

Western flower thrips and tomato spotted wilt virus

Dr Sandra McDougall, Industry leader (Vegetables), Vegetable Industry Centre, Yanco

Len Tesoriero, Industry leader (Greenhouse and Ornamentals), EMAI

Western flower thrips

Western flower thrips (WFT), *Frankliniella occidentalis* is primarily a pest as a vector of tomato spotted wilt virus (TSWV) in tomatoes, lettuce, potatoes, and capsicum. Its feeding can cause scarring and deformations on leaves and fruit, with seedlings and soft tissue particularly prone to feeding damage. Capsicums, cucumbers and beans are susceptible to fruit scarring.



Figure 1. WFT scarring on capsicums

WFT is more of a problem than other thrips species because it develops resistance to pesticides easily, hence there are few chemical options to control it.

WFT was first found in Western Australia in 1993 and has spread to all states and most production areas since. It originates from western USA.

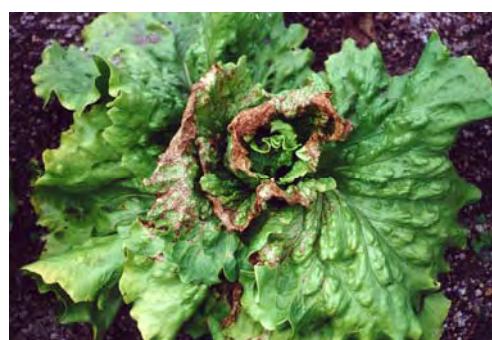


Figure 2. TSWV-infected lettuce

WFT description

Immature thrips are pale yellow, thin, wingless and up to 1 mm in length. Adults are also thin, with yellowish head and darker abdomen. They are about 1.5-2 mm in length, with two feathery wings.



Figure 3. Juvenile WFT



Figure 4. Adult WFT

The life cycle of WFT is illustrated in Figure 5. Eggs are laid into soft plant tissue. Within a few days eggs hatch into a wingless juvenile or larval stage. Thrips have two feeding larval stages followed by non-feeding pre-pupal and then pupal stages which tend to hide in soil crevices or within foliage. Winged adults emerge from the pupae to mate and feed. The length of the life cycle and life expectancy of the adults depend on temperature and food quality. At 30°C the life cycle is approximately 12 days while at 20°C it is 19 days.

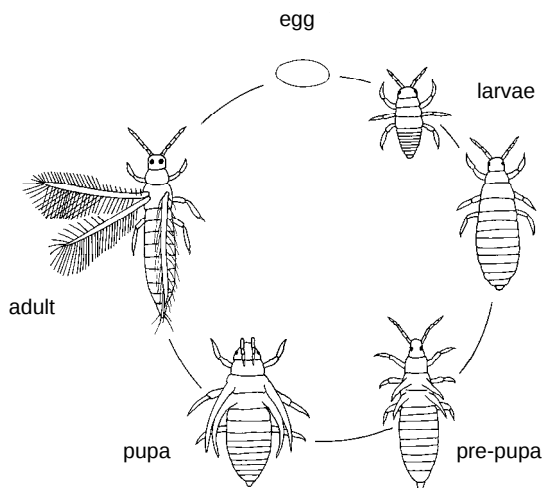


Figure 5. WFT life cycle

WFT hosts

Western flower thrips breeds on a wide range of flowering plants including weeds, vegetable crops and fruit trees.

Tomato spotted wilt virus

Tomato spotted wilt virus (TSWV) is a tospovirus transmitted by some species of thrips. WFT, tomato thrips (*Frankliniella schultzei*) and onion thrips (*Thrips tabaci*) are common vectors for TSWV in vegetables. Melon thrips (*Thrips palmi*) is also a vector for TSWV but is not widespread in NSW. Once a plant is infected with TSWV it cannot be cured, so prevention or use of tolerant varieties, if available, are the only management options.

TSWV Description

Tomato spotted wilt virus is one of the most widespread and damaging viruses affecting vegetable crops in Australia. TSWV was first described in Australia in 1915 and has been a sporadic problem since then. The arrival of the very efficient vector WFT has seen an increase in the seriousness of

the disease, particularly in hydroponic and covered systems.

TSWV causes significant damage to solanaceous vegetables such as tomatoes, potatoes and capsicums, but also to lettuce and a wide range of herbs and ornamental crops. Cucumber infections are symptomless.

TSWV hosts

Many hundreds of plants (>900) are TSWV hosts, most being in the Solanaceae, Asteraceae or Fabaceae. Some show symptoms and some do not.

Common weed hosts of both WFT and TSWV include amaranth, cape weed, pigweed, mallows, blue heliotrope, fat hen, purple top, shepherd's purse, nightshades, Scotch thistle and sow thistle.



Figure 6. Cape weed showing TSWV symptoms



Figure 7. Sow thistle

How do thrips acquire TSWV?

Thrips larvae must feed on a TSWV-infected plant to acquire the virus. Uninfected adult thrips cannot acquire the virus. Plague thrips and other non-host thrips cannot acquire the virus, nor can other insects such as aphids. TSWV is not spread in seed or via mechanical damage although it can be spread through cuttings used for plant propagation.

How do thrips transmit TSWV?

Once the thrips larva has acquired the virus, it will multiply within the larva. When an infected larva reaches adulthood it can fly to a new plant, transmitting the virus as it pierces the plant cells and sucks the contents. The virus does not pass through the egg stage so each succeeding generation of thrips must re-acquire the virus as larvae feeding on TSWV-infected plants.

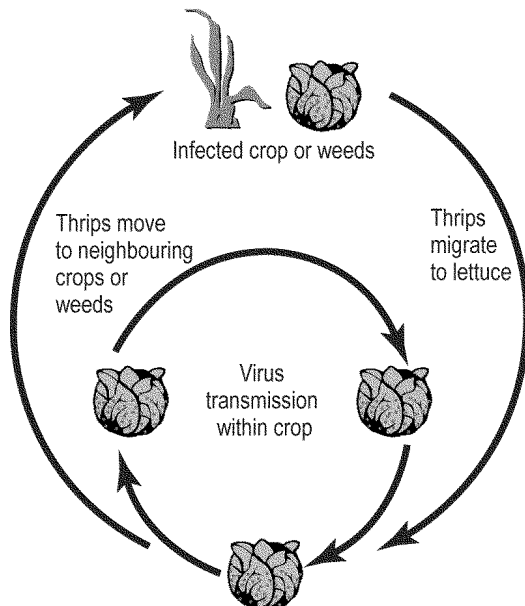


Figure 8. Diagram of thrips–TSWV transmission

Management options

A TSWV-infected plant cannot be cured. Management options focus on preventing infection and minimising spread.

- ❑ Source control
 - avoiding contaminated or infected seedlings
 - weed management within and surrounding crops
 - roguing and destroying infected plants
 - removing or cultivating in crops after harvest
 - screening greenhouses with thrips-grade mesh
- ❑ TSWV resistant varieties (capsicums)
- ❑ Monitoring crops for WFT and TSWV
- ❑ Biologically based Integrated Pest Management
- ❑ Foliar insecticide sprays to control WFT.

Source control

The most important management option is to reduce the populations of WFT and TSWV. Avoid bringing in seedlings contaminated with WFT or already infected with TSWV. Sourcing seedlings

from nurseries that are screened with thrips-grade mesh and actively monitoring for WFT and TSWV will greatly reduce your chances of bringing them onto your farm.

Given that both WFT and TSWV have very large host ranges, management of weeds within and surrounding your crops is essential. In areas where both WFT and TSWV populations are high, putting pressure on local councils and neighbours to also control roadside or paddock weeds, particularly broadleaf weeds, can greatly assist in reducing the overall regional pressure.

Trials in South Australia using native plants, particularly saltbushes and grasses that are poor hosts for WFT and TSWV, around greenhouses and along road verges can reduce the incidence of virus in nearby crops. The added benefit is that the plantings reduce the need for weed management around the structures.

If TSWV is noticed in crops, removing the plants showing symptoms will reduce the within-crop infection. Early detection and removal can greatly reduce final crop losses due to TSWV.

Chipping plants and leaving them on the ground is not sufficient; the infected plants must be removed completely from the farm, bagged or buried. If a planting is heavily infected with TSWV it may be much better to remove the whole crop to avoid infection of younger plantings.

Crops grown in greenhouses can be protected from WFT using thrips-grade mesh covering all openings and double doors to avoid thrips entering.

TSWV-tolerant varieties

Some varieties of capsicums and tomatoes are resistant to TSWV although strains of TSWV that break the resistance can develop in areas of high TSWV pressure. Therefore, if you do use resistant varieties it is still important to reduce the virus pressure through weed management and other sanitation measures.

Monitoring WFT and TSWV

Sticky traps, visual monitoring and vacuum sampling are all used to monitor WFT. Blue traps may be preferable for monitoring WFT because they are less attractive to other non-thrips species. Tapping flowers over a white tray is recommended when susceptible crops are flowering. As part of monitoring the crop for a range of pests a small proportion of thrips will be picked up in a vacuum sample, although this method of sampling is not recommended if primarily assessing for thrips numbers.

Not all plants that are infected by TSWV will show symptoms. Crops that are susceptible will tend to show symptoms on the new developing foliage after infection. Test kits are available for testing for TSWV.



Figure 9. Sticky traps for thrips monitoring

Alternatively, plant or thrips samples can be sent to state department diagnostic laboratories.

Biological controls

Biological controls have not been considered important for WFT control in Australia until recently. Thrips are highly mobile and small and many of the common generalist predators do not feed on them. Predatory mites are common but rarely appear to adequately control WFT numbers. Predatory mites such as *Transiueus* (= *Typhlodromips*) *montdorensis* and *Amblyseius cucumeris* are, however, proving to be effective in greenhouses that use only 'selective' chemistry and have adequate ventilation. Commercial rearing systems are being developed with existing commercial producers of beneficial organisms.



Figure 10. Predatory mites (*A. montdorensis* and *A. cucumeris*)



Figure 11. Predatory thrips larva (*Haplothrips*)

Some field trials are also assessing the potential for using soil amendments to raise soil organic carbon as a means of encouraging native predatory mites, particularly *Pergamasus* sp.

Another promising area is the use of entomopathogenic (insect infecting) fungi. Two groups have developed strains of *Beauveria* and *Metarhizium* fungi that are effective against thrips and some other sap-sucking insects. They are currently working with a commercial producer and the APMVA on registration.

Chemical controls

Insecticide applications targeting WFT can reduce WFT populations and reduce within-crop transmission of TSWV. Given that WFT is notoriously effective at developing resistance to chemicals used against it, is important to adhere to the recommended resistance management strategy (see 'Further Information').

Not all effective chemicals are available for all crops so it is similarly important to use only the chemicals specifically registered or available via Permit for your crop.

Correct chemical application can be extremely important for WFT; for example, make sure your spray equipment is properly calibrated, use insecticide rated nozzles, use the appropriate water rates, and spray only in suitable weather conditions. For more information pick up the Spray Sense information sheets from your nearest NSW DPI office or from the web site.

Integrated pest management

Integrated pest management (IPM) is a strategy that draws on a range of management tools with the goal of using the least ecologically disruptive techniques to manage pests to within economically acceptable levels. For TSWV and WFT management, an IPM approach concentrates on reducing the source of both WFT and TSWV. Where it is possible, the use of TSWV tolerant varieties are recommended. Monitor crops for both WFT and TSWV levels and when TSWV is observed rogue out and destroy the infected plants. If growing in a greenhouse use thrips-grade mesh on all openings and use double doors.

If WFT numbers are high enough to be causing physical damage at vulnerable stages or TSWV is present, then insecticide sprays may be needed. Use recommended rates, adhere to the resistance management strategy and apply sprays to maximise spray coverage.

Sending samples for identification

Management strategies are most effective when accurate identification of both thrips and viruses is made.

Adult thrips can be identified either from specimens collected into a vial or container, or from sticky traps. If it is likely to be some time before you can deliver or send the sample then, if possible, collect adults into a small quantity of rubbing alcohol (available at the chemist). Collect at least 10 specimens as handling and transportation may damage important diagnostic features used to identify the insects. Sticky traps can be covered in plastic cling wrap before removing from the field or greenhouse. Try to avoid squashing sticky traps as accurate identification is difficult if specimens are damaged.

For plants suspected of being infected with TSWV, collect a number of plants showing the range of symptoms. Wrap plant material in damp but not wet paper, place in a plastic bag, keep cool and send or deliver as quickly as possible.

Samples can be left at any NSW DPI office or sent to:

Insect specimens - Delivery or Postal

Attention: Sample Submissions

NSW DPI

OAI, Forest Road, Orange NSW 2800

Ph: (02) 6391 3980

Plant specimens-Delivery

Attention: Sample Submissions

Elizabeth Macarthur Agricultural Institute

Woodbridge Rd MENANGLE NSW 2568

Or Postal

Attention: Sample Submissions

NSW DPI Elizabeth Macarthur Agricultural Institute

PMB 8 CAMDEN NSW 2570

Ph: (02) 4640 6327

[fees are charged for diagnostic services]

NSW DPI Pest & disease diagnostic laboratories information and submission forms:

<http://www.dpi.nsw.gov.au/aboutus/services/das/plan-t-pests-diseases>

More information

General biology and management information



Managing Western Flower Thrips and Tomato Spotted Wilt Virus in Vegetables (2003) DPI Vic This CD rom has a series of 4 short videos in English or in Vietnamese covering topics: 1. Identifying the pest. 2. How the damage is caused 3. Non-chemical control and 4. Chemical control

It also has a section with fact sheets on WFT and TSWV, including an extensive list of TSWV hosts.

Can be ordered from:

http://www.vgavic.org.au/communication/research_and_development_shop/western_flower_thrips_cd_rom.htm

Thrips and Tospovirus – a management guide (2007)

QDPIF Persley et al. This 18 page guide covers each of the tospoviruses and thrips species found in Australia affecting vegetable crops, tables of host crops, excellent photos of virus symptoms, and basic management information.



http://www.dpi.qld.gov.au/4790_11607.htm



Viruses spread by thrips (2011)

This 5-page fact sheet covers summary biology and management information on the thrips species that are vectors of viruses and on the tospoviruses that are transmitted to vegetable crops in Australia.

http://www.dpi.qld.gov.au/26_19759.htm

Identification resources

Identification of western flower thrips (2002)

An informative PowerPoint presentation that shows the key features that enable identification of Western flower thrips (WFT) versus the other thrips that are commonly found in vegetable crops.



<http://www.hin.com.au/Resources/Western-Flower-Thrip-Identification>



Which thrips is that? (2005)
NSW DPI M Steiner et al. This factsheet contains information, photographs, and diagrams to assist with the correct identification of the different thrips species that are found in vegetable crops. The guides also show examples of thrips damage and show where to look for

damage on plants.

<http://www.dpi.nsw.gov.au/agriculture/horticulture/pests-diseaseshort/multiple/thrips/which-thrips-is-that>

Information manuals/guides

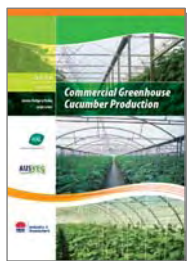
Keep It Clean (2009) NSW I&I J. Badgery Parker et al. Comprehensive guide for greenhouse growers that lists and describes more than 70 management practices that can significantly reduce the costs and losses that can result from pests and diseases.



A series of summary fact sheets and example record sheets are also available to download. Manual can be down loaded or hard copy ordered.

<http://www.dpi.nsw.gov.au/agriculture/horticulture/greenhouse/pest-disease/general/preventing>

Commercial Greenhouse Cucumber Production



(2010) NSW I&I L. James and J. Badgery Parker. This 216 page growing guide for greenhouse cucumber growers includes sections on managing crop pests. This manual can be purchased.

<http://www.dpi.nsw.gov.au/aboutus/resources/bookshop/commercial-greenhouse-cucumber-production>

Revegetation by design guidebook (2006)

Weeds in and around crops can be major sources of WFT or TSWV. Work in the northern Adelaide plains with native vegetation has found that many native plant species are not hosts for either pest. This 76 page guide covers information on property planning, establishment and maintenance of native vegetation.



Companion field guide also available:

http://www.sardi.sa.gov.au/_data/assets/pdf_file/0008/44945/reveg_by_design_guidebook.pdf

http://www.sardi.sa.gov.au/_data/assets/pdf_file/0005/103469/SARDI_Reveg_Guide_2009.pdf

Integrated pest management in lettuce: information guide (2002)
NSW Agriculture McDougall et al. 150pp



<http://www.dpi.nsw.gov.au/aboutus/resources/bookshop/ipm-lettuce-infoguide>

Integrated pest management in greenhouse vegetables:

information guide (2002) NSW Agriculture Goodwin & Steiner 216pp



<http://www.dpi.nsw.gov.au/aboutus/resources/bookshop/veg-ipm-info-guide>

Both information guides provide information about IPM, what it is, recognizing and monitoring of pests, beneficials, diseases and weeds (lettuce only), spray application and record sheets.

Companion field identification guides are also available:



Pests, beneficials, diseases and disorders in lettuce (2003) NSW Agriculture McDougall & Creek

<http://www.dpi.nsw.gov.au/aboutus/resources/bookshop/ipm-lettuce-field-id-guide>

Pests, diseases, disorders and beneficials in greenhouse vegetables (2002) NSW DPI Goodwin

<http://www.dpi.nsw.gov.au/aboutus/resources/bookshop/veg-ipm-field-id-guide>

Pests, Beneficials, Diseases and Disorders in Cucurbits (2009) NSW DPI Napier & Draper

<http://www.dpi.nsw.gov.au/aboutus/resources/bookshop/op/cucurbits-field-id-guide>

Lettuce Best Practice: Integrated Pest Management (2010)

<http://www.hin.com.au/Associations/HSPN/Resources/Manual-Lettuce-Ute-Guide>

<http://www.dpi.nsw.gov.au/agriculture/farm/chemicals/general/spray-sense-leaflet-series>

www.ipmtechnologies.com.au > IPM tools> Insecticide compatibility