

Demonstration Plots Show the True Nature of *Potato virus Y* Problems: A Research Update

Jonathan Whitworth, USDA-ARS, Aberdeen, Idaho

Potato virus Y (PVY) typically causes a mosaic symptom in infected potato plants. Other symptoms include necrotic tissue in the leaves, stems and tubers. If only mosaic symptoms are present, the result is a loss of yield (a quantitative loss), but with necrotic symptoms present in tubers, the loss can be more serious with a rejection of the tubers for fresh pack or processing – a quality loss. Reaction of symptoms in the plant can vary depending on the potato variety and the virus strain in the plant. This variation can range from no visual symptoms to severe symptoms that kill the plant.

PVY is mainly spread by aphids in a non-persistent manner, which means that the virus particles are on the aphid's stylet and when it probes or feeds on a plant, the virus particles are transmitted and the plant is inoculated with virus. An aphid acquires the virus from an infected plant within seconds and once it lands on a healthy plant can transmit the virus in seconds. This occurs before any insecticide can stop the feeding and transmission.

In the past, seed growers and the seed certification system have been able to control the level of PVY in seed by a system of roguing – removing diseased plants, and inspections and tolerances to quantify the amount of virus in a seed lot. However, due to new varieties that don't express PVY symptoms very well and PVY strains that have mild expression, levels of PVY have risen.

PVY strains include PVY^O, PVY^{NTN}, PVY^{N:O}, and PVY^{NW_i} among others. The O strain is referred to as the common or old strain and typically produces good visual foliar symptoms and no tuber necrosis in most varieties. The N strains typically have milder symptoms and tend to cause tuber necrosis in some varieties.

As part of a Specialty Crop Research Initiative grant by the USDA-NIFA, a demonstration plot was set up at Othello, Washington to train seed growers, inspectors, and industry in PVY symptoms. This plot consisted of 42 varieties and three PVY strains. Each plot had a healthy (non-inoculated) row, a PVY^O row, a PVY^{N:O} row, and a PVY^{NTN} row. Varieties included all market classes such as russets, reds, and yellows.

Some examples of symptoms showed that Ranger Russet and Yukon Gold had severe reactions when infected with PVY^O to the point that plants were severely stunted on June 20th when the field day was held. Those same plants were dead on July 27th (Figure 1). The other rows infected with the N strains had plants with mild symptoms compared to the healthy plants. In another example, Silverton Russet showed mild symptoms on both dates (Figure 2).

A goal of potato breeding programs is to incorporate PVY (and other virus) resistance into industry ready varieties. It is important to understand the difference between resistant and tolerant. A variety that has no foliar or tuber symptoms can still be infected with PVY-this is an example of a tolerant variety. It is better to have a variety that is susceptible to PVY that doesn't

produce tuber symptoms when infected than a variety that is susceptible and has tuber symptoms. Russet Burbank and Norkotah Russet are both PVY susceptible, but don't produce tuber symptoms when infected. These are PVY susceptible, but tuber necrotic tolerant. Silverton Russet also doesn't produce good foliar symptoms, so it is tolerant as well. The danger of Silverton types is that they still are a source of inoculum for more sensitive varieties planted nearby.



Figure 2. Silverton Russet PVY symptoms on June 20th (left) and July 27th (right). Rows from left to right are healthy, PVY^O, PVY^{N:O}, PVY^{NTN}.

Photos courtesy M. Pavek, S. Gray

Resistance is now available in some potato varieties. There are two types, strain specific resistance and resistance against all strains. Strain specific is resistance against one strain such as PVY^O but susceptibility to another such as PVY^{N:O}. Premier Russet and Yukon Gem have strain specific resistance. Resistance against all strains of PVY is called extreme resistance and can be attributed to major genes such as *Ry_{sto}* or *Ry_{adg}*. These genes come from the *Solanum stoloniferum* or *S. t.* subsp. *andigena* species of potato. *Ry_{sto}* is in Payette Russet, a new fresh pack and processing potato that is resistant to all strains of PVY. Eva is a round white chipping variety that also has extreme resistance. More PVY resistant varieties are nearing the final stage of approval as breeding programs work to incorporate these genes, but until they are widely grown, knowing the characteristic symptoms of PVY and buying seed with no or low virus levels is critical.

Post-harvest testing is done on all seed lots destined to produce seed and on most of the lots destined for commercial production. It is critical for a buyer to know the post-harvest virus results before buying any seed. The tests are done with a sample from each seed lot being grown-out in the winter in the field or in a greenhouse. The majority of the field tests are done in Hawaii (some are done in Florida) in December and January. Results are made available by the grower to the buyer with the use of a Plant Health Certificate. This certificate includes the summer inspection results and the post-harvest test results.

While it is difficult to keep PVY out of all seed, you should expect that early generation seed has no virus or almost no virus and later generation seed has low virus.

Remember that the more generations a seed lot is grown in the field means more exposure to virus. Because it is difficult to see PVY mosaic in all varieties, all states ELISA (lab test) leaves of those varieties from those grow-outs. ELISA will detect all strains of PVY. A few states ELISA test leaves of all varieties in their program. The Plant Health Certificate will show post-harvest results for visually inspected plants and/or ELISA tested plants (Figure 3).

The PVY demonstration trial was a great success with 150 people attending. Similar demonstration trials are planned for 2018 in Washington, Wisconsin, and Maine. The 2018 trials will have a core set of the same varieties and a set regional specific varieties.

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NORTH AMERICAN CERTIFIED SEED POTATO HEALTH CERTIFICATE - CROP YEAR 2003

Grower Name: _____ City, State/Prov.: _____ Variety: _____ Acres: _____

Importer Name: _____ City, State/Prov.: _____ Quantity Shipped: _____ Size: _____

Lot Certification: Certification #: _____ Seed Class/Gen.: _____ Certifying State/Prov.: _____

Lot origination from tissue culture: No Yes Year micropropagated for planting: _____

Production environmental pedigree: Fill 1 column per production year, use different initials in Greenhouse and Field boxes for different farms (e.g. JSF for John Smith Farms); indicate a sub-varietal lot with a "*" after farm initials; describe other footnotes in notes below.

1996	1997	1998	1999	2000	2001	2002	2003

Year of Production: _____ Greenhouse (insect excluding) & sterile soil: _____ Field (note special measures below): _____ Certification No.: _____ Number of years produced: _____ Certifying State: _____ in field soil: _____

Summer Field Readings Field inspections: 1st, 2nd, 3rd, Final. Less Than: _____

Post harvest readings Location: _____ Sample No.: _____ Plant Count: _____

ELISA test results for latent viruses %PVY %PVX

Other Diseases Bacterial Ring Rot: _____ Late Blight: _____

Notes: _____

The above information is accurate to the best of our knowledge:

Program official / title: _____ Date: _____ Agency: _____ Telephone: _____ FAX: _____

Approved for use by the Certification Section of the Potato Association of America

Figure 3. North American Plant Health Certificate. Green box shows summer field readings, blue is post-harvest readings from visual inspection, and red is ELISA test results for leaves tested in the lab.