1-1-1996

Western flower thrips

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Recommended Citation
Cook, David; Dadour, Ian; Steiner, Ernie; and Scourse, Brett (1996) "Western flower thrips," Journal of the Department of Agriculture, Western Australia, Series 4: Vol. 37 : No. 3 , Article 4.
Available at: http://researchlibrary.agric.wa.gov.au/journal_agriculture4/vol37/iss3/4

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Western flower thrips (Frankliniella occidentalis Pergande) is a serious pest of floral and vegetable crops. From its original habitat in western USA it has now spread throughout North America, Mexico, New Zealand and Europe. David Cook, Ian Dadour, Ernie Steiner and Brett Scourse outline its biology and the control options available.

Western flower thrips were detected for the first time in Australia in 1993 at a flower farm in Yangebup, about 30 km south of Perth. Several growers reported control failures against thrips, despite having used numerous insecticides, for up to six months before western flower thrips (WFT) were identified. WFT has subsequently spread to all states: Queensland and New South Wales (1994), Tasmania and South Australia (1995), and Victoria (1996).

**Pest status**

WFT damages plants through feeding, laying eggs and being an efficient vector of plant tospoviruses, in particular, tomato spotted wilt virus. WFT attacks a wide range of plants, with over 220 recorded hosts, and is particularly damaging to most crops in a greenhouse environment, where optimal temperatures and humidity allow its numbers to proliferate.

The thrips feeds on flowers and new plant growth (buds, young leaves) by piercing the plant cells and sucking out the contents. The empty cells subsequently collapse and die. The resulting distortion, wilting and/or scarring is not always visible immediately after feeding, but subsequently appears when the affected flowers, leaves or fruit grow and distort.
White chrysanthemum flowers are targets of WFTO.

WFT are pests of numerous commercial crops including ornamentals and cut flowers (chrysanthemum, rose, carnation, impatiens, gloxinia, gerbera, asterprimula, cineraria), vegetables (cucumber, lettuce, tomato, beans, egg-plant, peppers) and fruit (strawberries, stone fruit).

Life cycle
WFT are tiny, thin insects around 2 millimetres long with two pairs of feather-like wings folded over their back. Female WFT are typically larger than males (1.8 millimetres compared with 1.2 millimetres).

The adult thrips vary from pale yellow to dark brown and are invariably concentrated within flowers of a crop.

Females insert eggs into soft plant tissue (flowers, fruit, leaves), which hatch into pale yellow nymphs with distinctly bright red eyes.

The first instar nymphs start feeding immediately and it is during this first 48 hours of feeding that the nymphs can acquire virus particles for transmission as adults. The second instar nymphs continue feeding, but cannot retransmit any virus particles they ingest.

The nymphs favour minute cracks and crevices and are therefore inaccessible to many control agents. The second instar nymph then moult into prepupa and then pupa, characterised by the appearance of wingpads and short antennae. Pupation occurs mainly in the soil within the top 1 to 5 millimetres, although some pupae remain on leaves and in flowers. The two pupal stages remain dormant and do not continue feeding.

Newly emerged adults remain inactive for the first 24 hours as their cuticle hardens. They then become very active for several weeks. Females lay around 1 to 1.5 eggs per day and average 100 eggs in their lifetime at an optimum temperature of 20°C. WFT are susceptible to dry heat, hence their numbers decline over the hot
summer months. Temperature causes large differences in developmental times and reproductive capacity. Although not necessary for oviposition, the availability of pollen greatly increases the fertility of females.

Different host plants have very little influence on developmental rates.

**Control options**

**Insecticides**

This pest has proven difficult to control, because it lives well within flowers and buds. This hinders chemical contact. In addition, there are two inactive pupal stages that live primarily in the soil, out of reach of foliar insecticides. Also, strains of WFT from Britain, USA, Europe and Africa have been found to be highly resistant to a number of common horticultural chemicals (organophosphates, carbamates, pyrethroids and abamectin). Nevertheless, several insecticides have been identified that have the potential to control WFT infestations.

Agriculture Western Australia has screened a range of insecticides to determine their level of control of WFT adults and nymphs. These trials have been conducted on cut flower crops (chrysanthemums, carnations), vegetables (capsicums) and fruit (strawberries).

Each insecticide was applied once and its effectiveness assessed from 1 to 11 days post-spraying. Insecticides were generally less than 50 per cent effective at three or more days post-spraying, except for methamidophos. On ornamentals, methamidophos was the most effective insecticide, followed to a lesser extent by dichlorvos, cyhalothrin, fluvalinate and maldison. On capsicums, cyhalothrin, methamidophos, and chlorpyrifos gave the best control, whereas methiocarb, maldison, and methomyl were most effective on strawberries (Table 1). Because of the short-term effectiveness of most insecticides (less than three days), frequent spraying, every three to seven days, is required for effective control.

Three spray applications were tested using a range of insecticides in a WFT-infested strawberry crop, each insecticide was applied three times at seven day intervals. The results again highlighted the difficulty in finding insecticides capable of having a significant impact on field infestations of WFT adults (Table 2). The exceptions were Regent® (fipronil) and the experimental compound AC 303,630 (chlorfenopyr). These insecticides have been identified in laboratory bioassays developed by Dr Grant Herron (Biological and Chemical Research Institute, Rydalmere, NSW) as being most effective against WFT.

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**Table 1. The most effective insecticides against field infestations of WFT in field flowers, capsicums and strawberries**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Active ingredient</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cut Flowers</strong></td>
<td>methamidophos, dichlorvos, t-fluvalinate, maldison, methiocarb</td>
</tr>
<tr>
<td><strong>Capsicums</strong></td>
<td>methamidophos, l-cyhalothrin, chlorpyrifos</td>
</tr>
<tr>
<td><strong>Strawberries</strong></td>
<td>methiocarb*, maldison, methomyl</td>
</tr>
</tbody>
</table>

*Very long withholding period. Only useful at the end of harvest, between crops.*

Check for chemical registration on all food crops before application. Read the label before use and spray under cool conditions to prevent damage to plants.

**Table 2. Efficiency of several insecticides after three spray applications (each seven days apart) against WFT infesting strawberries**

<table>
<thead>
<tr>
<th>Active ingredient</th>
<th>Adults</th>
<th>Nymphs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imidacloprid</td>
<td>11.4</td>
<td>77.2</td>
</tr>
<tr>
<td>Tau-fluvalinate</td>
<td>3.1</td>
<td>82.2</td>
</tr>
<tr>
<td>Mevinphos</td>
<td>11.2</td>
<td>80.2</td>
</tr>
<tr>
<td>Mevinphos + Syntral</td>
<td>0.8</td>
<td>85.2</td>
</tr>
<tr>
<td>Methomyl</td>
<td>18.8</td>
<td>77.9</td>
</tr>
<tr>
<td>Fipronil</td>
<td>62.0</td>
<td>96.6</td>
</tr>
<tr>
<td>Chlorfenopyr</td>
<td>39.4</td>
<td>99.2</td>
</tr>
<tr>
<td>Melaleuca oil</td>
<td>2.1</td>
<td>70.0</td>
</tr>
<tr>
<td>Neem</td>
<td>15.9</td>
<td>57.9</td>
</tr>
<tr>
<td>Formanate</td>
<td>26.7</td>
<td>64.5</td>
</tr>
</tbody>
</table>

*Calculated as the average of all 7 post-spray assessments.*
Orius armatus adult with a WFT pupa speared on its proboscis.

Both fipronil and chlorfenopyr reduced numbers of WFT with successive sprays (nymphs fell from 15 per flower to 2.5 and 1.2 nymphs per flower respectively after three spray applications). Most insecticides had a substantial impact on the thrips nymphs after three successive sprays (58 to 99 per cent mortality), but only fipronil and chlorfenopyr gave a substantial reduction in numbers of adults.

A greater number of effective chemicals must be identified for use against WFT to prevent the development of insecticide resistance. At present, our recommendations for insecticide control are based on overseas results and our own field trial findings. In addition, off-label permits are presently being sought to provide growers across Australia with legal recommendations against WFT in the worst affected crops, namely, ornamentals, tomatoes, strawberries, capsicum, lettuce and cucumbers.

Some insecticides have been assessed as soil drenches against the pupal stages of WFT. These trials demonstrated that WFT can be controlled in the soil phase by drenching with solutions of either chlorpyrifos, parathion-methyl or to a lesser extent fenamiphos. Tests at Agriculture Western Australia by Kevin Seaton and Darryl Hardie showed that both parathion-methyl and chlorpyrifos (when applied at 0.2 milligrams per litre in 1 litre of insecticide solution per square metre) reduced thrips emergence from soil by 90-95 per cent when assessed up to 21 days post-drenching.

Chlorpyrifos is a potent soil insecticide with a half-life of 60-120 days. It is used widely to control pests of households, turf, ornamentals and horticultural crops.

Cultural control
An integrated pest/disease management approach is the best way to control the WFT/tomato spotted wilt virus complex as there is no complete natural resistance available against either organism. A range of cultural control strategies can be adopted to minimise the impact of WFT spreading tomato spotted wilt virus. In a greenhouse/glasshouse environment, further control options include:

- Use of fine-mesh screens to prevent and/or minimise WFT invasion into and between greenhouses.
- Regular disinfection of each house between crops (seal the house and allow it to reach extreme temperatures for several days).

Use of indicator plants to signal the presence of thrips carrying virus. For example, petunia hybrids 'Calypso' or 'Super Blue' are highly susceptible to tomato spotted wilt virus and rapidly develop visible symptoms. By placing yellow cards (not sticky traps) on a small stake next to the potted indicator plant, thrips will be attracted to that plant and increase the chances of detecting viruliferous thrips.

Biological control
Natural enemies of thrips include predatory mites (Amblyseius cucumeris), parasitic wasps (Ceranisus menes), fungi (Verticillium lecanii) and predatory bugs (Orius species).

Anthocorids in the genus Orius (pirate bugs) are generalist predators, attacking many soft-bodied arthropods on flowers including spider mites, aphids, psyllids, whiteflies and lepidopteran eggs. However, pirate bugs are also important predators of thrips and several species of Orius have been successful biological control agents of WFT, especially in greenhouse ornamental and vegetable crops.

The native bug Orius armatus was recently identified in Perth actively predating WFT in field carnations. This predator significantly reduced numbers of WFT nymphs, but as with many beneficial insects, was susceptible to spraying. Further work is required to determine the cost and practicality of using Orius armatus in an integrated pest management strategy against WFT.

For further information contact David Cook, Ernie Steiner and Brel Scourse on (09) 368 3333. Ian Dadour can be contacted at UWA on (09) 380 2227.