Best Management Practices to Minimize the Spread of PVY

compiled by Ryan Barrett, Research & Agronomy Coordinator, PEI Potato Board
based on research by Dr. Mathuresh Singh and research team, Potatoes New Brunswick

Over the past five years, the PEI Potato Board has supported research into improved management practices for Potato Virus Y (PVY) as part of the Canadian Horticultural Council's National Potato Research Cluster. This research has been led by Dr. Mathuresh Singh and his team at ACS Lab, operated by Potatoes New Brunswick. Dr. Singh's team has published several scientific papers resulting from their PVY research, and Mathuresh has also presented results to Island growers on multiple occasions. In this factsheet, we seek to emphasize some of the best management practices for management of PVY tested in this research project.

Minimizing the impact of PVY in potatoes requires a two-pronged approach: minimizing PVY inoculum in seed, and reducing the spread of PVY in the field. By examining PVY spread in a number of grower fields in New Brunswick over a five year period, Dr. Singh and his research team were able to identify which factors had the greatest impact on minimizing PVY levels.

Planting Clean Seed:

One of the factors with the largest effect on minimizing PVY levels is planting seed with the lowest virus level possible. In New Brunswick research, it was found that seed lots planted with zero percent PVY had significantly lower PVY levels at the end of the season compared with fields planted with some starting virus level (Fig. 1). This makes logical sense, as having fewer PVY infected plants for aphids to pick up the virus from dramatically decreases the likelihood of spread to nearby plants within the field. While aphids can bring PVY from other fields or other hosts such as nightshade weeds, minimizing the initial inoculum in the field is one of the single largest factors in reducing in-season PVY spread. In addition, effective rogueing of seed fields to remove infected plants early is essential to limiting the spread of PVY as even seed lots with a zero post harvest test may contain some infected plants. This is especially important if planting a seed lot with a virus level higher than zero.

Application of Mineral Oils/Insecticide:

Over several years, Dr. Singh and his team have been able to conclusively show that the regular application of mineral oils in combination with the use of insecticides has

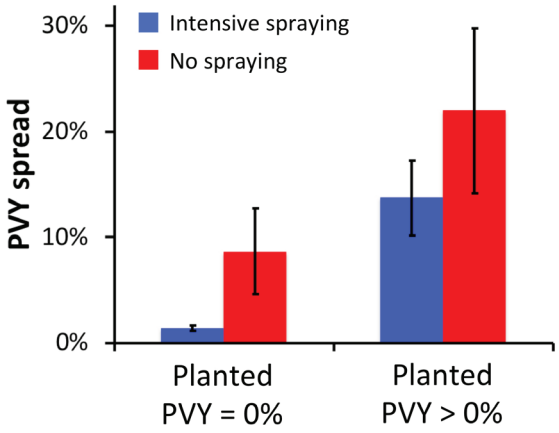

Figure 1: Effect of PVY inoculum planted in the field. Fields planted with no detectable PVY (Planted PVY = 0%) show much less PVY spread even than intensively managed fields (many mineral oil and insecticide sprays) if planted with detectable levels of PVY (Planted PVY > 0%). Data from: MacKenzie, Tyler DB, Xianzhou Nie, and Mathuresh Singh. American Journal of Potato Research 93, no. 6 (2016): 552-563.

consistently shown to be very effective at minimizing the spread of PVY in-season (Fig. 2). By examining both grower practices over several years, as well as testing on a plot basis over multiple years, the New Brunswick team has identified that weekly application of 2 L per acre of mineral oil is essential to impairing the ability of non-colonizing aphids to transmit PVY. Growers who maximized their time of protection with mineral oil (starting before 30% emergence and continuing until just before top-kill) showed the greatest control of PVY spread. Rates higher than 2 L per acre (5 L per hectare) did not show any significant improvement in the reduction of PVY spread.

Also of high importance is minimizing the window between plant emergence and the first oil spray (Fig. 3). Reducing this window had a high correlation with reduced PVY spread, as well as maintaining a frequent spray schedule. From 2010 to 2014, the average number of days between first emergence and first spray reduced from 36 to 24 days, with average PVY spread declining substantially during that time.

The best level of PVY control was seen when insecticides were combined with mineral oils for approximately half of the total sprays (Fig. 2). However, the timing of these insecticide sprays and the type of insecticide used was key to optimum control. The most effective timing for insecti-

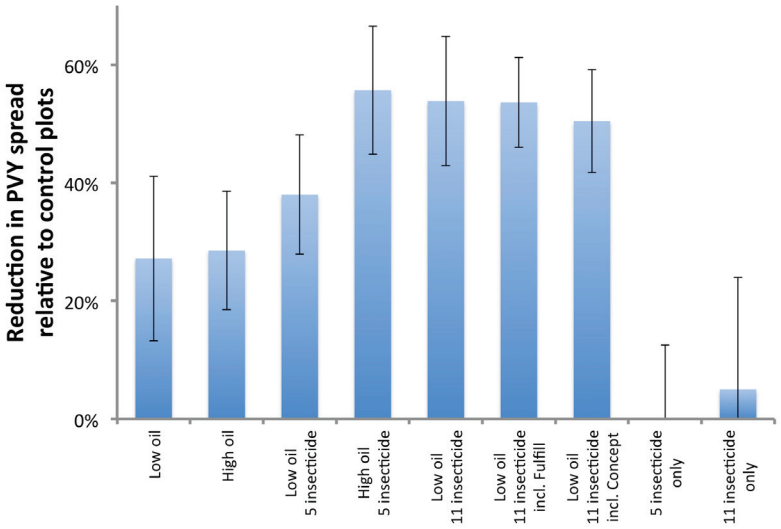

Figure 2: Effectiveness of various foliar spraying treatments on reduction of PVY spread. Bars are averages of trials in two different years, and indicate reduction of PVY spread from the level measured in control (unsprayed) plots. Most effective treatments were combined mineral oil & insecticide spray, followed by mineral oil spray alone, and insecticide spray alone had no effect on PVY spread reduction. PVY spread in control plots in each year averaged 11% (2014) and 22% (2015). Data from: MacKenzie, Tyler DB, Jacques Lavoie, Xianzhou Nie, and Mathuresh Singh. American Journal of Potato Research 94, no. 1 (2017): 70-80 .

cide sprays is generally early and mid-season, when aphid numbers are highest and the growing potato plants are most sensitive to infection. The number of aphids found per trap in early and mid-season is highly correlated with PVY spread, so controlling aphids at those times is most important. The New Brunswick team has also done substantial work to identify which types of insecticides are most effective at interrupting aphids in the quickest possible fashion to prevent PVY spread, as slow-acting chemistries will still allow aphids to probe leaves and pass on the virus. Their research has shown certain chemistries to be the most effective, including pyrethroids (such as lambda-cyhalothrin) or flonicamid. Trade names for these insecticides include Matador, Silencer, and Beleaf. Use of insecticides alone (without use of mineral oil) was found to be

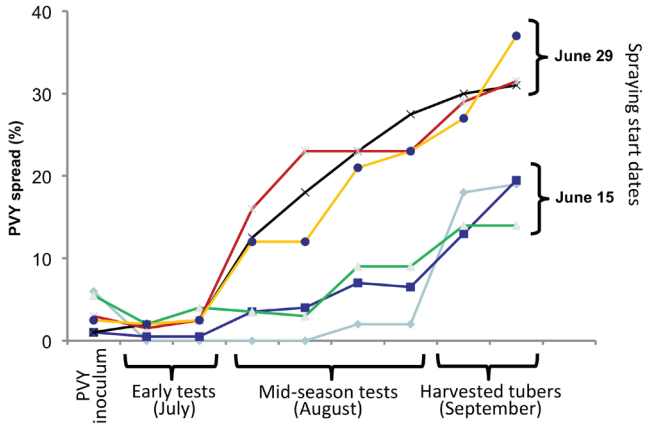

Figure 3: PVY spread through the growing season in six fields in which mineral oil and insecticide spraying programs were started at different dates. Three fields where spraying began mid-June had PVY spread almost reduced to half of those where spraying began two weeks later in late June.

the most effective, especially if used early in the season when aphid numbers are often highest and plants are growing quickly.

Delaying Planting Date:

Dr. Singh's team found that a slight delay in planting date was associated with moderately significant reduction in PVY spread. By planting slightly later, it is possible in some years to delay full emergence until after the peak of early-season aphids has passed, usually in mid to late June. From 2010 to 2014, planting dates moved back by two weeks on average in the research team's monitored grower fields. Moving planting date too late may significantly limit yield, so finding a compromise on planting date is important.

Environmental Variables:

While weather conditions are not controllable, some have more impact than others on PVY spread. The New Brunswick research team determined that mean temperature in the preceding winter can have a moderately significant impact on PVY spread, with higher winter temperatures favouring higher virus levels. This is likely due to reduced winter mortality of aphids as well as increased likelihood of volunteer potatoes.

Variables with relatively lower correlation with PVY spread included mean daily temperature in July and the number of days with rain during the growing season. Variables which did not have a significant correlation with PVY spread included total precipitation during the growing season, average temperature during the growing season, the number of aphids per trap in late season, and the number of days between last oil spray and top killing. However, this should not be used as an excuse to stop oil sprays early, as there was little variation in this data as

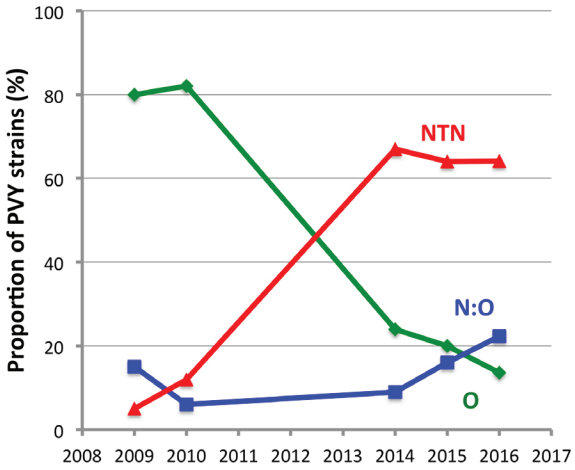

Fig. 4 Changes in proportions of PVY strains since 2009. Proportion of the traditionally dominant PVYO strain has dropped by a factor of five in the last decade, replaced mostly by PVYNTN, though recently PVYN:O has also begun to rise. Data from: MacKenzie, Tyler DB, Jacques Lavoie, Xianzhou Nie, and Mathuresh Singh. American Journal of Potato Research (2018): 1-10.

most growers in the study continued to spray oil consistently up to top-kill.

Changing PVY Strain Populations:

One of the major revelations from Dr. Singh's research has been the changing nature of PVY strains in Canada. Previously, the dominant strain found in Canadian potatoes has been PVYO. In recent years, recombinant, necrotic PVY strains such as PVYN:O and PVYNTN have increased in prevalence, with PVYNTN now accounting for more than 60% of infections (Fig. 4). Controlled field experiments have shown that PVYNTN is particularly aggressive, spreading much more readily than other strains. These studies have also shown that PVYNTN produces a higher percentage of infected tubers and a higher number of tubers per plant than PVYO, which may partially explain the growing dominance of PVYNTN.

In addition, both PVYN:O and PVYNTN tend to display fewer foliar symptoms (mosaic) than traditional PVYO. This impacts the ability to identify infected plants during rogueing. The variation of symptoms on both foliage and tubers has been shown to be variety-dependent, with the NB research team cataloguing the relative severity of symptoms on thirty different varieties. For example, the round white variety Eva has shown to be very resistant to all strains of PVY. On the other hand, varieties such as Envol and Yukon Gold appear to be particularly susceptible to the recombinant strains, with necrotic lesions evident on tubers. Thus far the New Brunswick researchers have not shown severe necrotic effects from PVY in most of the dominant varieties grown in Prince Edward Island, such as Russet Burbank or Goldrush.

Recent research results from Dr. Singh's team have shown that these recombinant strains also appear to be more likely to be spread by mechanical damage to foliage. Controlled field experiments have shown that PVY spread can be several times higher in wheel tracks than in neighbouring rows, due to the exposure of sap from foliage on wheels travelling down the row and infecting plants through damage to leaves and stems. Further research into the mechanical transmission of PVY is ongoing, but growers of high-generation seed may need to consider changing the management of wheel tracks or using tramlines.

Summary:

Research by Dr. Mathuresh Singh and his research team in New Brunswick has made significant progress in improving our understanding of PVY spread. From these studies, the key messages for reducing PVY spread include:

- **Plant certified seed with the lowest PVY virus level possible.** Starting with clean seed is associated with significantly lower levels of in-season spread. For cost-conscious growers, the research team feels that this is the single most cost-effective management decision for PVY spread reduction.
- **Weekly application of at least 2 L per acre of mineral oil** from soon after emergence until shortly before top kill, **combined with use of effective insecticides** like lambda-cyhalothrin or flonicamid, has been proven to have the lowest rate of PVY spread. While frequency of spray (weekly) is important, higher rates (above 2 L per acre) of mineral oil, and use of other insecticide chemistries have not been shown to significantly decrease spread.
- **Delaying planting to avoid early season aphid populations**, as well as decreasing the interval between plant emergence and first spraying, is significantly correlated with reduced PVY spread.
- Early rogueing, even in seed plots with a zero virus rating, is important in all seed fields to reduce the risk of virus spread in-season.

Sincere thanks to Dr. Mathuresh Singh, Dr. Tyler MacKenzie and the rest of the team at Agricultural Certification Services in Fredericton, NB for providing results from their research as part of the CHC National Potato Cluster 2, completed in April 2018.