Department of **Employment, Economic Development and Innovation**
Agri-Science Queensland

Plant viruses spread by thrips

Integrated virus disease management

Tomato spotted wilt virus symptoms on tomato fruit

Melon thrips

Thrips are minute, slender insects less than two millimetres long and feed on flowers and leaves of plants using piercing and sucking mouthparts. They belong to the insect order Thysanoptera. High populations can cause physical damage to leaves, buds and fruit. A small number of thrips species are also the sole vectors or carriers of all viruses in the *Tospovirus* or tomato spotted wilt group of plant viruses. Tospoviruses are among the most damaging viruses worldwide in many vegetable, field and ornamental crops.

Thrips that transmit tospoviruses in Australia

Western flower thrips (WFT) (*Frankliniella occidentalis*)

This species had its origins in the western United States (US) and has now spread, largely through international trade, to many countries in the northern and southern hemispheres. It has been present in Australia since 1993 and occurs in all states.

WFT feeds on flowers and new plant growth of many species, including capsicum, tomato, beans, lettuce and eggplant. It is an efficient vector of *Tomato spotted wilt virus* and the increased importance of this virus worldwide over the last 20 years is related to the wide international dispersal of WFT.

Tomato thrips (*Frankliniella schultzei*)

Tomato thrips originated in south America and occur throughout Australia. Tomato thrips prefer to feed in flowers and have a wide range of hosts including tomato, tobacco, capsicum, lettuce, grain legumes and many weed species. Tomato thrips can transmit most tospoviruses.

Melon thrips (*Thrips palmi*)

This species is widely distributed throughout South-East Asia, Japan, the Pacific region and parts of northern Australia. Melon thrips have a wide range of host plants, particularly among members of the cucurbit (Cucurbitaceae) and potato (Solanaceae) families. The species is an important vector of the *Watermelon silver mottle virus* group of tospoviruses, which are common throughout Asia. *Capsicum chlorosis virus*, which occurs in northern Australia, is a member of this group.

Queensland Government

Iris yellow spot virus symptoms on onion

Tomato spotted wilt virus symptoms on lettuce

Onion thrips (*Thrips tabaci*)

This species most likely originated in the Mediterranean region and is common in temperate and subtropical areas where it is favoured by warm, dry weather.

Although onion is the preferred host, onion thrips can infest a wide range of vegetable and weed species.

Tospoviruses in Australia

Tomato spotted wilt virus (TSWV)

TSWV was first found in Australia in 1915 and remains one of the most important viruses affecting vegetable crops.

Host plants: TSWV has one of the largest range of host plants of any plant virus, infecting over 900 species of weeds, field crops, vegetables and ornamentals. The vegetable crops most severely affected in Australia are capsicum, tomato, potato and lettuce.

Symptoms: TSWV infection causes a wide range of symptoms, depending on the host affected, age of plants, variety and weather conditions. The range of symptoms seen include ringspots, line patterns, mottling and chlorotic blotches on leaves. Both leaves and fruit are often distorted with dark spots or ring patterns on fruit.

Capsicum chlorosis virus (CaCV)

CaCV was first identified in 1999 from capsicum plants at Bundaberg and has since been found in all capsicum and tomato production areas of Queensland. The virus has also been found in capsicum at Kununurra in the Ord River area of Western Australia.

CaCV is distinct from TSWV and belongs to the *Watermelon silver mottle virus* or serogroup IV tospoviruses, which are widespread and damaging throughout Asia.

Hosts: The crop hosts of CaCV in Australia are capsicum (including chilli types), tomato and peanut. The virus also infects several weeds, particularly *Ageratum conyzoides*, which plays an important role in the survival and dispersal of the virus.

Tospoviruses are among the most damaging viruses worldwide

Symptoms: Although the symptoms of CaCV resemble those of TSWV, there are several distinct features. In capsicum, chlorosis or yellowing on leaf margins and between the veins develops on young leaves, which often become narrow and curled with a strap-like appearance. Older leaves become chlorotic with ringspots and line patterns developing. The fruit on infected plants is small, distorted and often scarred on the surface.
Leaves on infected tomato plants develop chlorotic spots, blotches and mottling. Fruit from infected plants are often small and develop chlorotic rings and necrotic areas.

Iris yellow spot virus (IYSV)

This virus is of increasing importance in onion bulb and seed crops worldwide and occurs in several Australian states.

Symptoms: Infected onion plants develop dry, straw-coloured, spindle or diamond-shaped spots on leaves or seed stalks. The spots may have green centres and concentric rings of alternating green and straw-coloured tissue.

Impatiens necrotic spot virus symptoms on begonia

Impatiens necrotic spot virus symptoms on spathaphyllium

Hosts: The natural hosts of IYSV appear to be largely restricted to members of the Allicaceae family and include onion, garlic, leek, shallot and several species of ornamental plants.

Spread: The virus is spread from plant to plant by the onion thrips. The virus survives in abandoned onion crops, volunteer onion plants and possibly alternative weed hosts. There is no evidence that the virus is spread in bulbs or onion seed.

Impatiens necrotic spot virus (INSV)

This tospovirus has been important in the ornamental industry in the US and Europe for some years, particularly in greenhouse-grown crops.

The virus was first detected in Australia in 2010 on several ornamental species in a nursery on the north coast of New South Wales.

INSV is a potential threat to the vegetable industry as lettuce, potato and spinach are damaged by the virus in the US, and the principal vector (the western flower thrips) is common in vegetable production areas in Australia.

Symptoms of INSV are similar to those caused by TSWV and laboratory tests are required to positively identify the virus.

Spread of tospoviruses

All tospoviruses are transmitted by thrips and cannot be spread by other sap-sucking insects (e.g. aphids, leafhoppers) or chewing insects (e.g. beetles).

The transmission process is a complex biological system. Virus transmission can only occur if the viruses are acquired from an infected plant by newly hatched thrips (first or early second instar nymphs). More mature insects, including adults, may acquire the viruses, but the tospovirus cannot complete the life cycle within the insect to allow transmission.

The nymphs can acquire a virus during feeding periods of less than 30 minutes. Once acquired by immature thrips, the viruses circulate and multiply within the insect and are transmitted to plants as the adult thrips pierce and suck the contents of plant cells. Thrips remain infective for life but do not pass the virus to their offspring through their eggs.

About five days are needed from the time the virus is acquired by a thrips from an infected plant until it is able to transmit the virus to another plant. This allows time for the virus to move and multiply in the insect's gut and salivary glands. Thrips can then transmit the viruses in feeding periods as short as five to ten minutes.

Tospoviruses are not carried in seed or on cutting, pruning and cultivation equipment. They are not spread by handling plants and do not survive in soil and decaying crop residues.

Management

Infected plants cannot be cured. Virus management aims to prevent or reduce levels of disease in crops by removing or avoiding sources of virus infection and minimising spread by thrips.

Use healthy planting material. Tospoviruses can be introduced in infected seedling plants (transplants). Seedling production should be located well away from production areas, kept weed-free and systematically monitored for pests and diseases with a regular spray schedule in place.

Tomato spotted wilt virus symptoms on capsicum

Distorted, unmarketable capsicum fruit from a plant infected by capsicum chlorosis virus

Thrips-proof netting or UV absorbing plastic provides a higher level of protection for seedling production.

Crop/farm hygiene. Old infected crops infested by thrips are a major source of virus and should be sprayed for thrips and removed as soon as possible, particularly if young crops are planted nearby.

Avoid overlapping sowings of susceptible crops and sequential plantings side by side to minimise virus spread from one crop to the next.

Weeds along headlands, irrigation channels and in fallow land provide host plants for thrips and viruses. Disease levels are often higher in crop rows adjacent to these areas. Destroy weeds well before planting, not as crops are planted, as virus-infected thrips may migrate from the wilted weeds to the young plants.

Maintaining a clean buffer zone free of weeds at least 25 m between a virus source and a susceptible crop can considerably reduce virus levels.

Management of thrips with insecticide. Reducing thrips populations using appropriate insecticides can help reduce virus spread. However, insecticides are often of limited value in tospovirus control, as virus spread from non-crop areas is an important source of infection and thrips only require limited feeding times for virus transmission. Significant disease levels can occur when thrips numbers are low in crops, and there is little evidence of direct feeding damage, as small numbers of thrips moving into a crop can result in significant virus transmission. Frequent use of insecticides may also lead to development of insecticide resistance in thrips populations.

Management in protected cropping situations. Greenhouses should be fumigated between crops and the soil treated to kill pupae, which could infest new plantings.

Keeping the greenhouse hot, dry and empty for at least seven days will kill thrips egg and pupal stages after hatching.

Thrips are the only insects that can spread tospoviruses

There are limited options for using biocontrol agents against thrips in protected cropping. The predatory mite *Typhlodromips montdorensis* and the native bug *Orius armatus* have given promising results against western flower thrips in greenhouse capsicum crops grown in hydroponic systems.

Care needs to be taken with insecticide use, including seedling drenches, as insecticides can severely disrupt biocontrol programs.

Resistant varieties. Capsicum and tomato varieties with resistance to TSWV are available. Although effective, the resistance is controlled by single dominant genes, *Sw-5* in tomato and *Tsw* in capsicum, which are vulnerable to the development of resistance-breaking strains of TSWV. Such strains of TSWV have been identified at several locations in Australia. The development of these is most likely to occur when the resistance genes are challenged by high virus pressure, which provides greater opportunity for the selection and establishment of resistance-breaking strains. When resistant varieties are used, care should still be taken with crop/farm hygiene and other preventative measures to reduce sources of virus and prolong the useful life of the resistant varieties.

Using resistant varieties is part of a disease management strategy, not a reason to ignore other vital means of reducing virus reservoirs and spread.

More information

For more information, contact the Department of Employment, Economic Development and Innovation (DEEDI) on **13 25 23** or visit **www.deedi.qld.gov.au**

Thrips and tospoviruses: a management guide. **www.deedi.qld.gov.au**

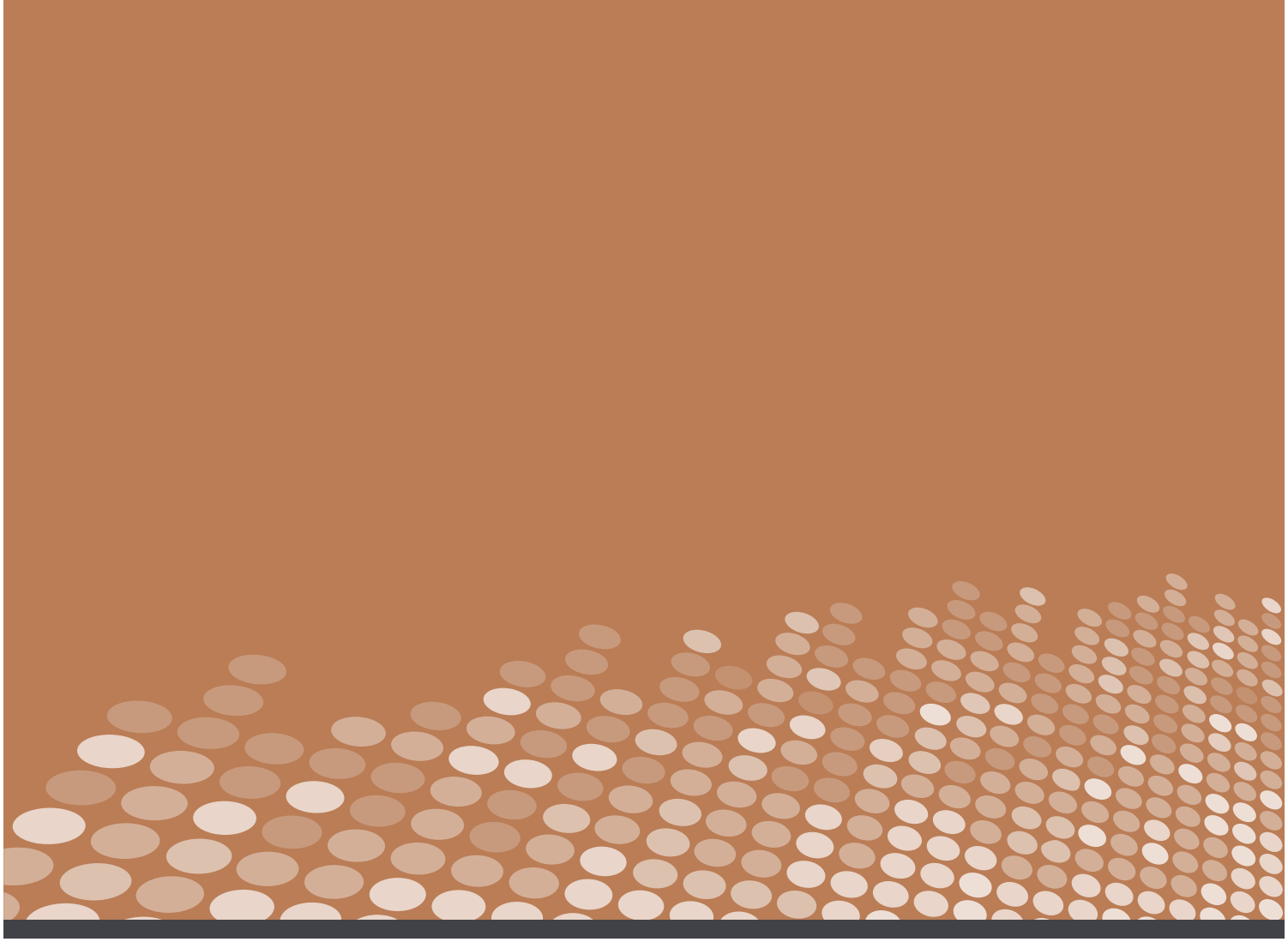
What thrips is that? A guide to the key species transmitting tomato spotted wilt virus in New South Wales. New South Wales Department of Industry and Investment.

Management of thrips and tomato spotted wilt virus. Western Australia Department of Agriculture and Food Farmnote 69/2004.

Diseases of vegetable crops in Australia (eds Persley, Cooke & House 2010), available from CSIRO Publishing at **www.publish.csiro.au**

This technical reference note has been produced by Denis Persley and Cherie Gambley (DEEDI) as part of Horticulture Australia Limited project VG0 7128—Integrated management of virus diseases in vegetables.

Tomato spotted wilt virus symptoms on tomato leaves



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