A NEW POTATO VIRUS VECTOR MONITORING PROGRAM BY AUSPICA[1]

AuSPICA has introduced an innovative solution to monitor insect vectors in potato crops. Passive suction traps installed in the field take samples of potential virus vectors, which are then sent to Intertek laboratories for rapid DNA analysis. The data developed builds information on the presence of potato virus vectors during the growing season and in the long term builds trends on vector populations in potato growing regions. By Barry Strahan* and Dr Nigel Crump

1. Australian Seed Potato Industry Certification Authority (AuSPICA)

*Corresponding email: barry.strahan@auspica.org.au

Viruses can potentially reduce both yield and tuber quality of potato crops. In Australia, three viruses are of particular significance: PVY (Potato virus Y), PLRV (Potato leafroll virus) and TSWV (Tomato spotted wilt virus). All are spread by insect vectors; PVY and PLRV by aphids and TSWV by thrips. Monitoring and controlling these insects is key to limiting virus spread and loss of marketable crop yield.

POTATO VIRUS Y

Visual symptoms of PVY can vary greatly from variety to variety. In some cases infection is impossible to detect visually when walking through the potato crop, as infected plants may be asymptomatic and show no symptoms of disease. If present, symptoms can include mosaic or mottling of the leaves (Figure 1), stunting, and uncharacteristically rough or distorted leaves. With low level PVY infection, tuber symptoms may be minor with minimal yield loss and tuber cracking.

When PVY is present in seed, the effects on yield on subsequent commercial crops can be severe. A study in the US found that for every 1% of PVY in the seed, the yield of the subsequent crop decreased by 0.18t/ha. PVY impacted both marketable yield and tuber size[1]. PVY^{NTN} strain can sometimes cause necrotic rings on tubers (Figure 2), but not all PVY^{NTN} infections show this symptom. Conversely, tuber necrosis is not a definite indicator of PVY infection. Tubers, and plants, with no apparent visual symptoms can also be infected with PVY.

The best control for PVY and the other viruses discussed below is to use clean certified seed with known low virus levels, where feasible use resistant varieties, adjust planting and desiccation times to avoid periods of high vector insect pressure, maintain an effective management program which includes, scout crops for vector insects, and rogue out infected plants during the growing season. It is also important to properly dispose of crop waste and control self-sown potatoes as these can act as a source of infection. Weed populations should also be considered as possible virus hosts and can provide a safe harbor for insect pests.

Seed cutting is considered to be a contributing factor spreading PVY, so effective disinfection of cutting equipment and the priority cutting of known clean seed lots before cutting seed lots with known levels of PVY can reduce the spread of virus across seed lots.

Figure 1. PVY symptoms in Atlantic. Photo by Barry Strahan

Figure 2. PVY^{NTN} tuber necrosis. Photo by Nigel Crump

TOMATO SPOTTED WILT VIRUS (TSWV)

Like PVY, TSWV impacts the marketable and total yield of crops. TSWV causes a general reduction in tuber size. In some cases necrotic spots occur internally on tubers. These can extend to the skin as concentric rings.

Symptoms of TSWV in the field (Figure 3) include necrotic leaf spots. These can have concentric rings, sometimes leading to a misdiagnosis as target spot, a fungal disease caused by Alternaria species. Severely affected stems and even whole plants can die. Plants grown from infected tubers are often most severely affected, with stunted growth in the form of a rosette.

POTATO LEAFROLL VIRUS (PLRV)

PLRV (Figure 4) causes reduced tuber set and size. In some varieties, PLRV can also cause necrotic brown flecks in the tuber vascular tissue, affecting marketability.

Visual symptoms can vary depending on whether it is a new/primary or seed borne/secondary infection. Primary infection tends to be concentrated in the young leaves, which appear pale and dry or brittle with rolled leaf margins, sometimes with a hint of red or purple.

Seed tubers from infected plants carry the disease and will cause secondary infection. Such secondary symptoms are similar but more severe, showing first in the lower leaves before progressing to the new growth. Plants with secondary infection can, in some cases, be stunted and hidden under the canopy of neighbouring plants as the infected plants are out competed and over shadowed. Crop walks prior to row closure are therefore important to identify the disease and rogue infected plants.

Figure 3. Tomato spotted wilt virus. Photo by Nigel Crump

Figure 4. Potato leafroll virus. Photo by Barry Strahan

TARGETING THE VECTORS OF POTATO VIRUSES

Regular scouting of potato crops, particularly seed crops, is the best way to identify and monitor insect pests and/or beneficials as part of an IPM (Integrated Pest Management) strategy. However, it can be hard to get a bigger picture of insect presence and movement across a wider region. Traditionally, yellow sticky traps or water traps have been used to monitor aphids and thrips. However, getting the insects identified to species level and subsequently counted is difficult and expensive. Obtaining a quick result, as to what insect is present, particularly at species level, is not always possible, however the application of new DNA diagnostic technology provides a valuable solution.

AuSPICA have collaborated with diagnostic laboratory Intertek to develop a passive suction trap that can be installed in field to capture flying insects, including aphids and thrips. The total capture of insects is sent to Intertek for DNA analysis to identify and quantify which insect species are present. This is done quickly – in a matter of days of the laboratory receiving the sample – allowing informed decisions to be made by growers, including correlating with recent localised crop scouting activities.

The team at AuSPICA has been working hard over the past couple of years to bring this program from concept to field implementation. The team has built and tested the passive suction traps and worked with Intertek Laboratories to develop and validate a testing procedure. This enables the DNA of target insect species to be identified in the trap samples. Currently we can detect three species of thrips and two species of aphids, with more insects to be included in the future.

The large Macquire traps (Figure 5) are mounted just above canopy height in potato fields and spin to track the wind, acting as a funnel. Insects are attracted by the traps yellow colour, then drawn into the sample tube though passive suction. The solution contained within the tube preserves the insect DNA, ready for collection and delivery to the laboratory for testing.

For the 2022-23 season, with financial support from Seed Potatoes Victoria, AuSPICA installed four traps strategically located around the Ballarat district, two in the Otway's and another two in the Portland district. Samples were collected weekly. Sites for the traps were chosen to provide a snapshot of insect movement across each district from week to week.

Once testing is completed each week, certified seed growers and AuSPICA affiliated members in the respective district receive an SMS text message to notify them of trap results. The message includes information on insect species detected and the quantity of insects measured at each site, reported as low, medium, or high (Figure 6).

As the program progresses, data can be plotted year on year and cross referenced to highlight high risk periods seasonally, helping growers plan planting and desiccation dates, along with making informed decisions as to the appropriate management of target insect vectors.

The traps are provided as a commercial service to all growers. Please contact AuSPICA if you are interested in having insect monitoring included in your crop next season.

In the coming seasons, the test will be expanded to include detection and quantification of Serpentine Leaf Miner as well as other insect pests. This will further improve the application of this technology for use by the Australian potato industry.

Figure 5. Macquire trap. Photo by Barry Strahan

AuSPICA
Potato Virus Insect Vector Population Monitoring
3/4/23

TOWN 1
Green peach aphid – Low (1-10)

No Target species detected for the following trap locations.
TOWN 2
TOWN 3
TOWN 4

Target Species
Western flower thrips
Common blossom thrips
Onion thrips
Green Peach aphid
Potato aphid
It is always recommended to scout crops for localized insect pressure.

Figure 6. Example of SMS message

Insect trap results at a given site – early detection of Onion thrips the vector for TSWV and aphids (Green Peach Aphid) vector for potato virus PLRV and PVY. Note: CT value shown in the graph relates to the level of insect DNA in a given sample.

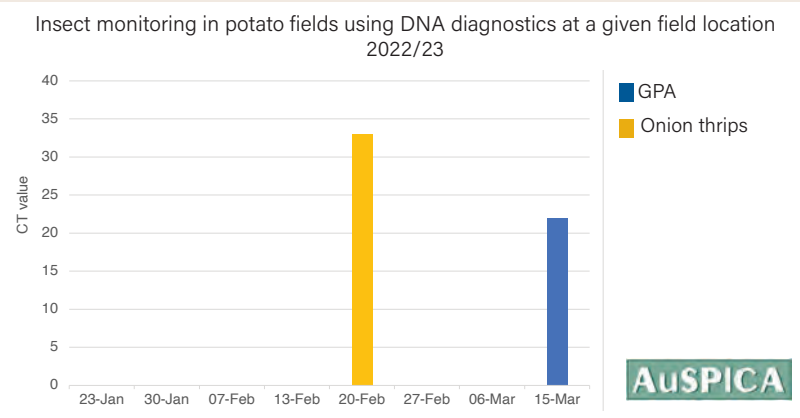

Figure 7. Example of trap data

REFERENCES

1. Phillip Nolte, Jonathan L. Whitworth, Michael K. Thornton, and Christopher S. McIntosh. 2004. Effect of Seedborne Potato virus Y on Performance of Russet Burbank, Russet Norkotah, and Shepody Potato Plant Dis. 88:3, 248-252