

Managing sweetpotato viruses in Australia

Grower guide April 2016

For Horticulture Innovation Australia Ltd Project VG13004

Innovating new virus diagnostics and plant bed management in the Australian sweetpotato industry



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This project has been funded by Horticulture Innovation Australia Limited using the Vegetable Industry levy and funds from the Australian Government.

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Contents

Key messages	ii
What are plant viruses?	1
What sweetpotato viruses are in Australia?	1
How are sweetpotato viruses spread?	2
Non-persistent transmission	2
Persistent transmission.....	2
What are symptoms of sweetpotato virus infection?	2
Symptoms include:.....	3
Symptoms (cont.):.....	4
How to reduce losses from virus and phytoplasma diseases.....	5
Start with clean planting material	5
Minimising virus re-infection in plant beds	5
Practice vigorous farm hygiene.....	6
Monitor and manage commercial crops	6
Managing fields post-harvest	7
Biosecurity awareness	7



Key messages

- Sweetpotato viruses can have a major impact on the yield and quality of sweetpotatoes in Australia.
- The most critical strategy for managing sweetpotato viruses is using clean planting material sourced from a reliable supplier.
- Clean sweetpotato plants become re-infected when vectors (aphids, whiteflies, jassids) spread viruses and phytoplasma from infected plants.
- Managing sweetpotato viruses in commercial crops is about reducing the probability and rate of virus re-infection, by:
 - Starting with clean materials.
 - Being vigilant in maintaining nursery beds as virus and vector free as possible.
 - Ensure no sweetpotato plants or materials (apart from current nursery beds or growing commercial crops) exist on farm. This means removing old crops and volunteer plants, including dump sites for reject roots.
 - As far as practically possible around your farm, eliminate weeds related to sweetpotatoes, and vegetation that supports vector insects.
- Report any unusual plant symptoms to appropriate agencies, as there are important sweetpotato virus diseases not currently in Australia that could severely impact the industry.

What are plant viruses?

Plant viruses are viruses that affect plants. Sweetpotato viruses are not able to survive or multiply without a host plant or vector. They are extremely small and are made up of a core of genetic material or nucleic acid (either DNA or RNA), which contains all the information necessary for them to multiply, surrounded by a protective protein coat.

Some sweetpotato viruses are found wherever sweetpotato is grown. Viruses can occur alone or there may be two or more viruses in a plant. Usually, the more viruses in a plant, the lower the yield.

What sweetpotato viruses are in Australia?

There are currently four main virus problems known to occur in Australia currently, along with their vectors:

- **Sweetpotato feathery mottle virus (SPFMV)**; spread by aphids (Picture 1); non persistent
- **Sweetpotato chlorotic fleck (SPCFV)**; vector is unknown; persistence unknown
- **Sweetpotato collusive virus (SPCV)**; vector is unknown; persistence unknown
- **Begomoviruses group**; spread by whiteflies (Picture 2); persistent; actual virus species to be determined

Although not strictly a virus, similar principles apply to a type of bacterium called:

- **Phytoplasma or Sweetpotato little leaf (SPLL)**; spread by jassids (leafhoppers) (Picture 3); persistent.



Picture 1. Aphids
(1.5 to 2.5 mm long)



Picture 2. Whitefly
(0.8 to 1.2 mm long)



Picture 3. Leafhoppers
(5 mm long)



How are sweetpotato viruses spread?

Most plant viruses are transmitted from plant to plant by sap-sucking insects. These are called vectors or carriers. The most important sweetpotato virus vectors are aphids, whiteflies and leafhoppers. Apart from cropped sweetpotatoes, other plants are important in the life cycle of many viruses and their vectors, as both viruses and vectors are able to survive adverse conditions and intervals between crop cycles in weed hosts, volunteer crop plants, abandoned crops, and vegetative plant parts. **Infected plants cannot be cured.**

Insects can transmit viruses in two ways:

Non-persistent transmission

Virus particles become attached to the mouthparts of the insect as it feeds on virus-infected plants. The insect then transfers the virus particle onto the next plant it feeds on. This method is very quick, and insects only need to feed for a short time (a few minutes) to transmit the virus between plants.

Persistent transmission

Virus particles are taken in via mouthparts of the insect into the gut (and stored in the salivary glands) as it feeds on virus-infected plants. The insect then transfers the virus particles onto the next plant it feeds on. This method is slow as insects need to feed for some hours to obtain the virus. The insect is then infected with the virus for the rest of its life.

What are symptoms of sweetpotato virus infection?

Visible virus symptoms vary with different cultivars and environmental effects. Symptoms are not always visible. Symptoms are usually easier to see when plants are stressed due to other deficiencies or excesses e.g. environmental stresses, nutritional disorders, pest attack.

Symptoms include:

- Vein clearing (Picture 4).
- Pale areas/spots on leaves sometimes with purple edges (Picture 5).



Picture 4. Vein clearing, symptoms of SPFMV



Picture 5. Purple edged spots and feathering

- Bent, twisted and long roots (Picture 6) are sometimes caused by virus infection reducing the number of usable roots. Note that this can also be caused by a range of other factors e.g. high soil nitrogen levels, prolonged waterlogging.
- Russet cracking (Picture 7) and internal cork caused by SPFMV can also reduce storage root quality.
- Small pale spots (Picture 8) caused by SPCV.



Picture 6. Long, twisted roots symptom



Picture 7. Russet cracks from SPFMV



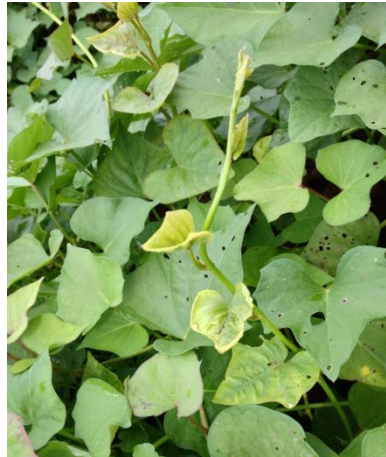
Picture 8. Chlorotic (yellow) spot symptom

Symptoms (cont.):

- Leaf curl (Picture 9) caused by Begomovirus.
- Little leaves, often round with curled up edges, caused by phytoplasma and/or Begomovirus (Picture 9).
- Yellowing and stunting of the whole plant (Picture 10), or the plant grows many stems giving it a bushy appearance, characteristic of SPLP (Picture 11).



Picture 9. Begomo-like virus, leaf curl symptom



Picture 10. SPLP symptoms



Picture 11. SPLP symptoms

- Less latex is produced in vines and roots.
- Stunted root system.
- Less storage roots are produced, smaller storage roots are produced.



How to reduce losses from virus and phytoplasma diseases

Start with clean planting material

The most important strategy for growing healthy sweetpotatoes is to source clean pathogen-tested planting material from a reliable supplier.


Sweetpotato feathery mottle viruses and begomoviruses are endemic in the main sweetpotato growing areas of Australia. It is inevitable that sweetpotatoes multiplied on growers' properties over several seasons in these areas will be virus infected, unless they are using insect-proofed structures and vigilant monitoring programs. The only exception may be very isolated properties, screened by large areas of non-host vegetation, with low densities of weeds and stringent farm hygiene protocols.

- Use Pathogen Tested (PT) planting material.

Minimising virus re-infection in plant beds

Assuming you are starting with clean material, the next step is to multiply up your material (probably using bedding roots in nursery plant beds) to minimise the chance and rate of reinfection.

- Locate nursery plant beds as far as practically possible from commercial sweetpotato plantings, or any other potential sources of virus infection. However this should be balanced by the need to meticulously observe and manage the plant beds, so they should be easily accessible to the responsible manager on a regular (e.g. daily) basis.
- Ideally, use windbreak plantings to further isolate plant beds. Windbreaks can reduce the spread of virus vectors into the plant bed area, as well as promote superior irrigation distribution.
- Regularly inspect plant beds for any signs of virus or phytoplasma. Remove any suspicious plants immediately.
- Maintain a regular program for keeping vectors out of the planting beds. Non-organic growers can rotate a sequence of systemic and contact pesticides according to registered uses.
- Vectors of non-persistent viruses will eventually be killed after feeding on plants sprayed with systemic insecticide. However, because these viruses can be transmitted within seconds, many plants become infected before the insect dies or moves out of the crop. Do not simply rely on systemic insecticides to manage virus vectors.

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- Insecticides are more effective against persistently transmitted viruses because insects are killed before they have time to acquire and transmit the virus.
 - Severe virus re-infection is the primary reason why plant beds become ineffective as sources of planting material. The longer you can keep virus levels in your plant beds low, the more options you have for extending the life of those beds.

Practice vigorous farm hygiene

- Maintaining good farm hygiene is the simplest and most important tool you can use to help manage pest populations. Good farm hygiene will reduce the number of pests developing on and being spread around your farm. Using a combination of management options can be successful in keeping virus infection to a minimum.
- Meticulously manage weeds of the Convolvulaceae family, which includes morning glory, bell vine, red and pink convolvulus, mile-a-minute or coastal morning glory and bindweed. These are related to sweetpotato, and potentially carry many of the diseases that infect your crop.
- Also manage weeds that may sustain pests including aphids, silverleaf whitefly and jassids.
- Clean vehicles and equipment when moving between farms. Also be conscious of people as carriers of potential contaminants, such as soil on boots, or insects in clothing.
- Hygiene principles apply not just to your cropped land, but extend to your headlands, borders, native strips, roads and laneways, drainage areas. Importantly, maintain good hygiene around your packing and machinery sheds as well, being particularly vigilant about sweetpotato materials, either roots or plants.

Monitor and manage commercial crops

- Sequential plantings close together will make it easier for pests such as aphids and silverleaf whitefly to move into new crops.
- Where practical, plant new crops up-wind of old crops, to reduce the risk of pests and diseases being blown from old to younger crops.
- Remove all stunted plants, e.g. SPLP infected plants, when/if they appear in the field.
- Crops are likely to be infested with pests when dry weather, e.g. in spring, dries off the surrounding weeds and other vegetation, particularly when your crop is the only green vegetation around. Be particularly vigilant and ready to act in these circumstances.



Managing fields post-harvest

- Once a crop has been harvested, get rid of the remaining materials as quickly as possible. Use a rotary hoe to chop up leftover sweetpotatoes into smaller pieces to increase rate of decomposition. The combination of a pesticide to kill the pest, and a herbicide to kill the regrowth crop is beneficial in managing all sweetpotato insect pests like silverleaf whitefly. Not spraying and leaving the regrowth crop in the ground results in a breeding ground for pests, which then spread into new crops.
- Remove all sweetpotato residues from previous crops, e.g. leftover storage roots and residue that could harbour pests. Volunteer plants will attract and maintain or increase populations of virus. Apart from in the field, volunteer plants can also arise in areas where reject sweetpotatoes are stored or dumped. Manage **all** sweetpotato materials on your farm.

Biosecurity awareness

There are numerous sweetpotato viruses present in other parts of the world that we do not currently have in Australia. Growers should be alert to the potential introduction of these viruses, and report any unusual plant symptoms through the appropriate biosecurity channels for their state. Growers can also currently contact Sandra Dennien, as investigating potential new viruses is in scope of Hort Innovation Project VG13004.

Of particular concern is Sweetpotato chlorotic stunt virus (SPCSV). In combination with the potyviruses, SPCSV causes the synergistic reactions responsible for sweetpotato virus disease (SPV) and has been found in other disease complexes as well. It is suspected of being in Papua New Guinea; SPV causes 50-70% yield reductions in affected crops. A fact sheet on this virus will soon be lodged on the ASPG website.