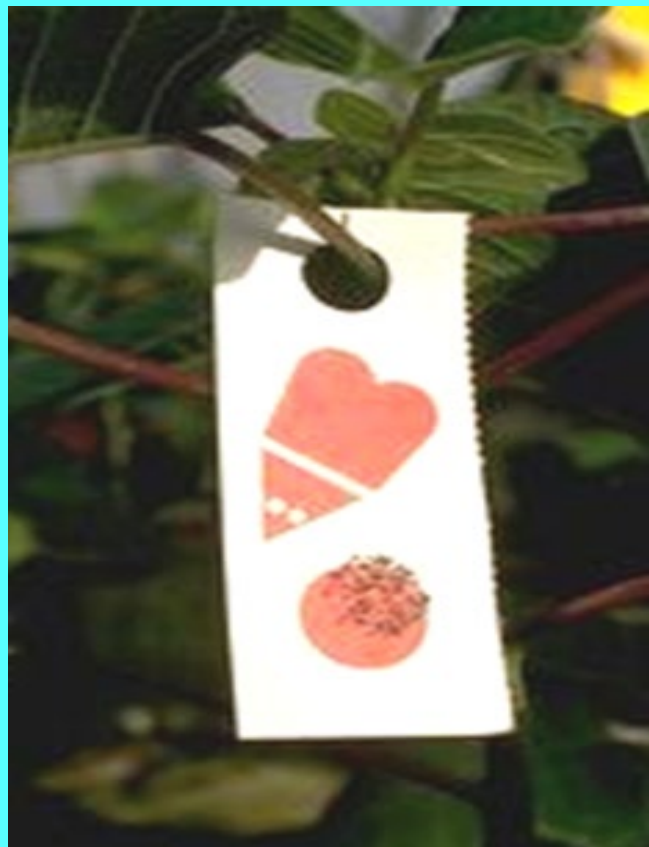


2022 GH IPM BC Workshop: Greenhouse, western flower, and chilli thrips and banker plants for Orius: ID, BC, insecticides, and management



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Learn2Grow®

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Types of thrips damage



What is greenhouse IPM?

Preventative thinking



Assume cuttings will arrive with thrips.

- **Misting weekly botanigard sprays (3x)**
- **Nematodes weekly**
- **Mites weekly, bridges help mites move around**
- **Banker plants, for thrips use ornamental peppers for pollen feeding, for Orius use *Gerbera***

What is greenhouse IPM?

- When developing an IPM program, it is important to know what pests you have. Learn the major characteristics for pest and damage identification and how to monitor for the pests.
- Determine threshold levels for each pest. At low densities, biological control and biorational pesticides may be used. High pest densities may call for conventional pesticides, but these should be avoided whenever possible to conserve beneficials.



IPM Program For Thrips

MONITORING FOR VIRUSES

- **Remove flowers from indicator plants before placing them in greenhouses because petunia flower petals do not express local lesions and attract western flower thrips away from leaves.**
- **Flag indicator plants with blue pie pans or metal sheets to increase effectiveness since western flower thrips are most sensitive to blue colors.**
- **Look for feeding scars, which are whitish and have an irregular outline. Brown or black-edged lesions will develop on the edges of thrips feeding scars within 3 days if a tospovirus has been transmitted. If a tospovirus outbreak occurs in the greenhouse, look for patterns of injury that correlate with variations in air movement, humidity, and temperature.**
- **Control measures include removal of infected plants and controlling or excluding thrips.**

IPM Program For Thrips

BIOLOGICAL CONTROL

Commercially available predators to help control western flower thrips are:

- Minute pirate bug, *Orius* spp.
- Predatory mites, *Amblyseius swirskii* (warm temp) “Swirskii mite”, *Neoseilus cucumeris*. *Hypoaspis miles*. are soil-inhabiting and feed on thrips pupae.
- Parasite of greenhouse thrips is *Thripobius semileteus* (right).
- In soil or foliage use *Beuaveria* fungus or nematodes



Jack Kelly Clark
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Species of thrips



Top, Eastern flower thrips
Middle, chilli thrips
Far top, greenhouse thrips
Bottom, Western flower thrips

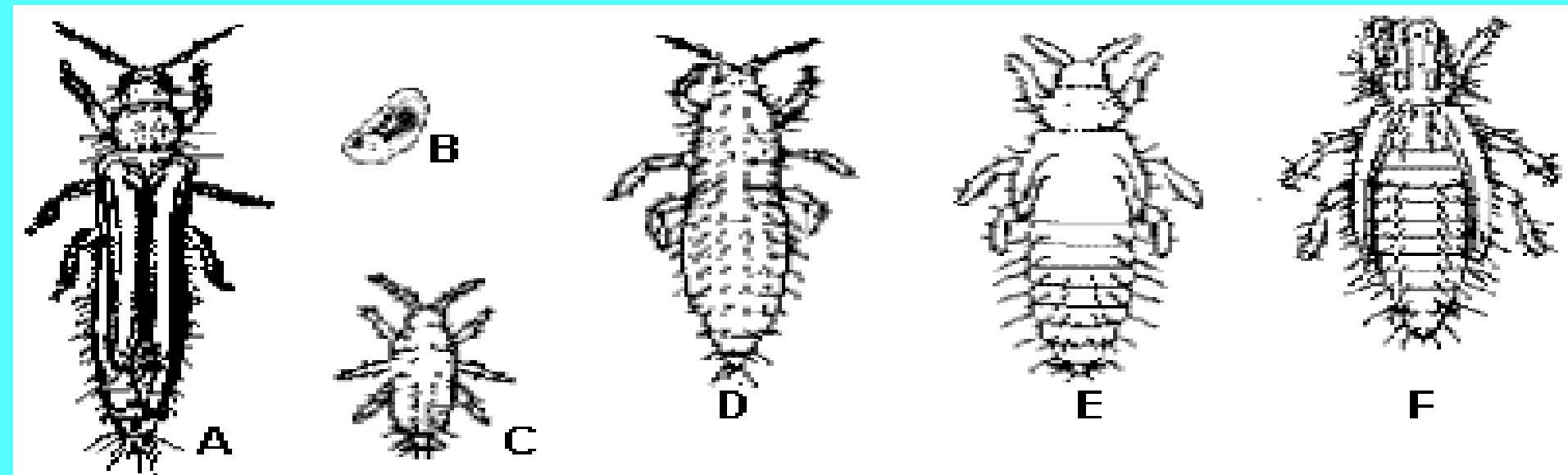


IPM Program For Thrips

Order Thysanoptera, Family Thripidae

GENERAL DESCRIPTION OF THRIPS

- Four featherlike wings, with fine hairs on the edges.
- Six life stages: egg, first instar, second instar, prepupa, pupa, and adult.
- Thrips insert eggs into plant tissue or in soil.
- The first two instars and adults feed by piercing +sucking
- Adult feeding is rasping damaging creating long lesions.
- Look for black fecal spots.



IPM Program For Thrips

DAMAGE

- **Western flower thrips primarily feeds on flowers but also sometimes on new vegetative growth, whereas greenhouse thrips feeds primarily on foliage. Direct feeding damage includes streaking, spotting, and tissue distortion.**
- **On orchids, western flower thrips feeding and egg laying will leave translucent ‘pimpling’ spots on petals and leaves.**
- **The stippling damage caused by thrips feeding on individual cells is often confused with mite stippling.**
- **Western flower thrips can vector tomato spotted wilt virus as well as many other viruses.**

IPM Program For Thrips

DESCRIPTION OF THE PESTS

The Eastern flower thrips, *Frankliniella tritici*

- Very common before western flower thrips
- Thrips feed on over many plant species.
- Feed on all plant parts.



IPM Program For Thrips

DESCRIPTION OF THE PESTS

- The chilli thrips or yellow tea thrips, *Scirtothrips dorsalis*, is an extremely successful invasive species from Asia over the last twenty years.
- Chilli thrips feed on over 100 plant species.
- Feed on all plant parts.



IPM Program For Thrips

DESCRIPTION OF THE PESTS

Western flower thrips (WFT),
Frankliniella occidentalis

- WFT has three color forms: pale form, is white and yellow, intermediate form with a dark orange thorax and brown abdomen; and a dark form.
- WFT usually feed in enclosed tissues such as flowers, buds, or growing tips. Adults also feed on pollen and on spider mites. Eggs laid in plant leaves. Females will lay male eggs if unmated and female eggs are produced once mating has occurred. Development times to complete one generation of western flower thrips varies from 11 days (77° to 87°F) to 44 days (50° to 60°F).



IPM Program For Thrips

DESCRIPTION OF THE PESTS

- Greenhouse thrips, *Heliethrips haemorrhoidalis*, are tiny, black, insects with whitish to translucent wings folded back over their thorax and abdomen. Legs are also a whitish color. Nymphs are whitish to slightly yellowish in color and produce a globule of fecal fluid at the tip of their abdomen. These globules of fluid increase result in black specks on foliage.



What is biocontrol?

**Recognizing beneficial
insects/biocontrol agents**

IPM Program For Thrips

BIOLOGICAL CONTROL

Commercially available predators to help control western flower thrips are:

- Minute pirate bug, *Orius* spp.
- Predatory mites, *Amblyseius swirskii* “Swirskii mite”, *Neoseiulus cucumeris* and *Hypoaspis miles*. *Hypoaspis miles* are soil-inhabiting and feed on thrips pupae.
- Parasite of greenhouse thrips is *Thripobius semileteus* (right).
- In soil or foliage use fungus or nematodes



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University of California

Thrips Predatory Mite (*Amblyseius cucumeris*)

Class Arachnida

Order Acari

Family Phytoseiidae



This mite feeds primarily on immature thrips, as the adults are too large for them to kill. Release when thrips populations are low.

Ideal conditions are 66 to 80 degrees F and a relative humidity of 65 to 72 percent.

***A. cucumeris* are shipped as adults in bran.**

Thrips Predatory Mite (*Amblyseius swirskii*) **“Swirskii mite”**

Class Arachnida
Order Acari
Family Phytoseiidae



This mite feeds primarily on immature thrips and whiteflies. Release when thrips populations are low.

Ideal conditions are 72 to 80 degrees F and a relative humidity of 72 percent.

Predatory Mite (*Hypoaspis miles*)

Class Arachnida

Order Acari

Family Phytoseiidae

This mite attacks fungus gnats and thrips pupae.

Females lay eggs in soil. Eggs hatch in 1 to 2 days. Each mite consumes 5 to 20 prey per day and algae or plant debris when prey is scarce. The entire life cycle is 7 to 11 days.

Release rates: 5,000 mites treats 500 to 1,000 plants; 10,000 to 25,000/per acre.



IPM Program For Thrips

CULTURAL CONTROL

- **Because western flower thrips and greenhouse thrips feed on a large variety of plant species, keep production areas free of weeds, which can serve as hosts for thrips populations.**
- **Most commercially available screens have pore sizes slightly larger than the width of the western flower thrips thorax (145 microns), meaning that some winged adults can penetrate these openings. However, covering openings to the greenhouse with fine screens does exclude most thrips. Be sure that the ventilation system on an existing greenhouse can accommodate the reduced flow caused by a fine screen or else the system will need to be modified.**

IPM Program For Thrips

CULTURAL CONTROL

- **Carefully inspect plants being brought in to start a new crop to ensure that they are free of thrips and other pests. A holding area where plants are kept for about 11 to 12 days is useful so that plants can be inspected for any infestations that may develop. Treat any infested plants if necessary.**
- **Blue sticky cards are most attractive to western flower thrips. However, yellow cards are easier to count and more commonly used for insect monitoring. Place yellow sticky cards vertically in the crop canopy, with the lower one-third of the trap in the leaves and the upper two-thirds above the leaves. As the crop grows, the traps will need to be raised. Three traps per cultivar is adequate.**

IPM Program For Thrips

MONITORING FOR VIRUSES

It is also important to monitor for viruses that western flower thrips vector, such as impatiens necrotic spot virus (INSV) and tomato spotted wilt virus (TSWV) (both are tospoviruses).

It is difficult to diagnose tospovirus infections of greenhouse plants using visual symptoms alone because symptoms can vary. Tospovirus symptoms often mimic symptoms caused by other problems, such as nutritional deficiencies.

Tospovirus infections may be systemic (i.e., virus symptoms are spread throughout the plant) or non-systemic (i.e., the virus symptoms are confined to a specific part of the plant). Tospoviruses, however, may be present even though the plant shows no symptoms.

IPM Program For Thrips

MONITORING FOR VIRUSES

The symptoms of tospovirus infections in floral crops are:

- Brown, black, or white spots
- Necrosis on the leaf petiole
- Yellow mottling or variegation
- Death of young plants or terminal meristems of older plants
- Brown or black cankers on the stem
- Stunting
- Veinal necrosis
- Concentric ring spots
- Mosaics
- Line or zonal patterns

**Begonia with tomato
spotted wilt virus**



IPM Program For Thrips

MONITORING FOR VIRUSES

Early warning is critical to the control of western flower thrips and to the prevention of tospovirus infections. Indicator plants are often used to detect thrips and virus problems. Indicator plants should meet at least one of the following criteria:

- Indicator plants should be more attractive to pests than the producing crop**
- Pests or pathogen must develop faster on indicator plants**
- Indicators must show feeding damage or virus symptoms more readily**
- Indicator plants should not contribute to the spread of the virus being monitored**

IPM Program For Thrips

MONITORING FOR VIRUSES

Petunia plants (*Petunia x hybrida*) are excellent indicators for presence of western flower thrips and transmission of tospoviruses because petunias are not systemically infected with either TSWV or INSV. In response to a tospovirus infection, petunias show a hypersensitive response: rapid death of plant tissues that also kills the invading virus.

The following petunia cultivars are excellent indicator plants:

- Calypso
- Super Blue Magic
- Blue Carpet
- Cascade Blue
- Summer Madness
- Burgundy Madness
- Red Cloud
- Super Magic Coral



Lesions on petunia leaves caused by feeding of western flower thrips

IPM Program For Thrips

MONITORING FOR VIRUSES

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IPM Program For Thrips

MONITORING FOR VIRUSES

In addition to the use of indicator plants, there are several kits designed specifically to test for tospoviruses vectored by western flower thrips. The test kits are available from www.agdia.com.



IPM Program For Thrips

MONITORING FOR VIRUSES

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Insecticides

IPM Program For Thrips

MONITORING and WHEN TO TREAT

- It is important to note that correct identification of pest thrips is essential in a monitoring program.
- Most insecticides must be applied at least two times, 5 to 7 days apart, for efficacy against western flower thrips.

White feeding scars and black excrement from greenhouse thrips

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Chemical class/mode of activity

The mode of action is the mechanism that kills the insects.



1. Organophosphates and Carbamates

Inhibit the enzyme cholinesterase. This prevents the termination of nerve impulse transmission.

2. Pyrethroids and Chlorinated Hydrocarbons

Destabilize nerve cell membranes.

3. Neonicotinyls

Work on central nervous system, cause over-stimulation and blockage of the postsynaptic nicotine acetylcholine receptors.

4. Novel insecticides

Mode of action specific.

IRAC numbers

- The Insecticide Resistance Action Committee (www.ircac-online.org) has assigned **IRAC numbers** for each chemical class, and these numbers are on labels to make it easier to rotate classes of insecticides and prevent resistance
- Neonicotinoid class, **4A**
- Carbamates, class **1A**
- Organophosphates, class **1B** are in the same group as the mode of action (cholinesterase inhibition) is the same.





Systemic insecticides

Organophosphates

dimethoate (Cygon)

Neonicotinoids

imidacloprid (Marathon, Merit), clothianidin, thiamethoxam, Dinotefuran, acetamiprid

Novel mode of action

pymetrozine (Endeavor)

Translaminar, or local, systemic activity

Microbial- abamectin (Avid)

IGR- pyriproxyfen (Distance)

PR- chlorfenapyr (Pylon)

SP- spinosad (Conserve)

OP- acephate (Orthene)

**Recognizing using
insecticides that conserve
beneficial insects/biocontrol
agents**

Neonicotinoids are systemic and should not be used on plants that beneficial insects will feed on in the greenhouse and when installed in the landscape.

Instead use biorational pesticides use biorational pesticides that are low in toxicity and do not create residues in leaves, pollen, and nectar.

Chemical class	Examples of common names	Bee Toxicity			
		No	Low	Mod	High
Carbamates	carbaryl				All x
Neonicotinoid	imidacloprid thiamethoxam clothianidin dinotefuran imid+bifenthrin				All x
	Less toxic: acetamiprid (A) thiacloprid (T) Pink above means systemic		All x		

Chemical class	Examples of common names	Bee Toxicity			
		Non	Low	Mod	High
Organophosphates	acephate, chlorpyrifos dimethoate malathion phosmet				All x
Pyrethroids	bifenthrin cyfluthrin fenpropathrin lambda- cyhalothrin permethrin				All x
Botanical	pyrethrins azadirachtin			x	x

Chemical class	Examples of common names	Bee Toxicity			
		Non	Low	Mod	High
Insect growth regulators	diflubenzuron tebufenozide	All x			
	azadirachtin buprofezin pyriproxyfen	x x		x	
	novaluron			x	
	cyromazine			x	
	Juvenile hormone	s-kinoprene		x	
Diamides	chlorantraniliprole cyantraniliprole	x			x
Macrocyclic lactones	abamectin/ avermectin				x

Chemical class	Examples of common names	Bee Toxicity			
		Non	Low	Mod	High
Miticides	acequinocyl extoxazole Fenpyroximate fenbutatin-oxide	All x			
	clofentezine, hexythiazox	x, x			
	bifenazate		x		
	pyridaben				x
	chlorfenapyr			x	
	spiromesiifen	x			
Spinosyns	spinosad, less toxic when dry		x		
Tetronic acids	spirotetramat			x	
GABA-channel	fipronil				x

Chemical class	Examples of common names	Bee Toxicity			
		Non	Low	Mod	High
Pyridine carboxamide	flonicamid	x			
Pyridine azomethines	pymetrozine		x		
Avermectin	emamectin benzoate				x
Other insecticides	<i>Bacillus thuringiensis</i> ,	x			
	potassium salts fatty acids soaps	x			
	horticultural mineral oils, neem oil	x			

Insecticides for thrips

Thrips control for adults and immatures

Neonicotinoid insecticides, such as Flagship, Safari and Tristar, have not shown good effectiveness against thrips lately.

Mesurol was one of the more effective products for thrips control, but results have been more inconsistent in recent years. Mesurol is a restricted-use pesticide in all states.

Biorationals for thrips

Thrips control for immatures use with BC

Biorational IGRs, insect growth regulators for immatures

Biorational IGRs are generally used in combination with **adulticides** and after a good knockdown has been achieved with other products.

Biorational Pedestal (novaluron), IGR has long been a part of thrips-control programs, causing death at the point of molting.

Biorational Enstar, IGR is labeled for thrips.

Biorational Fulcrom, Distance (pyriproxifen), IGR is labeled for thrips.

Biorationals for thrips

Thrips control in soil

Biorational Nematodes, *Steinernema feltiae* have been assisting growers to control the pupal stages of WFT. Applications to the media every two to three weeks. Provides fungus gnat control at the same time.

Biorational Distance (pyriproxyfen) +Talsatr (bifenthrin) soil drenches.

Biorational microbial insecticides

BotaniGard (*Beauveria bassiana*), Preferal (*Isaria*), Met52 (*Metarhizium*), Grandevo (*Chromobacterium*)

Insecticides for thrips

Thrips control for adults and immatures

- **Avid (abamectin) Tank mixed with a neem-azadirachtin-based insect growth regulator (IGR), such as Azatin O, AzaGuard or Molt-X and applied as a foliar application is effective when applied two times, seven days apart.**

Insecticides for thrips

Thrips control for adults and immatures

Pylon (chlorfenapyr) Foliar applications are typically made twice, seven days.

Conserve (spinosad)

Biorational Aria is a feeding blocker labeled for thrips suppression, not a knock-down

Scirocco (bifenazate + abamectin)

Mainspring (cyantraniliprole)

Insecticides for thrips

Thrips control with slower activity

Biorational Overture (pyridaly) A slower-acting insecticide, taking up to 7 days to see significant reductions in adult thrips populations from a foliar application.

Bioratona Kontos (spirotetramat) Drench applications show very good results, though they're slow to take full effect (up to three weeks). Foliar spray shown variable results. Geraniums + *Dracaena* are damaged by Kontos.

Biorational Aria is a feeding blocker labeled for thrips suppression, not an knock-down

The end result, beautiful flowers and healthy plants

