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Thrips Management in Greenhouses

Of the many species of thrips commonly found in greenhouses, flower thrips (*Frankliniella tritici*), western flower thrips (*Frankliniella occidentalis*) and chilli thrips (*Scirtothrips dorsalis*) are most problematic. Chilli thrips is the fastest spreading thrips and is found throughout North America, but mainly in Florida and Texas. Adults of these three species are about 1 - 2 mm long, slender and just visible to the naked eye. Adult thrips are hard to notice flying in the greenhouse, but both nymphs and adults can often be detected in the open blossoms of your greenhouse crops.

The most distinctive external feature of these thrips is found on the adults. They have 2 pairs of feather-like, long, narrow wings, which have few or no veins and bear fringes of long, fine hairs along their margins. The wings are held parallel along the back when at rest. Immature forms of thrips are wingless. Colors vary from white to straw yellow to brown. Chilli thrips are pale green to yellow with dark wings. Immatures are pale without wings. When examining small insects suspected of being thrips, use a 10x magnifier to help you look for these morphological characteristics.

It is not possible to accurately identify which thrips species is infesting a crop with a hand lens or from sticky cards. Differences in microscopic structures on the adult female thrips are used to tell one species from another. Therefore, adult thrips must be inspected under a compound microscope to accurately determine the species. To distinguish between the flower thrips, chilli thrips and western flower thrips, capture live adults and place them in a vial with alcohol. Take the sample to a University of Maryland Extension office for identification.

Thrips Damage

Thrips feed by piercing plant cells with their mouthparts and sucking out the cellular contents. The damage to plant cells caused by thrips feeding can result in deformation of flowers, leaves, and shoots. There is often silvery streaking and flecking on expanded leaves. Thrips often deposit tiny greenish-black fecal specks on leaves when they feed. Thought to be limited to west of the Mississippi prior to the 1980s, western flower thrips has become the most persistent species attacking greenhouse plants throughout the United States, Canada, and many countries in Europe and Asia.

The western flower thrips has the ability to transmit the tospoviruses, impatiens necrotic spot virus (INSV) and tomato spotted wilt virus (TMSV) to a wide variety of greenhouse plants. If thrips in your

greenhouse are identified as western flower thrips and you also have plants infected with tospovirus, you must practice rigorous thrips control. There is no cure for tospovirus; destroy infected plants. One western flower thrips adult can infect a plant after feeding for only 30 minutes. Because both the virus and the thrips attack such a wide variety of greenhouse crops and weeds, it may be difficult to eradicate the virus once it is found in a greenhouse.

Life Cycle

Most adult thrips in a greenhouse are females; in some species males are rare or unknown. Reproduction without fertilization is a frequent occurrence. Thrips are gregarious with large numbers often concentrated on the same leaf or flower. The length of the life cycle is strongly influenced by humidity and temperature. Thrips in warm greenhouses have a shorter generation time than thrips outdoors. In the greenhouse, thrips development may continue uninterrupted throughout the year if suitable crops are available. Outdoors during warm periods in late afternoon, thrips sometimes swarm and are caught in wind currents to be dispersed over a wide area.

Thrips control is extremely difficult due to several biological characteristics. Thrips eggs are inserted into leaf or petal tissue and are thus protected from insecticides. The eggs hatch into larvae which usually remain protected in flower buds or foliage terminals. The insects pass through two larval stages, both of which feed in these protected areas. Toward the end of the second larval stage, the insects stop feeding and move down into the soil or leaf litter to pupate. The thrips pass through two 'pupal' stages (prepupal and pupal), during which no feeding and little movement occurs. While in these pupal stages in the soil, they are protected from insecticides directed at the crop. There are currently no pesticides labeled as drenches to kill thrips pupae in soil. The adults can survive from 30 to 45 days. Female thrips lay 150 to 300 eggs depending on temperature and the host plant. Adults are found feeding in protected areas of the plant such as flowers and terminals. Hibernation takes place in the soil outside or in the soil under the benches in unheated greenhouses.

STAGE	Approximate duration at 68 – 98 °F
Egg	2 - 4 days
1st instar	1 - 2 days
2nd instar	2 - 4 days
Prepupal stage	1 - 2 days
Pupal stage	1 - 3 days
Adults	30 - 45 days

The pest's rapid developmental time (egg to adult in 7 to 15 days at fluctuating temperatures), high reproductive rate, and preference for protected areas can make early detection difficult. Adults fly readily and can be carried on wind currents or on clothing to greenhouses near infested fields. They can fly from sprayed to unsprayed areas or move in or out of a greenhouse through doors or vents.

Management Options

Eliminate the Alternate Hosts

Weed control is essential for a successful thrips control program. Weeds can serve as a refuge both for thrips and tospovirus. Eliminate weeds inside the greenhouse and also from areas immediately outside, particularly near vents and doors. Black

plastic mulch covered with coarse gravel can be used for weed control and to reduce thrips habitat around the greenhouse and under the greenhouse benches. Coarse gravel on plastic is an unfavorable site for prepupal and pupal stages of thrips.

Exclusion

The best control is to prevent thrips from coming into the greenhouse. Where a thrips invasion from outside is likely, microscreening may be more cost effective than frequent insecticide applications. With this method, it is important to start each crop cycle with a clean greenhouse and thrips-free plants. It is also essential to train employees to keep doors closed and screens in place. Even in a well-screened greenhouse, sticky cards should be used for early detection of thrips infestations. North Carolina State University has conducted field research using screening to prevent thrips from entering the greenhouse. They have found that microscreening with 100 holes per square inch is effective in screening out all life stages of thrips.

One concern with the use of microscreening is the reduction of air movement into the greenhouse. Several greenhouses using screening have overcome this reduction in airflow by using four to five square feet of microscreening for every one square foot of vent. For more information on installation of microscreening, obtain BRE FACTS 186, Insect Screening for Greenhouses at http://www.bre.umd.edu/facts186.htm

Early Detection – An Important Factor

Early detection of a thrips infestation is critical because the symptoms of thrips feeding are not often noticed until after damage or virus transmission has occurred and because an infestation is easier to control when it is small. When the crop is in flower, use a white piece of paper placed under open flowers. Gently tap the flowers and use a 10x magnifier to examine the insects that fall out. Yellow or blue sticky cards are the easiest way to detect the start of an infestation.

Place cards just above the crop canopy, at about one per 500 square feet and near doors, vents, and over thrips-sensitive cultivars to monitor the movement of thrips. Research has shown that blue sticky cards catch more thrips than yellow ones. If you want to monitor only for adult thrips, use the blue sticky cards. To monitor for a wider range of flying greenhouse pests such as winged aphids, whiteflies, and fungus gnats, use yellow sticky cards. The number of thrips per card should be recorded weekly and graphed to detect trends. This information will help you decide whether a population is increasing or decreasing and assist you in correctly timing your pesticide applications.

Chemical Control

Effective chemical control is complicated by the development of insecticide resistance. Resistance to certain organophosphate, carbamate, and synthetic pyrethroid insecticides has been documented in populations of western flower thrips. Several insecticide applications should be made at 5-day intervals to significantly reduce thrips infestations. Research at Cornell University has shown that 5-day application intervals are more effective than 7-day intervals. To determine whether your insecticide applications are effective, monitor your sticky cards on a weekly basis. Note whether the number of adults caught is decreasing

and check plants for thrips. Decide whether to continue the 5-day spray schedule based on the number of adults on the sticky cards, and the number of thrips on the plants.

Since thrips often feed in protected areas of the plant, apply insecticides with equipment that produces very small spray particles of 100 microns or less. Equipment such as electrostatic sprayers generally applies an extremely fine particle size of under 40 microns. Smaller spray particles are best suited for penetrating deep into protected areas of the plant where the thrips are present. Thoroughly spray flowers, if open, since thrips populations are highest in the center of the open flower.

If insecticides must be used, rotate insecticides among different chemical classes to help delay the development of insecticide resistance. Maintain the use of an effective insecticide for more than one generation of a pest before rotating to another class of insecticide. In general, use the same material for 2 months before changing to the next class of insecticides unless you notice a failure to control.

Biological Control

The predatory phytoseid mites, *Amblyseius cucumeris*, *Iphiseius degenerans*, and *A. swirskii*, appear to be well suited for immature thrips control on greenhouse crops. Like thrips, they prefer small niches where contact between predator and prey is likely even without specific searching. These predators feed on pollen when thrips populations are low and must be introduced before a thrips population has built up to damaging levels. The mites establish themselves on leaves, usually on the undersides, and are most effective in attacking 1st instar thrips larvae. They use their chelicerae to pierce the thrips and suck out the cellular fluids. The predaceous mites will establish themselves on a crop, mate and reproduce in the greenhouse. These mites are susceptible to many insecticide sprays. Use biological control for other pests or be selective in pesticides used, selecting insect growth regulators or using biorational materials such as *Beauveria bassiana* or azadirachtin that have minimal impact on predators. If using predaceous mites for western flower thrips control, it is essential to use INSV monitoring plants or on-site INSV serological testing kits.

Predatory mites can be supplied in shaker bottles, applied in paper sachets, or set out on strips. Growers shake the bottle of mites and a grain carrier onto the crop. The sachets are hung on plants or on marker stakes. Remove sachets when plant material is removed and replaced with another crop. Strips are rolled out down a bench. Adult *A. cucumeris* feed on one thrips per day for its 30-day life. Adult *I. degenerans* feed on 4-5 thrips per day for its 30-day life. *I. degenerans*, *A. swirskii* and some strains of *A. cucumeris* do not undergo diapause and can be released during the short days of winter. Temperature is critical with *A. swirskii* since it is not active below 59°F. Release 1 – 5 predaceous mites per square foot of growing area, but check with supplier since release rates vary depending on predatory mite species used.

Three of about 70 species of predatory true bugs in the genus *Orius* (minute pirate bugs) are generally commercially available for thrips control: *O. insidiosus* (insidious flower bug), *O. tristicolor* (minute pirate bug), and *O. albidipennis*. Pirate bugs are voracious, reproduce well in greenhouses, and may provide better thrips control because they

attack all stages of thrips. In floriculture crops apply 2-6 *Orius* per square yard of production area.

Several pathogens have been investigated for control of thrips. The entomopathogenic fungus, *Beauveria bassiana*, applied as a fine mist spray directly onto thrips, has been used to control western flower thrips in greenhouses. Some growers have used *B. bassiana* in combination with insecticides to improve control of thrips. The entomopathogenic fungus, *Metarhizium anisopliae*, recently became commercially available.

Table 2. Insecticides Registered for Flower Thrips Control in Greenhouses*

Chemical Name	Trade Name	Chemical Class	Re-entry Interval
Abamectin	Abamectin E-Pro EC, Ardent EC, Lucid 2F, Minx, Quali-Pro Abamectin EC	Avermectin	12 hr
Acephate	Acephate Pro 75 WSP, Acephate 97Up, Avatar, Orthene TT&O WSP, Orthene TT&O 97, Precise 4%G	Organophosphate	24 hr
Acetamiprid	TriStar 70 WSP	Neonicotinoid	12 hr
Azadirachtin	Aza-Direct, Azatin XL EC, Ornazin 3%EC**, Molt-X, Neemix 4.5, Neemazad 1.0% EC, Triact 70	Botanical	4 hr 12 hr**
Beauveria bassiana JW-1 strain	Naturalis-O	Fungus	4 hr
Beauveria bassiana GHA strain	BotaniGard WP and ES	Fungus	4 hr WP 12 hr ES
Bifenthrin	Talstar F	Pyrethroid	12 hr
Chlorfenapyr	Pylon	Pyrrole	12 hr
Chloropyrifos	DuraGuard ME	Organophosphate	24 hr
Chloropyrifos + Cyfluthrin	Duraplex TR	Organophosphate + Pyrethroid	24 hr
Cyfluthrin	Decathlon 20 WP	Pyrethroid	12 hr
Dinotefuran	Safari 20 SG, Safari 2G	Neonicotinoid	12 hr
Fenoxycarb	Preclude TR	Fenoxycarb	12 hr
Fenpropathrin + Acephate	Tame/Orthene TR	Pyrethroid + Organophosphate	24 hr
Flonicamid	Aria (WDG)	Flonicamid	12 hr
Imidacloprid	Benefit 60WP, Imida E-Pro 2F, Lada 2F, Mallet 2F, Mantra 1G, Mantra 2F, Marathon 1% G, Marathon II	Neonicotinoid	12 hr
Horticultural oil	Ultra-Pure Oil, Saf-T-Side, SuffOil-X	Oil	4 hr
Insecticidal soap	Bonide Insecticidal Soap, Concern, M-Pede	Potassium salts of fatty acids	12 hr
Kinoprene	Enstar II (F)	Juvenile hormone analogues	4 hr
Lambda-cyhalothrin	Quali-Pro Lambda GC-O, Scimitar GC	Pyrethroid	24 hr

Table 2. Insecticides Registered for Flower Thrips Control in Greenhouses (continued)

Chemical Name	Trade Name	Chemical Class	Re-entry Interval
Metarhizium anisopliae Strain F52	Met 52 EC	Fungus	0 hr
Methiocarb	Mesurol 75 WP	Carbamate	24 hr
Nematodes, entomopathogenic	Nemasys, others		None
Nicotine	Fulex Nicotine Fumigator		Meet WPS requirements
Novaluron	Pedestal	Benzoylurea	12 hr
Permethrin	Astro 3.2 EC, Permethrin E-Pro, Perm-Up 3.2 EC	Pyrethroid	12 hr
Pyrethrins and Piperonyl butoxide	Pyrenone Crop Spray, Prentox Pyronyl Crop Spray, Pyreth-It	Pyrethrin	12 hr
Pyridalyl	Overture 35 WP	Pyridalyl	12 hr
Spinosad	Conserve SC	Spinosyn	4 hr
Tolfenpyrad	Hachi Hachi	Pyrazole	12 hr

Table 3. Insecticides Registered for Chilli Thrips Control in Greenhouses* (Testing conducted at University of Florida Extension (IFAS) and found to be effective on chilli thrips)

Chemical Name	Trade Name	Chemical Class	Re-entry Interval
Abamectin	Avid 15% EC	Avermectin	12 hr
Acephate	Acephate Pro 75 WSP, Acephate 97Up, Avatar, Orthene TT&O WSP, Orthene TT&O 97, Precise 4%G	Organophosphate	24 hr
Chlorfenapyr	Pylon	Pyrrole	12 hr
Dinotefuran	Safari 20 SG, Safari 2G	Neonicotinoid	12 hr
Imidacloprid	Benefit 60WP, Imida E-Pro 2F, Lada 2F, Mallet 2F, Mantra 1G, Mantra 2F, Marathon 1% G, Marathon II	Neonicotinoid	12 hr

*** Read label before applying any pesticide. Pay close attention to any phytotoxicity information for specific crops. The information given herein is supplied with the understanding that no discrimination of unnamed products is intended and no endorsement of named products by University of Maryland Extension is implied.**

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