FACT SHEET

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Government of South Australia
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Kelly Citrus Thrips Management

Introduction

Kelly's citrus thrips (KCT), *Pezothrips kellyanus*, emerged in the 1990's as a serious citrus pest in inland Australia, particularly in the Riverland-Sunraysia region.
KCT feeding on young and mature fruit causes scurfing and rind blemish respectively. These blemishes downgrade fruit quality and reduce the pack-out of export quality fruit.
Navel and Valencia oranges, lemons and grapefruit are the most affected varieties. Despite the application of control measures, up to 20-40% of the fruit from these varieties may be rendered unsaleable in quality fresh markets. The combined cost of KCT crop losses and control measures in the Riverland alone are estimated to be at least $10 million per annum.

Figure 1: KCT on open lemon flower

Damage

Kelly's citrus thrips (KCT) appears to be the sole cause of scurfing (or halo) damage to citrus fruit in inland Australia. Other thrips, such as plague thrips (*Thrips imaginis*), are commonly found in citrus flowers but soon disperse at the end of flowering and are largely absent when the damage occurs.
Most of the scurfing damage is caused by the larval stages of KCT during the first four to five weeks after petal fall. KCT larval densities typically peak from two to four weeks after petal fall. However, damage can continue to occur until the end of December, particularly if the weather remains mild.
Because of variation in KCT abundance the length and intensity of the scurfing risk period varies from year to year. This variation highlights the importance of regular crop monitoring to achieve good control.

Figure 2: KCT scurfing (or halo) damage

The KCT larvae congregate under the calyces of the young fruitlets. As they feed their rasping mouthparts burst open rind cells enabling them to suck up the juices. The resultant damage to the rind initially appears as silvery scars under the calyx, and as the fruit grows, this scurfing damage moves and expands across the surface of the fruit.
On mature fruit, scurfing can range in severity from narrow to broad haloes around the calyx up to expansive patches of scarring which can cover much of the fruit surface (Figure 2).
Additional damage from KCT can occur because of adult and juvenile thrips feeding at contact points between mature fruits. This damage appears as rind bleaching (Fig. 3).

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Figure 3: KCT rind bleaching damage

Figure 4: An adult (dark, winged), two 2nd-instar larvae and two 1st instar larvae of KCT

KCT Identification

Because there are other thrips species present in inland Australian citrus orchards, and some of these may be mistaken as KCT, thrips must be identified carefully.

KCT Adults (Figure 4)

- 1-2mm in length, with fringed wings
- black (other black thrips may occur in citrus, but KCT is the most common species)
- can be common in citrus flowers, and later in the season around contact points of touching fruit

KCT LARVAE (Figure 4)

- small, wingless (you will need a 10x hand lens)
- pale yellow – bright orange
- in spring they shelter under fruit calyces

KCT Life Cycle

KCT females lay eggs in all parts of the citrus flowers. When flowers are unavailable, they will lay eggs on fruit or even on leaves. Larvae hatch from the eggs and develop through two stages (instars). The mature second-instar larvae drop from the citrus canopy to the leaf litter and soil, particularly along the drip line, where they pupate in the upper 20mm soil-layer.

The pupal stages (prepupa and pupa) do not feed. Adults later emerge from the soil and move up into the canopy to feed and reproduce.

The time taken to complete their life cycle ranges from as little as two weeks in mid-summer to 2.5 – 3 months in winter.

Season	The average number of days for KCT to complete a generation
Spring and Autumn	25-28
Summer	14
Winter	70-80

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KCT are in greatest abundance in citrus during flowering. The extended flowering period of navel oranges, in which the first flowers open 4-5 weeks ahead of the main flowering flush, allows KCT to develop through at least one generation 'on site' prior to the main flush. This enables KCT densities to be more abundant and destructive during the critical period of early fruit development in November.
The abundance of KCT is generally low during the non-flowering months, particularly in winter.
Lemons, which flower sporadically throughout the year, appear to be an important source and refuge for KCT.

Where are the main sources of KCT?

KCT does not infest any weeds or cover crops associated with inland Australian irrigated orchards and vineyards.
Nine non-citrus host-plant species, which KCT breed and develop on, and another eight non-citrus plant species, which adult KCT feed upon, have been identified in the Riverland-Sunraysia region. Most of these plant species flower in spring and have white or pale yellow, fragrant flowers (eg. star jasmine, honeysuckle, native frangipani).
However these non-citrus 'hosts' are relatively uncommon in the Riverland-Sunraysia region, both in orchards and the surrounding landscape.
A KCT trapping study in the Riverland has revealed no evidence of long distance migration, but localised citrus orchard-to-orchard movement of KCT does occur.
Taken together these observations suggest that the KCT pest population in citrus is primarily cycling within and between the different citrus varieties grown in a region.

Natural enemies of KCT

The wasp parasitoid *Ceranisus menes* and a range of predators, such as spiders, lacewing larvae, apple dimpling bug and various species of phytoseiid, erythreid, anystid and stigmaeid mites attack KCT in the canopy of Riverland-Sunraysia citrus orchards, but none appear to exert significant control on these KCT populations.
More than 45 species of predatory mite have been identified in Riverland-Sunraysia citrus soils, and a number of these predatory mite species have been shown to develop and reproduce on KCT alone. Citrus orchards vary substantially and consistently in the survival rates of soil-dwelling KCT pupae. Importantly, low pupal survival is associated with higher soil-dwelling predatory mite abundance and with low KCT adult and larval densities and damage in the orchard.
What can be done to enhance the populations of these beneficial soil mites and their control of KCT?
As much as possible avoid the use of organophosphate (OP) insecticides, such as chlorpyrifos and methidathion. The run-off of foliar sprays of these insecticides substantially reduces the abundance of these soil-dwelling predatory mites. By contrast, commonly used herbicides such as glyphosate, diuron and bromacil do not appear to directly kill these beneficial mites. Whether herbicidal control of the ground cover may indirectly harm these mite populations by modifying the microclimate, reducing their food supply, etc., is unknown.
Riverland orchards that have higher percentages of grasses as groundcover generally have the higher soil-dwelling predatory mite densities and higher KCT mortality. Whether certain grasses provide a benefit to the predators and thereby aid the biological control of KCT remains unclear.
Building up soil organic matter content by the addition of compost amendments or various types of crop or animal refuse (eg. grape mark, etc) will boost beneficial mite populations and KCT mortality. Studies are underway to establish the minimum level of organic matter content needed to support an effective predatory mite population for KCT control.
Recent New Zealand work has revealed that placing a 10 cm layer of mulch (25% composted green garden waste and 75% woody material) under citrus trees causes substantial kill of KCT pupae. Whether this occurs as a result of boosting the activity of natural enemies such as predatory mites, or by some other mechanism, is presently unclear.

Crop Monitoring

Adult thrips can be found in flowers, but damage does not occur until after petal fall. In the spring monitor regularly for KCT larvae from petal fall onwards. Finding adult KCT is not a trigger to spray. Rather, they highlight the need to continue monitoring to assess the abundance level of KCT larvae.

Choose a block of citrus and monitor 100 fruitlets from across the whole block. If you have a large property, monitor a few blocks to get a representation of KCT levels across the property.

To find KCT larvae, look between the fruitlet and calyx. This is easily done until calyx closure. Once the calyx closes, the calyces must be peeled back or the fruitlets twisted from the stem to expose the larvae.

Spray navel oranges, lemons and grapefruits if the percentage of fruit infested by KCT larvae is 5% or greater. For Valencia oranges this spray threshold is 10% or greater.

Nb. The period of greatest scurfing risk occurs during the first four to five weeks after petal fall. However it is important to continue monitoring blocks after calyx closure as the length and intensity of the KCT risk period does vary from season to season.

Chemical Control and Resistance

Good spray coverage and timing is essential.

Ensure thorough coverage to the whole outer canopy, including the treetop where there is often greater damage. Spray as soon as possible once monitoring indicates that KCT abundance exceeds the spray threshold.

The choice of insecticides for KCT control in Australia is currently very limited. In South Australia most growers are using the organophosphate (OP) insecticides chlorpyrifos (eg. Lorsban®) and/or methidathion (eg. Supracide®). Although neither of these insecticides is specifically registered for KCT control in citrus, their use for KCT control in SA is permitted under SA legislation. Growers in other States should carefully read insecticide labels and seek advice from chemical resellers for their choice of KCT insecticide.

ALWAYS READ THE LABEL

Users of agricultural chemical products must always read the label and any Permit, before using the product, and strictly comply with the directions on the label and the conditions of any Permit. Users are not absolved from compliance with the directions on the label or the conditions of the Permit by reason of any statement made or omitted to be made in this publication.

The repeated use of these OP insecticides has resulted in some KCT populations in Riverland-Sunraysia citrus developing substantial resistance to these insecticides, and disrupts the biological control of all citrus pests, including KCT itself.

SARDI trials have tested two new insecticides, the neonicotinoid thiamethoxam (Actara™) and the spinosyn spinosad (Success™). Actara™ is very effective against KCT, but has been shown to be harsh on wasp parasitoids such as *Aphytis*. Actara™ will be best suited in seasons when KCT pressure is high, and in orchards with a history of heavy KCT damage. Success™, especially when applied with oil, provides effective control of low to medium density KCT infestations. Success™ in combination with oil will be suited to seasons when KCT pressure is low to moderate, and in orchards with a history of modest KCT damage.

Actara™ and Success™ have different modes of action from each other and from OP insecticides. Once registered[†], they will be able to be used in an insecticide rotation program with the OPs to help delay the development of further resistance. In the meantime, resistance can only be stemmed through minimizing the number of insecticide sprays by:

- regularly monitoring to achieve optimal spray timing for all pests, and
- ensuring the sprayer set-up is providing thorough coverage.

[†]At the time of fact sheet publication neither Actara™ and Success™ were registered for use in Australian citrus.

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