

case study

Over recent seasons growers and processors have noticed an increase in the incidence of virus disease in their potato crops. Of particular concern is an increase in the level of potato leafroll virus. This broadsheet describes what viruses are, why you need to be concerned, and what steps you can take to minimise infection in your crops.



Management of potato viruses

What is a virus?

Viruses are small transmissible pathogens which use components of their host plant cells to multiply. In the process of infecting their host, they often damage or disrupt the plant's normal growing pattern, causing such visible symptoms as leaf mottle, leaf distortion, plant stunting and flower colour break. Less visible problems caused by virus infection may include slower growth of plants, inefficient use of nutrients and reduced tolerance to other stresses. In potatoes, leaf mosaics reduce the leaf area available to produce food. Leafroll virus blocks the food movement channels of the plant.

Viruses may be spread vegetatively (in corms, bulbs, tubers or cuttings), mechanically (on knives, secateurs or through movement of equipment, people and animals), by insect vectors (thrips,

aphids or whitefly), aerially by pollen, in soil, by fungi or by parasitic nematodes.

WHY SHOULD I BE CONCERNED?

All growers want to produce a good product at a reasonable cost in order to get a good return. If the crop has a viral infection yield will be affected. This loss may be in the form of small tuber size, lower yield weight or both. When a crop has one disease its susceptibility to others may be increased.

If a grower is producing seed tubers certification standards need to be met to attract custom. Even if standards are met, complaints from customers concerned about virus symptoms in their crops can cause embarrassment. Export markets may also require guarantees of tuber health to be met before shipments can be made.



HOW ARE POTATO VIRUSES TRANSMITTED?

Virus disease is usually transmitted vegetatively from infected seed tubers. Plants become infected by mechanical transmission, for example, rubbing of plant stems and leaves, abrasion against spraying or cultivating equipment, and damage to tubers from bins or harvesters. Aphid vector transmission is also very important. Some viruses, such as leafroll, are transmitted 'persistently', that is after feeding for some hours. Other viruses are 'non-persistent', and transmission takes only minutes. Aphids may carry virus into a crop from infected volunteer potatoes or weeds. Aphids may also move a virus around within the crop. They can even transmit viruses to sprouted potatoes in storage.

Mosaics

Mosaics may be caused by individual viruses or by mixed infections, for example, PVX and PVY; PVX, PVY and PVS; or other combinations.

POTATO VIRUS Y (PVY) – SEVERE MOSAIC

Field symptoms: Leaf bunching and crinkling, mild or strong yellow leaf mosaic, necrotic veins, leaf spots and leaf dropping (Figures 1a, 1b and 1c).

Different strains may cause different symptoms in different cultivars. For example, a strong mosaic and necrotic leaf spotting occurs in Russet Burbank and Red Kind Edward.

Tuber symptoms: One strain of PVY can cause blistering, necrotic rings or arcs, and cracking on tubers of Rua, Nadine and other cultivars.

Transmission: Aphid or mechanically transmitted.

POTATO VIRUS A (PVA)

Symptoms: Related to PVY but symptoms are usually much milder.

ALFALFA MOSAIC VIRUS (AMV) AND POTATO AUCUBA MOSAIC (PAMV) – CALICO MOSAIC.

Symptoms: Bright yellow blotches and banding on leaves (Figure 2).

Transmission: Aphid or mechanically transmitted.



Figure 1a. Potato virus Y: rugose leaf symptom in cv Karaka



Figure 1b. Potato virus Y: leaf-drop streak symptom in cv Tahiti



Figure 1c. Potato virus Y: tuber necrosis in cv Rua.



Figure 2. Alfalfa mosaic virus: leaf calico symptom in cv Russet Burbank

In New Zealand we know of the following potato viruses:

Virus	Mechanical transmission	Aphid transmission	Yield losses observed	
			Overseas	New Zealand
Mosaics				
PVY	Y	Y	10-80%	Up to 38%
PVA	Y	Y	15%	-
AMV	Y	Y	-	-
PVX	Y	N	10-20%	-
PAMV	Y	Y	-	-
Leafrolling				
PLRV	N	Y	50-90%	Up to 84%
Other				
PVS	Y	Y	10-40%	-
PVM	Y	Y	10-40%	-



Figure 3. Potato viruses X and S: mild leaf mottle in cv Russet Burbank.

VIRUS X (PVX) – MILD MOSAIC

Symptoms: Mild leaf mottle or yellow mosaic between veins (**Figure 3**).

Different strains may cause different symptoms in different cultivars. For example Desiree shows no clear symptoms of PVX, whereas Russet Burbank shows a mosaic.

Transmission: Only mechanically transmitted, but is quite contagious and may survive on leaf trash or machinery.

LEAFROLL VIRUS (PLRV)

Primary leafroll occurs on plants infected by aphids in the current season while secondary leafroll is carried vegetatively in the seed tuber from the last season. Leaf rolling symptoms may also be caused by environmental stresses or *Rhizoctonia* fungus.

Field symptoms: Primary–upper leaf curling with yellow and red colouring (**Figure 4a**). Secondary–plants are stunted, lower leaves curl up and are leathery to touch (**Figure 4b**).

Tuber symptoms: Russet Burbank may show a 'net necrosis' symptom.

Transmission: Aphid vectors only.



Figure 4a. Potato leafroll virus: primary leafrolling in cv Rua



Figure 4b. Potato leafroll virus: secondary leafrolling (left) cv Rua

Other viruses

These viruses have milder symptoms but they are important because they increase the impact of other viruses in the host plant.

POTATO VIRUS S (PVS)

Field symptoms: Very mild mosaic, usually symptomless.

Transmission: Mechanical (quite contagious), some strains are aphid transmissible.

POTATO VIRUS M (PVM) RELATED TO PVS

Field symptoms: Very mild mosaic, leaf crinkling, plant stunting.

If you are unsure of the disease identity take a specimen and have it identified by AgriQuality NZ, Crop & Food Research or your crop agent.

Aphid vectors

In New Zealand the main aphid vectors of potato viruses are: green peach aphid (*Myzus persicae*) (**Figure 5**), potato aphid (*Macrosiphum euphorbiae*), foxglove aphid (*Aulacorthum solani*), and melon aphid (*Aphis gossypii*).

Other aphids that are found on potatoes and may at times transmit viruses include pea, blue-green and cereal aphids. As a guide, in spring/summer aphid numbers increase until hot weather prevails, when numbers drop off. Populations begin to build up again in late summer/autumn. This build-up sometimes leads to late season transmission, especially in seed crops.



Figure 5. Green peach aphid (wingless)

How should we control the spread of viruses?

The ideal solution would be to only grow cultivars resistant to viruses. Many cultivars currently grown have high levels of resistance, for example Rua to PVY, Ilam Hardy to PVX and Y, Sebago to PVY. Red Rascal has tolerance to PLRV. Unfortunately, there is no completely resistant cultivar with all the necessary attributes of a perfect multi-purpose potato. We must, therefore focus on other management factors, listed below, to control viruses.

Seed tubers

A key to reducing most virus problems is a supply of high quality, pathogen-tested seed tubers, for example those produced under the NZ Seed Potato Industry seed potato certificate programme. These tubers are not resistant to all viruses but they are carefully tested to be free from them. Producers of pathogen-tested seed need to:

- ensure all laboratory, glasshouse and field quality control standards are being met
- ensure that any unsatisfactory clones are deleted
- ensure stringent hygiene standards are applied to seed containers, cuttings, and crop management.

Grower practices

Growers can help themselves to produce healthy crops by following these guidelines during all stages of production. The aim is to keep the crop clean by:

- using only seed from a reliable source
- avoiding damaging tubers while handling
- using clean, sanitized storage bins
- ensuring grading equipment is clean
- ensuring seed is cut hygienically with disinfected knives
- avoiding inter-row cultivation, using herbicides if possible
- following a proper crop rotation (e.g. 5-7 years between seed crops, 3-5 for ware crops)
- ensuring the seed bed is clean and free of trash, volunteers and weeds

- moulding very early to reduce machine contact with plants and avoid plant damage
- moving from crop to crop wearing clean clothes and moving from known healthy blocks to 'doubtful' or less healthy (e.g. always move from pathogen-tested to Group 1 then to Group 2)
- not sowing the crop in the irrigation track
- inspecting and roguing at emergence (many susceptible plants at 10-20 cm tall will show clear virus symptoms)
- monitoring the crop diligently for aphid infestations
- applying chemicals by air, again to avoid plant contact with equipment
- spraying off seed crops as soon as possible after certification to avoid late season virus transmission by aphids
- clearing up trash, burying or feeding waste tubers and spraying off volunteers

Seed cutting

If cutting seed to get consistent tuber size, growers and processors will need to:

- thoroughly wash or steam clean equipment (knives or machine blades) prior to disinfection (see below) since it is important to remove potato wastes that interfere with the activity of the disinfectant
- use a suitable disinfectant frequently and between seed lines, and ensure adequate chemical contact with equipment for 10 minutes. Corrosive chemicals must be rinsed off. Suitable disinfectants currently include: bleach (2.4% a.i. sodium hypochloride), 1% benzoic acid or 10% hydrogen peroxide sanitisers
- disinfect between seed lines, at rest breaks and at the end of each day
- not cut seed with long sprouts
- dry cut tubers and treat with a suitable fungicide before sowing.

Aphid management

Special attention needs to be given to vector control before and during the growing season. Such control methods include:

- storing seed in aphid-proof stores
- weed control around margins will help eliminate aphid havens
- pesticide chemical treatment of tubers, before sowing, with registered materials
- crops only to be sown into volunteer-free blocks
- foliar pesticide applications after scouting
- selecting correct chemical spray groups

Growers must scout crops to decide on when to spray. When growing seed, begin checking for aphids soon after emergence, as part of your roguing programme. Continue weekly, to ensure tuber treatments and sprays are still working effectively. For example, some tuber treatments will protect tubers for less than a month after sowing, depending on environmental conditions.

When scouting for aphids, ideally a district aphid management scheme should act as a guide to when virus vectors are actually flying. Otherwise growers will need to rely on their own judgement. Scouting should commence weekly before the effects of any tuber treatment have worn off to ensure early infestations do not take hold. As a guide, examine the top, mid and base leaves from 50 plants, taken randomly from throughout the crop. If you detect more than 10 wingless aphids/100 leaves, it is likely that aphids are colonising and the crop should be sprayed with insecticide. Look for likely hot spots, such as gaps in windbreaks, paddock margins and gateways. Remember, your prevailing wind may blow insects in, so work from that direction.

To assist Canterbury seed potato growers an aphid monitoring programme is under development. Check the website: www.aphidwatch.com for progress.

One final point, your potato industry relies on dedication to high product standards from all those involved. Any failure in one area reflects on everyone in the industry.

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