Factsheet 14/09

Protected ornamentals

Horticultural Development Company

Stoneleigh Park
Kenilworth
Warwickshire CV8 2TL
T: 0247 669 2051
E: hdc@hdc.org.uk

# Thrips control on protected ornamental crops

Jude Bennison, ADAS

**Thrips are an important pest of ornamental bedding plants, pot plants and cut flowers. They cause direct feeding damage and some species can also transmit viruses. This factsheet provides guidelines on the recognition of native and quarantine thrips species, the damage they cause and information about their biology and control.**

## Action points

- Learn to recognise thrips adults on sticky traps, and both thrips adults and larvae on plants.
- Be aware of the thrips species present on the nursery (confirmed by an entomologist).
- Learn to recognise thrips feeding damage and symptoms of thrips-transmitted viruses.
- Practice good nursery hygiene and weed control to minimise sources of infestation.
- Plan and start biological pest control programmes before thrips/feeding damage are seen.
- Monitor traps and plants regularly.
- Pay particular attention to favourite host plants and bought-in plant material.
- Keep up to date with current biological and chemical control options.
- Only use a pesticide if necessary, selected according to the thrips species present and whether or not an IPM programme is in place.
- If a quarantine thrips species is suspected, contact Fera, Plant Health and Seeds Inspectorate immediately (see further information section).

## Introduction

Thrips are one of the most serious pests of protected ornamental crops, feeding on a wide range of plant species. Damage caused by their feeding can make plants unmarketable. It is important to know which thrips species are present on the nursery, in order to use the most effective control strategy. For example, the main species damaging UK protected ornamental crops is the western flower thrips (WFT) (*Frankliniella occidentalis*), which is resistant to many pesticides. On ornamental crops, WFT damages leaves, flower buds and petals (Figure 1).

**1 Typical petal damage to chrysanthemum caused by western flower thrips feeding**

# Thrips recognition and biology

Although expert microscopic examination is often needed to confirm the exact thrips species, certain features such as colour of the adults or larvae can help in recognition. WFT is described in detail below, and other relevant species are described briefly to help to distinguish them from WFT. Information is also given on thrips biology and behaviour, as this knowledge can help to plan control strategies.

## Native or established thrips species

**Western flower thrips (WFT) (*Frankliniella occidentalis*)**
WFT was introduced to the UK on infested plant material in 1986 and since then has become widely established, mainly on protected crops, but also on some outdoor crops such as strawberry. WFT is no longer a notifiable, quarantine pest in the UK.

*Host plants*
WFT is a major pest of many protected edible and ornamental crops. Common flowering bedding and pot plant hosts include brachycome, chrysanthemum, cineraria, cyclamen, dahlia, fuchsia, impatiens, ivy-leaf geranium, primula and verbena. Cut flower hosts include alstroemeria, chrysanthemum, dahlia, gerbera and lisianthus. Foliage plant hosts include ficus, maranta, palms and radimachera. Weed hosts include chickweed, clover, groundsel, mallow, shepherd's purse and thistle.

*Adults*
Like other thrips species, WFT adults are small, slim insects, with narrow wings fringed with hairs. Female WFT (Figure 2) are slightly larger (1.5 to 2 mm long) and darker than the males. The females usually have a yellowish head and front half of the body and a brownish back half. The males are yellowish all over. WFT adults can be found on upper or lower sides of leaves but prefer to feed in flowers or buds if present. Adults can live for several weeks. On chrysanthemum, they live for about 75 days at 20°C and 31 days at 25°C. The temperature 'threshold' for WFT flight is 20°C.

*Eggs*
Like those of other thrips species, WFT eggs are not visible as the females lay them into plant tissue.

*Larvae*
WFT larvae (Figure 3) hatch from the eggs after a few days, depending on temperature. On chrysanthemum, at fluctuating summer temperatures of 18.5°C night and 36°C day, they hatch after three days. There are two larval stages, neither of which have wings. First stage larvae are less than 1 mm long and colourless or white. They feed for two or three days before developing into the second stage larvae which are about 1 mm long and yellow. The second larval stage lasts for about 10 days at 20°C and five days at 25°C, but develops more slowly at lower temperatures. When fully grown, most of the late second stage larvae drop from the plants to pupate in the ground, growing media or substrate. However, a small proportion may pupate on the plants, in sheltered places such as on the undersides of lower leaves, or hidden in flowers.

*Pupae*
Like other thrips species, WFT has two pupal stages; the prepupa and the pupa, neither of which feed. Both these stages are yellowish and about 2 mm long. The prepupa has short immature wings and short, forward-pointing antennae. The prepupal stage lasts only for a day or two then develops into the pupa which has longer immature wings and longer antennae which fold backwards over the body. The pupal stage (Figure 4) lasts for about five days at 20°C and three days at 25°C. When pupation is complete, the adult thrips emerges from the pupal case.

**2 Western flower thrips adult female**

**3 Western flower thrips larva**

*WFT development and survival*
WFT are more of a problem between spring and autumn, but breeding can continue all year on host plants in heated glasshouses (eg on AYR chrysanthemum). WFT can develop between 10°C and 35°C. However, WFT can survive in a quiescent state at lower temperatures over the winter in soil, on plants or on plant debris, in glasshouses, tunnels, or outdoors. At typical summer glasshouse fluctuating temperatures, WFT develop from egg to adult in only 11 days. The pest can therefore breed very quickly during the summer and can go through many generations per year, particularly in heated structures.

**Onion thrips (*Thrips tabaci*)**
The onion thrips is native to the UK. It is a common pest of outdoor vegetable crops such as onion and leek, in addition to many protected edible and ornamental crops. Although WFT is now usually the predominant species on protected crops, onion thrips is still frequently found. Bedding, pot plant and cut flower hosts are the same as those listed for WFT.

*Life stages*
Onion thrips can look very similar to WFT. In the UK, the adults (Figure 5) are always female and vary in colour from greyish yellow to brown. First stage larvae are colourless or white. Second stage larvae tend to be greenish, rather than yellow as in WFT. Adults and larvae feed on leaves and in flowers, and the older larvae drop to the ground to pupate.

***Echinothrips americanus***
This species is not native to the UK but is not a notifiable quarantine pest. It was first confirmed in the UK in 1995, on syngonium imported from the Netherlands. Since then, it has occurred under glass at many UK sites, usually on foliage plants including dieffenbachia, fatsia, ficus, philodendron and spathiphyllum. It has also been recorded on chrysanthemum, impatiens and poinsettia.

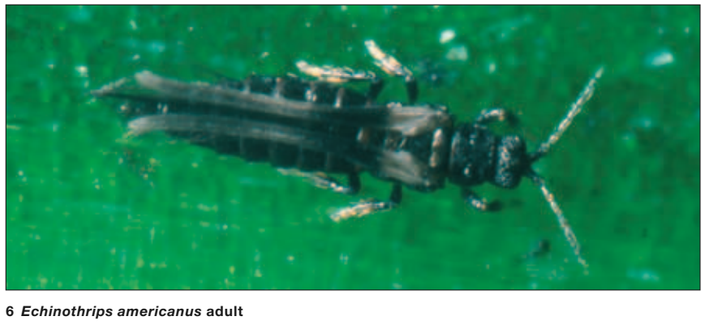
*Life stages*
*E. americanus* adults (Figure 6) are more obvious to the eye than WFT (females are up to 2 mm long). Adults are dark brown to black, with distinctive pale areas at the bases of the wings, giving the thrips the appearance of having pale 'shoulders'. The larvae and pupae are whitish-yellow and paler than those of WFT or onion thrips. Unlike WFT or onion thrips, *E. americanus* always pupates on the leaves.

**Banded-winged palm thrips (*Parthenothrips dracaenae*)**
This species is not native to the UK but is not a quarantine pest. It is established under glass and in internal landscaping in the UK and can occur on foliage plants, including citrus, chamaedora, croton, dracaena, ficus, kentia palm, stephanotis and tradescantia. The adults are brown and the wings look pale with a dark band across them, giving a striped appearance. The larvae are white and translucent.

**Glasshouse thrips (*Heliothrips haemorrhoidalis*)**
This originally tropical species is also established under glass in the UK and sometimes occurs on protected ornamentals. It is not a quarantine pest. It feeds mainly on foliage and pot plant hosts including orchids and palms, and has even been found on some ferns. The pest has also been recorded on

**4 Western flower thrips pupa**

**5 Onion thrips adult**



**6 *Echinothrips americanus* adult**

begonia, chrysanthemum and fuchsia but is not a common pest of these plants in the UK. The adults are dark brown to black (occasionally bicoloured with an orange-yellow abdomen) with pale wings, and the larvae and pupae are whitish-yellow. The larvae often have a large round droplet of reddish or black fluid at the end of the body, which drops onto the leaf and can lead to the growth of sooty moulds.

**Grain thrips (*Limothrips* spp.)**
Grain or cereal thrips, (eg *Limothrips cerealium*) often fly into glasshouses during the summer, particularly during harvesting of nearby cereal crops. They are commonly known as 'thunderflies' or 'thunderbugs' as they take flight in large numbers in warm, humid conditions. The adults are dark brown or black (Figure 7) and are easily distinguished from WFT or onion thrips on sticky traps. Grain thrips do not breed on bedding, pot plants or flower crops.

## Quarantine thrips species

The following two thrips species are not native to the UK and are quarantine pests, notifiable to Fera Plant Health and Seeds Inspectorate (PHSI) whenever found or suspected (see Further information section).

**Melon thrips (*Thrips palmi*)**
The melon thrips is a serious pest in Asia and parts of Australasia, the USA, the Caribbean, South America and Africa. *T. palmi* has a wide host range, including chrysanthemum, ficus and orchids. So far there has been only one outbreak in the UK, on chrysanthemums, which was suc-cessfully eradicated in 2001. However, Fera Plant Health and Seeds Inspectorate has repeatedly intercepted the pest on various plants and produce and there is a continued risk of importing it on cuttings and plant material. The adults are small and yellow (Figure 8), about 1 to 1.3 mm long. The larvae are creamy yellow to pale orange and drop to the ground to pupate. *T. palmi* does not disperse well and is likely to be spread on infested plant material rather than by adult flight. The pest is unlikely to survive the UK winter outdoors.

**Chilli thrips (*Scirtothrips dorsalis*)**
The chilli thrips or yellow tea thrips is a notifiable quarantine pest. It has not been detected in UK nurseries, but at the time of printing there was an ongoing outbreak under glass in a botanical garden in the south of England. The pest is native to Asia but in recent years has started to spread rapidly across the world, including to Africa, Israel, the Caribbean, North and South America. Fera PHSI has repeatedly intercepted the pest since 2005 on produce from India and Kenya, and also from St. Lucia and Thailand. *S. dorsalis* has a wide host range including both edible and ornamental plants. Ornamental hosts have included chrysanthemum, dahlia, hydrangea, and rose. *S. dorsalis* adults (Figure 9) are small, about 1 mm long, with pale yellow bodies and wings that appear dark when at rest against the body. The larvae are pale. The larvae pupate both in the ground and on the plants. The pest is unlikely to survive the UK winter outdoors.

7 Grain thrips adult on yellow sticky trap

8 Melon thrips adult

9 Chilli thrips adult

# Thrips damage symptoms

## Direct feeding damage

Feeding by thrips adults and larvae on leaves and petals causes small white or silvery flecks or patches, which later turn brown and necrotic. Small black specks of thrips faeces are usually visible within the bleached areas (Figure 10). Feeding in leaf and flower buds can also cause distortion and stunting (Figure 11). Damage can downgrade plants or render them unmarketable, and severe infestations can cause significant plant losses.

The quarantine pest *T. palmi* feeds on leaves (initially along the midrib and veins), stems and flowers, causing silvery scars, distortion, yellowing and stunting. Severe infestations can kill plants. On chrysanthemum, unlike WFT, *T. palmi* tends to feed on upper leaf surfaces rather than in flowers.

The quarantine pest *S. dorsalis* feeds on young leaves, flower buds and fruits, causing scarring, malformation, curling, blackening and shrivelling. Severe infestations can cause total defoliation and heavy crop losses.

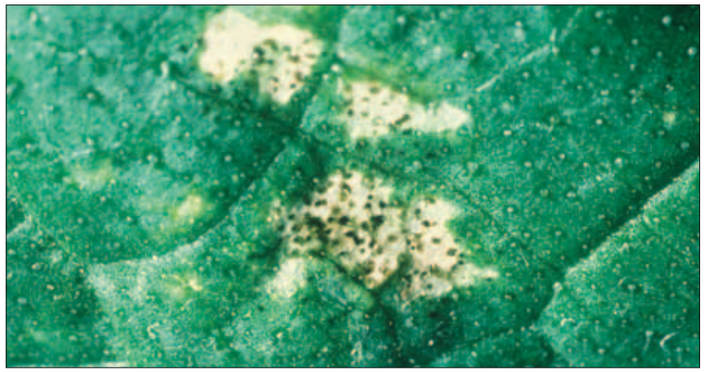
## Damage caused by thrips-transmitted viruses

WFT and onion thrips can transmit tospoviruses, introduced to the nursery either via infected plant material, then spread by resident thrips vectors, or via immigrating viruliferous adult thrips flying from nearby infected crops.

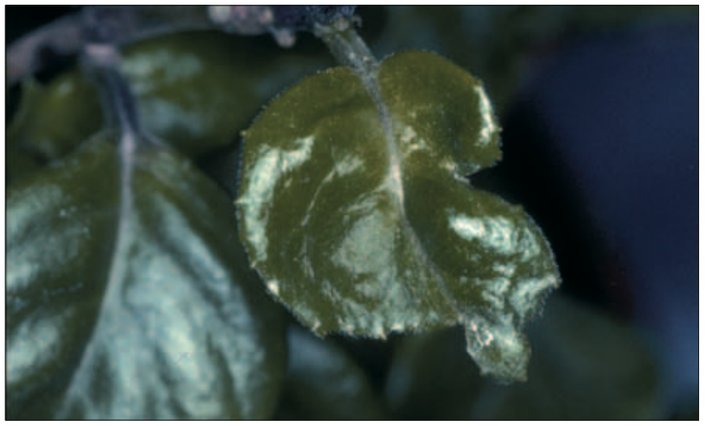
- *Tomato spotted wilt virus* (TSWV) and *Impatiens necrotic spot virus* (INSV) are currently the most important tospoviruses in the UK. In the UK, the thrips vector for both viruses is WFT. First stage WFT larvae acquire the virus when they feed on infected plants, and when they become adults they transmit the virus to other plants during feeding. There is a wide range of ornamental host plants for the TSWV virus including aster, chrysanthemum, cineraria, cyclamen, dahlia, fuchsia, impatiens, ivy-leaf geranium, lily, nemesia, primula, ranunculus and verbena. More recently, INSV has also been confirmed on a more restricted host range, including chrysanthe-mum, cineraria, coleus, dianthus, diascia, fuchsia, lobelia, nemesia and verbena. Symptoms of both viruses include chlorotic or necrotic leaf spots, leaf rings, leaf line patterns, distortion, bronzing, yellowing and necrosis, stem blackening and growing point death (Figure 12). Outbreaks of both viruses are now less prevalent than in previous years, probably due to improved methods of WFT control.

- *Chrysanthemum stem necrosis virus* (CSNV) is also spread by WFT but there has been only one case in the UK. Symptoms included dark stem lesions and some leaf necrosis. The infected crop was removed and the virus eradicated. CSNV is notifiable to Fera PHSI whenever found or suspected.

- *Iris yellow spot virus* (IYSV) was confirmed for the first time in the UK in 2007, on lisianthus. The vector of IYSV is the onion thrips, *Thrips tabaci*. On lisianthus, IYSV symptoms include pale necrotic leaf spots, necrotic streaks on stems, plant stunting and flower distortion. Further details about IYSV are provided in the HDC Factsheet 19/08, 'Iris Yellow Spot Virus: A potential threat to the onion industry'. IYSV is notifiable to Fera PHSI whenever found or suspected. If the presence of a notifiable pest or disease is suspected, you must immediately inform Fera PHSI (see Further Information Section).



10 Small black specks of thrips faeces are often visible within the bleached areas of leaves and petals affected by thrips



11 Typical young leaf distortion caused by thrips feeding (fuchsia leaf)

12 Typical symptoms of tomato spotted wilt virus on impatiens

## Sources of infestation

Considering possible sources of thrips is very important when planning thrips management programmes. Sources of infestation include:

- The resident population in the glasshouse or polythene tunnel, particularly where host crops are present all year round. This is the most common source of the main thrips pest (WFT).
- Bought in cuttings or young plants infested with thrips or eggs. Importing plant material increases the risk of quarantine thrips species.
- Plant debris from previous infested crops.
- Soil, growing media, used matting, pots and trays containing thrips pupae.
- Adjacent infested crops or infested crops in nearby structures.
- Weed hosts.

## Integrated thrips management

The main thrips pest of protected ornamental crops, WFT, is resistant to many pesticides. Therefore the most effective control strategies are those used within an Integrated Pest Management (IPM) programme. IPM strategies include cultural, biological and chemical options, together with regular monitoring. The strategies described here are particularly relevant to WFT and onion thrips and may not be as effective against other species. If a quarantine thrips species is confirmed, Fera PHSI will issue a Notice outlining specific measures to eradicate the pest and prevent it spreading to other nurseries. This will be designed in consultation with the grower and will include the required cultural, biological and/or chemical control methods, as appropriate for the nursery concerned.

## Monitoring

A regular monitoring programme, designed to spot the first sign of thrips and to detect any 'hotspots' or increase in population levels is critical for successful thrips management. Both sticky traps and plants should be monitored throughout the year, whenever susceptible crops or imported plant material is present.

**Sticky traps**

- Adult thrips are attracted to both yellow and blue sticky traps. Blue traps can be more effective than yellow at detecting low densities of WFT. However, yellow traps will catch all thrips species and thrips are more easily seen on yellow than blue. Yellow traps are also useful for monitoring other pests, eg leaf miners and whiteflies.
- Adults of some thrips species can be recognised easily. For instance, grain thrips are much darker than other species.
- WFT and onion thrips cannot be positively identified by eye. An entomologist can confirm the species using a microscope. Traps can then be monitored by a member of staff trained in thrips recognition.
- Position traps over favourite host plants, imported plants and near to doorways.
- Only use as many traps as can practically be checked every week (eg one trap every 500 $m^2$). More (eg one per 100 $m^2$) can be used in smaller glasshouses or tunnels, or in high risk situations, or when monitoring different crops in the same glasshouse.
- Position traps just above the plants using canes, plant labels or strings, and move them up as plants grow. If using IPM, placie the traps a foot above the plants to reduce the numbers of flying beneficial agents caught.
- Check traps weekly and record numbers of pest thrips species, making sure to replace them regularly.

**Thrips lures**

Two lures are available, designed to increase sticky trap catches of thrips, to aid early detection and help indicate population increases (Figure 13).

- A sex aggregation pheromone specific to WFT is available from Syngenta Bioline. The pheromone is produced by WFT males and attracts both male and female WFT for mating. The pheromone is supplied as small rubber lures which are stuck onto the lower section of sticky traps. These lures are also claimed to improve the efficacy of abamectin (eg Dynamec) against WFT, if used in the crop one hour before pesticide application. This is thought to be due to the lures increasing the activity of WFT adults.
- A thrips attractant for various thrips species including WFT and onion thrips is available from Koppert. As the attractant is not selective, it will not help to distinguish thrips species on traps. The attractant is supplied in small slow-release dispensers that are stuck onto sticky traps.

**Plant monitoring**

- Do not rely on sticky traps alone for monitoring thrips. Check susceptible plant species every week throughout the production period.
- Thrips can be present on the upper or lower sides of leaves and in growing points, buds and flowers. A useful method for monitoring WFT is to tap young growth and flowers onto a white plastic tray or white paper on a clipboard. Any dislodged thrips adults and larvae can be seen on the tray or paper.
- Look for direct damage symptoms such as white flecking on leaves or petals, distorted young leaves, buds and flowers. Also look for symptoms of thrips-transmitted viruses.
- Use favourite host plants or those particularly susceptible to damage as 'indicator plants'. For instance flowering verbena is very attractive to WFT, while WFT damage to petals shows up on chrysanthemum varieties with dark pink, orange or red flowers.
- Petunias can be used as indicator plants for TSWV. Within a few days of feeding by infected WFT, dark leaf spots develop.
- Pay attention to recently bought-in plants or cuttings, especially if imported.
- If any thrips are suspected to be a quarantine species, notify Fera PHSI immediately (see Further information section).

13 Western flower thrips female on trap

## Cultural control

Prevention of thrips problems is better than cure, and cultural control methods (of which there are many) play an important role in thrips management:

- If a previous crop has been infested, use a thorough clean-up programme to minimise thrips carry-over to following crops. Promptly dispose of any crop debris, unmarketable plants, weeds, used pots, trays and old matting. Place into sealed bags or covered containers, sited as far away from the glasshouse as possible, before taking the covered skips or trailers to a local authority disposal site.
- Ideally use new pots, trays and matting for each crop, or sterilise any to be re-used.
- Sweep, pressure wash and disinfect benches and concrete floors between crops.
- Soil steaming for sterilisation (eg between successive chrysanthemum crops), will reduce the risk of thrips survival in the soil.
- Conventional sticky traps or long 'curtain' traps can be useful to trap thrips adults in empty structures, or between infested crops and new batches of plants. However, they can also catch flying biological control agents too so they should be positioned and timed with care.
- Maintain strict weed control inside and around glasshouses or tunnels, including any empty structures. Aim for a minimum of a 3 metre weed-free strip around the outside edges of structures.
- Do not take cuttings from infested mother plants.
- Remove any heavily infested plants and any showing virus symptoms.
- Thrips can be carried on staff clothing. Staff should work in 'clean' glasshouses before known infested areas in any one day.
- Further information on nursery hygiene for ornamental crops and on soil disinfestation options for cut flower growers is provided in HDC Factsheets 10/07 'Guidelines on nursery hygiene for outdoor and protected ornamental crops' and 09/07 'Soil disinfection options for cut flower crops'.

## Biological control

Several biological control agents are available for the control of thrips. Those used on protected ornamentals are summarised below. Choice, combinations, timings and rates of release or application within an IPM programme should be planned carefully. If necessary, seek advice from the supplier or a specialist IPM consultant. The information given below refers mainly to WFT and onion thrips, which has a very similar biology to WFT.

***Amblyseius cucumeris***

This predatory mite is the main bio-logical control agent used against thrips in the UK and it can give very good control of WFT on bedding, pot plants and cut flower crops. *A. cucumeris* can develop between 8°C and 35°C, but needs a relative humidity of at least 65% in the plant micro-climate for the eggs to survive. Adult mites are oval, beige and about 0.4 mm long. They are wingless, so are best applied to touching plants to allow them to walk from plant to plant. They are very active but are difficult to find on ornamental plants as they are usually in the same hiding places as the thrips larvae on which they feed. *A. cucumeris* feeds only on young thrips larvae and not on the adults or pupae, so successful control depends on a regular preventive introduction programme. The predators can be sprinkled onto plants every week in a bran or vermiculite carrier, or released from slow-release sachets hung onto plants, pots or baskets (Figure 14).

14 Typical Amblyseius cucumeris slow release sachet on a hanging basket

Application can be done by hand, or using an automatic applicator such as the 'Airbug' supplied by Koppert (Figure 15). The slow–release sachets only need to be used every 6–8 weeks, and are supplied as individual sachets, or in strips ('Bugline', supplied by Syngenta Bioline – Figure 16) for use in cut flowers (eg chrysanthemums). The strips of sachets can be applied using the sprayer gantry, which saves labour and enables access to the crop.

***Amblyseius swirskii***
This predatory mite looks very similar to *A. cucumeris* and feeds on thrips larvae and also on whitefly eggs and young scales. *A. swirskii* is not native to the UK and only has a licence for release in fully enclosed glasshouses or tunnels. *A. swirskii* needs warmer temperatures than *A. cucumeris* to develop and establish in the crop; the minimum temperature is 15°C and optimum temperatures are 25–28°C, when it multiplies more rapidly than *A. cucumeris*. In bedding, pot and cut flower crops, a good strategy for using *Amblyseius* species would be to use *A. cucumeris* at the recommended preventive rate in the early season, then if thrips numbers increase, use higher release rates or switch to *A. swirskii* if temperatures are suitable.

***Hypoaspis miles and Hypoaspis aculeifer***
These ground-dwelling predatory mites are primarily used against sciarid flies, but will also feed on other prey in the growing media, soil or on matting, including thrips pupae. They should not be relied upon as the sole method of thrips control, but could supplement control when used alongside other biological control agents such as *Amblyseius* spp. The adult mites are up to 0.8 mm long, off-white with a large pale brown shield on their backs. *Hypoaspis* spp. need moist growing media, soil or substrate and temperatures above 15°C. They are supplied in tubs with a peat and vermiculite carrier for sprinkling on the floor or benches. The mites are very active and can often be seen running on the substrate surface or under pots and trays.

***Steinernema feltiae***
These insect-pathogenic nematodes were first developed as substrate drenches for the control of sciarid fly larvae. However, they are now also used successfully as foliar applications for WFT control, particularly on chrysanthemums. The nematodes kill the host insect by releasing a bacteria from their gut once inside the thrips body. *S. feltiae* can kill WFT adults and larvae on the plants, but their main role in WFT control is by killing the thrips larvae that drop to the ground to pupate, and the pupal stages in the ground. Nematode applications should be made weekly, and as they do not give a quick knock-down of thrips, they should start at low WFT densities or used preventatively. The microscopic nematodes are supplied in a gel-like carrier in plastic trays, for application in water. It is critical to follow all the product recommendations for effective results, such as correct application rate and use-by date, removal of fine filters in the application equipment and continued agitation of the spray tank during application.

***Atheta coriaria***
This ground-dwelling predatory (rove) beetle is available for control of sciarid and shore flies. Both the adults and larvae will also eat other prey in the growing media or soil, including thrips larvae and pupae. The adult beetle is about 3–4 mm long, dark brown and shiny, with short wings and an upturned rear end. The adults are very active and can both run and fly, but often remain hidden within the growing media and under pots or trays. The young larvae are small and white and older larvae are 3–4 mm long and brownish-yellow. The beetles are supplied in tubs in a compost and vermiculite carrier. Research in HDC project PC 261 showed that *Atheta* reduced WFT numbers on impatiens through use of the grower 'DIY' rearing-release system developed in HDC project 239a.


**15 The 'Airbug' automatic applicator from Koppert**

**16 Amblyseius cucumeris can be released to cut flower crops from this 'Bugline' strip supplied by Syngenta Bioline**

***Insect-pathogenic fungi***
Insect-pathogenic fungi are microbiological control agents and are therefore subject to the pesticide approval system (unlike predators, parasites and nematode biological control agents). Two fungal products are approved in the UK that will give some control of thrips:

*Verticillium lecanii*
The whitefly strain of this fungus ('Mycotal') will also infect thrips. Mycotal has approval for use on protected ornamentals, and is supplied as spores in a wettable powder for application as a high volume spray. To be effective, the fungus needs at least 18°C and a relative humidity of more than 75% for 10–12 hours after application. It is therefore most suitable for use during warm, humid weather, in propagation houses, or when rooting cuttings under polythene. Once the fungus has colonised the thrips body, it can be seen as white fluff on the body surface. Fungicides need to be chosen with care and their application timed to cause least harm to Mycotal; check the product label or contact the supplier.

*Beauveria bassiana*
This fungus (Naturalis-L) has recently been approved in the UK for use on any protected edible or protected ornamental crop, for control of whitefly and thrips. *B. bassiana* works in a similar way to *V. lecanii* but is not so dependent on high humidities. Infected thrips are covered with small balls of white fungus (Figure 17).

## Chemical control

- Thrips are difficult to control with pesticides. WFT is resistant to many pesticides, and UK populations of onion thrips collected from salad onion and leek crops have recently been shown to be resistant to pyrethroids.

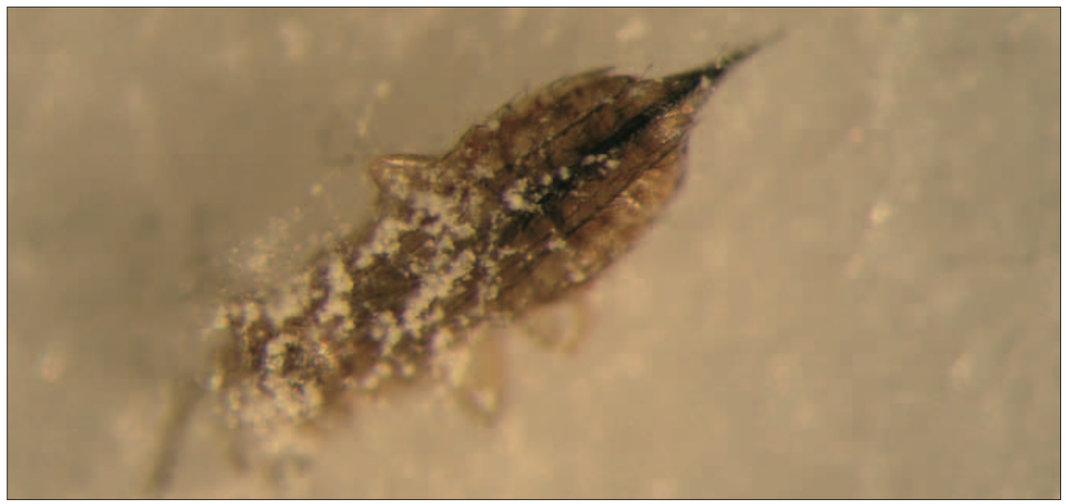
- In addition, thrips are difficult targets as adults and larvae often hide under leaves or in buds or growing points, and most pupae of WFT and onion thrips are located in the growing medium or substrate.

- Sugar solutions have sometimes been claimed to improve thrips control by luring thrips out of their hiding places and increasing exposure to foliar applied pesticides when used as a tank mix. A sugar solution product ('Attracker') is available from Koppert.

- An approved pesticide should only be used if necessary, and the choice will depend on thrips species present, history of pesticide efficacy on the nursery and whether or not IPM is being used.

- It is very important to follow pesticide label recommendations carefully, including Resistance Management Guidelines. Avoid using the same chemical or chemical group repeatedly, as this can select for pest resistance. For example, although spinosad (Conserve) is currently the most effective pesticide against WFT, resistance has occurred in some UK WFT populations (eg on chrysanthemum and strawberry where Conserve and Tracer respectively have been over-used).

- Table 1 overleaf lists pesticides that are currently approved on protected ornamentals that may give some control of thrips, depending on species and resistance status.



**17 Thrips infected with *Beauveria bassiana* are covered with small balls of white fungus**

**Table 1 Currently approved pesticides (May 2009) on protected ornamental plants that may give some control of thrips**

| Active ingredient | Product name (examples) | Insecticide group | Approval status for protected ornamentals | Appli-cation method | Compatability with biological control agents* | Comments |
|---|---|---|---|---|---|---|
| Abamectin | Acaramik<br>Clayton Abba<br>Dynamec | Avermectin | Label approval | High volume spray | Harmful to nematodes for up to 7 days and to most other bio-controls for up to 3 weeks | Contact and translaminar action |
| *Beauveria bassiana* | Naturalis-L | Entomopathogenic fungus | Label approval | High volume spray | Safe to some bio-controls | UK label details not yet available (May 2009) |
| Cypermethrin | Sherpa 100 EC<br>Toppel 100 EC | Pyrethroid | Label approval | High volume spray | Safe to nematodes Harmful to most other bio-controls for up to 12 weeks | Contact action. WFT and onion thrips likely to be resistant |
| Deltamethrin | Bandu<br>Cleancrop<br>Decathlon<br>Decis<br>Decis Protech<br>Pearl Micro | Pyrethroid | Label approval | High volume spray | Safe to nematodes Harmful to most other bio-controls for up to 12 weeks | Contact action. WFT and onion thrips likely to be resistant |
| Deltamethrin | Bandu<br>Cleancrop<br>Decathlon<br>Decis<br>Decis Protech | Pyrethroid | SOLA 1611/07<br>SOLA 1633/07<br>SOLA 1693/07<br>SOLA 1650/07 | Fog | Safe to nematodes Harmful to most other bio-controls for up to 12 weeks | Contact action. WFT and onion thrips likely to be resistant |
| Imidacloprid | Intercept 70 WG | Neonicotinoid | Label approval | Substrate drench | Safe to nematodes Harmful to some bio-controls for up to 6 weeks | Systemic action. Plants in containers only |
| Natural plant extracts | Eradicoat<br>Majestik | Physical pesticide | Exempt from pesticide regulations | High volume spray | Safe to bio-con-trols once spray deposit dry | Contact action |
| Nicotine | Nicotine 40% shreds | Alkaloid | Label approval | Smoke | Harmful to some bio-controls for up to 3 days | Fumigant action. Poor control of WFT likely. Approval for use expires 8 June 2010 |
| Nicotine | No-Fid<br>Stalwart<br>XL All Nicotine 95% | Alkaloid | Label approval | High volume spray | Harmful to some bio-controls for up to 1 week | Contact and fumigant action. Poor control of WFT likely. Approval for use expires 8 June 2010 |
| Pyrethrins | Pyrethrum 5 EC<br>Spruzit | Pyrethrins | Label approval | High volume spray | Harmful to some bio-controls for up to 1 week | Contact action. WFT and onion thrips likely to be resistant |
| Spinosad | Conserve | Spinosyn | Label approval | High volume spray | Harmful to some bio-controls (parasitic wasps) for up to 1 week | Contact and ingestion action. Usually effective against WFT but resistance confirmed in some UK populations where over-use has occurred |
| Teflubenzuron | Nemolt | Benzoylurea | SOLA 2120/07 | High volume spray | Safe to most bio-controls | Contact and ingestion action. Insect growth regulator. SOLA expires 31 Decenber 2013 |
| Thiacloprid | Agrovista – Reggae<br>Calypso | Neonicotinoid | SOLA 0474/08<br>SOLA 3728/06 | High volume spray | Harmful to some bio-controls for up to 2 weeks | Contact, translaminar and systemic action |
| Thiamethoxam | Centric | Neonicotinoid | SOLA 2230/08 | High volume spray | Harmful to some bio-controls for up to 2 weeks | Contact, ingestion and systemic action |
| *Verticillium lecanii* | Mycotal | Entomopathogenic fungus | Label approval | High volume spray | Safe to bio-controls | Contact action |

**Table continued...**

- SOLA = Specific Off-label approval
- Growers must hold a paper or electronic copy of a SOLA before using any product under the SOLA arrangements. Any use of a pesticide with a SOLA is at grower's own risk. Relevant SOLAs are sent to HDC members by HDC, or are available from CRD (see below) or from consultants.
- Always follow label or SOLA recommendations, including rate of use, and check the range of ornamentals listed which can be safely treated. If crop safety information is unavailable, test the product on a small number of plants first before use on a larger scale.
- The Long Term Arrangements for Extension of Use (LTAEU) are being phased out from 1 June 2009, due to EU harmonisation of pesticide regulations. All pesticides formerly permitted for use under the LTAEU (allowing extrapolation of use from a label approval or SOLA to use on an ornamental crop) are in the process of being evaluated by the Chemicals Regulation Directorate (CRD), formerly known as PSD. Where possible, CRD has issued new SOLAs to replace the LTAEU. However, some pesticides formerly permitted for use under the LTAEU no longer meet the regulatory requirements and these are not permitted for use after 1 June 2009. Some pesticides have not yet been processed by CRD and these can continue to be used under the LTAEU at grower's own risk after 1 June 2009, until they are processed further by CRD. Further, up to date information is available from the CRD Information Service (Tel. 01904 640500) or on the CRD website **www.pesticides.gov.uk**
- If in doubt about which products are permissible on ornamentals or how to use them correctly, seek advice from a BASIS-qualified consultant with expertise in ornamental plant production.
- **Important** – Growers must always check the current approval status of products listed in this factsheet before intended use as this could have changed since it was produced.

*Full details of compatibility of pesticides with biological control agents are available from biological control suppliers or consultants.

# Further information

## Other useful publications

- HDC Crop Walkers' Guide, Pot and bedding plants.
- HDC Factsheet 19/08: 'Iris Yellow Spot Virus: A potential threat to the onion industry'.
- HDC Factsheet 10/07: 'Guidelines on nursery hygiene for outdoor and protected ornamental crops'.
- HDC Factsheet 09/07: 'Soil disinfection options for cut flower crops'.
- HDC Project 261 Protected bedding and pot plants: Evaluation of western flower thrips control by *Atheta coriaria* using an on-nursery rearing system.
- ADAS/Defra IPM in protected ornamental crops, a best practice guide for UK growers (available from ADAS UK Ltd, Boxworth, Cambridge, Tel. (01954) 256214).

## Suppliers of biological control agents

**Agralan Ltd**
(Biobest products)
The Old Brickyard
Ashton Keynes
Swindon
Wilts SN6 6QR
Tel. (01285) 860015
**www.agralan.co.uk**

**Becker Underwood UK**
(insect-pathogenic nematodes)
Unit 1
Harwood Industrial Estate
Harwood Road
Littlehampton
West Sussex BN17 7AU
Tel. (01903) 732323
**www.beckerunderwood.com**

**BCP Certis**
Newbury House
Court Lodge Farm
Hinxhill, Ashford
Kent TN25 5NR
Tel. (01233) 667080
**www.bcpcertis.com**

**Biowise**
Hoyle Depot
Graffham, Petworth
West Sussex GU28 0LR
Tel. (01798) 867574
**www.biowise-biocontrol.co.uk**

**Fargro Ltd**
Toddington Lane, Littlehampton
West Sussex BN17 7PP
Tel. (01903) 721591
**www.fargro.co.uk**

**Koppert UK Ltd**
Green House
Hornefield Business Park
Hornefield Road
Haverhill Suffolk CB9 8PQ
Tel. (01440) 704488
**www.koppert.co.uk**

**Syngenta Bioline**
Telstar Nursery
Holland Road
Little Clacton, Clacton
Essex CO16 9QG
Tel. (01255) 863215
**www.syngenta-bioline.co.uk**

Biocontrol agents and sticky traps can also be obtained through most horticultural merchants.

## Useful contacts

**Food and Environment Research Agency (Fera)** – Incorporating the Plant Health and Seeds Inspectorate (PHSI)
Sand Hutton York
Yorkshire YO41 1LZ
Tel. (01904) 465625
**www.fera.defra.gov.uk/contactUs/contactPlh.cfm**

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