Strain	
PVY <sup>ntn</sup>	Potato Tuber Ringspot Disease	Europe, Greece, Italy, Portugal, North America: California and Pacific Northwest 2000
	Tuber Necrotic Strain	
	Tuber Necrotic Ringspot Disease	
PVY <sup>c</sup>	Stipple Streak Strain	Australia, India, UK, and some parts of Europe