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What to do about Potato Virus Y

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The ability to manage Potato virus Y (PVY) in seed potatoes has become increasingly important since 2002 (Crosslin et al. 2002, Singh et al. 2003). This is about the time that new PVY strains started to be detected across North America. In addition, newer cultivars with poor PVY symptom expression have become more common. Some of these new PVY strains produce milder mosaic symptoms than PVY^O, the common strain. These factors make the traditional methods of roguing less effective. Unlike leafroll virus that can be controlled with insecticides and roguing, PVY can be acquired and transmitted by aphids so quickly that existing insecticides are of little use for control of virus spread.

The amount and type of aphids also play a part in PVY spread. Although green peach aphids are the most efficient vector of PVY, other aphids such as bird cherry oat aphid, which transmits PVY less efficiently, can be present in such high numbers that it is actually more important as a PVY vector. In fact, any probing aphid that lands on PVY-infected potatoes can probably acquire and transmit the disease. At the present time, more than 50 species of aphid are considered to be PVY vectors. It is important to understand what changes have occurred in the seed industry in order to plan a useful strategy for keeping early generation seed potatoes free of PVY.

In previous years, a majority of the crop was Russet Burbank and PVY that was present was the PVY^O strain. Symptoms included a typical mosaic pattern of green and yellow on the leaves, vein burning (necrosis) on the underside of the leaves, and leaf drop on the plant resulting in a 'palm tree' like effect. New cultivars, such as Russet Norkotah and Shepody were introduced, and PVY symptoms in these tolerant cultivars were mildly expressed almost to the point of being latent. Seed agencies responded with ELISA lab testing these cultivars at the post-harvest stage. Additional cultivars such as CalWhite, Gem Russet and GemStar Russet also poorly express PVY symptoms, but were not grown in as large of acreages as Russet Norkotah and Shepody.

New laboratory tools will help aid the grower and certification agencies in reducing the levels of PVY in the seed crop. ELISA, a serological test, remains the workhorse of all seed programs, and can very efficiently and accurately detect PVY, even in varieties that don't show good, recognizable symptoms when infected with the virus. Recently, fairly inexpensive tests have been made available to the grower, which can be used in the field to detect PVY and other viruses. These are 'quick' tests that consist of a small strip of paper embedded with antiserum that turns color when virus infected plant sap is applied to it. These tests can be used to test a few suspect plants to get an idea of symptoms in a specific seed lot. These tests are available from companies in the U.S. and Europe. Cost ranges from $3.50 to $9.00 per test depending on the company and the number of tests purchased.

For research purposes, RT-PCR (reverse transcriptase polymerase chain reaction), a molecular test, can be used to target and amplify even small amounts of viral RNA to detectable levels. Specific 'primers' for different strains can be used to detect which strain is in a plant sample. This method can also be used on grower samples, but because of the cost it is best used for bulk testing where the result shows that PVY of a certain strain exists in a seed lot. ELISA is still best used to determine the percentage of PVY in a seed lot because the cost per test is much lower allowing a high number of tests to be run in a lot.

Another promising laboratory test is a membrane-based macroarray, which would allow testing for multiple viruses from multiple samples on a platform the size of a microscope slide. Macroarray tests are still in development. Both the macroarray and the RT-PCR test are molecular-based and can be used to target specific strains of PVY more readily than ELISA. Use of laboratory tests with good cultural practices will limit the amount and spread of PVY.

The right cultural practices combined with a limited generation seed certification system can help reduce PVY. In a limited generation system, the seed stocks start from virus-tested tissue culture stock. In an ideal situation, isolation of early generation seed stocks from those of later generations helps to continue the 'isolation' of seed away from any virus source. Certainly traditional seed areas, defined by short growing seasons and late-season aphid flights, play a role in avoiding virus sources and vectors. Crop borders, which consist of a non-PVY host crop, can be planted around small early generation seed lots to provide a buffer between the seed lot and the in-flight of aphids. Aphids are attracted to differences in wavelength that exist between a green potato crop and freshly cultivated fallow strips. Research in the mid-west by Difonzo et al. (1996) showed that crop borders around small plots resulted in lower PVY in the resulting winter grow-out than did fallow-bordered crops.

Recent results have indicated that when virus is within a seed lot, the effect of a crop border is lost (J.A. Davis, personal communication). This crop border effectively serves as a cleaning station for aphids that come into the crop with PVY. Since PVY is a stylet-born virus, virus particles on the surface of the stylet of an aphid get left in the tissue when an aphid probes a plant. If this plant is part of the crop border, then when the aphid enters the small seed lot, its stylet is clean. Growers have effectively used winter wheat borders planted in the spring so that it doesn't head out and stays green all summer.

Finally, an effective long term strategy for PVY control involves using resistant cultivars. This would be the first and best option, but the choices a grower makes for cultivars is often determined by the market. A second best strategy would be to plant a cultivar that has good PVY-mosaic expression so that a grower can effectively rogue the seed lot. Roguing in any case is best done early in the season when the plants are big enough to express PVY but before any aphid flights. Multiple trips into the field to rogue may be necessary if the grower doesn't know the window of expression or if there is uneven emergence where younger plants may express later than others. Use of solid set sprinklers in early generation lots can help to minimize trips into the field of early generation lots, because a small amount of mechanical transmission is possible, though the greatest risk of virus transmission is by aphids. When going into an early generation field, disposable boot covers and pants also help to minimize chances of transmitting disease from one field to the next. Early generation seed represents a major investment, and every care should be taken to keep it free of PVY and other potato diseases. No one of these steps can solve PVY problems, but used together they can be effective tools to reduce virus to manageable levels.

How much of an effect can PVY have on the commercial grower? Research at the University of Idaho indicated that 1% seed-borne PVY can cause a 1.5 cwt/A yield loss in either Russet Burbank, Russet Norkotah or Shepody potatoes (Nolte, et al, 2003). Small percentages of PVY (less than 10%) will probably not cause a detectible yield loss.

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Did You Know?

If you enlarged a PVY particle to one foot in length, an approximately ten-ounce tuber of relative size would stretch from here to the Pacific Ocean.

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