MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK•EASTERN SHORE

Fact Sheet

Fact Sheet 762

Thrips Management in Greenhouses

Of the many species of thrips commonly found in greenhouses, two species, flower thrips (*Frankliniella tritici*) and western flower thrips (*Frankliniella occidentalis*) are most problematic. Adults of both species are about 1 mm long, slender and just visible to the naked eye. You may not notice adult thrips flying in the greenhouse but you can often detect both nymphs and adults in the open blossoms of your greenhouse crops. The most distinctive external feature of this group 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 (Figure 1). Immature forms of thrips are wingless. Colors can vary from white to straw yellow to brown. 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 even with a hand lens. 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 and western flower thrips, capture live adults and place them in a vial with alcohol. Take the sample to a Maryland Cooperative Extension office for identification. Species identification is not possible from sticky cards.

Thrips Damage

Thrips feed by piercing plant cells with their mouthparts and sucking out the cellular contents (Figure 2). 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 (Figure 3). Thrips often deposit tiny greenish-black fecal specks on leaves when they feed (Figure 4).

The distribution of western flower thrips was thought to be limited to west of the Mississippi, prior to the 1980s. This 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 tospoviruses impatiens necrotic spot virus and tomato spotted wilt virus (TSWV and INSV) 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; infected plants must be destroyed. 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 plants, including greenhouse crops and weeds, it may be difficult to eradicate the virus once it is found in a greenhouse. For more information on tospovirus visit the University of Maryland web site, at URL www.agnr.umd.edu/users/tospovirus.

Life Cycle

Most adult thrips seen 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 temperature and humidity (Table 1). 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. Control of thrips 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 (Figure 5), 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 greenhouse bench in unheated greenhouses.

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 an infested field. They can fly from a sprayed to an unsprayed area, or can move into or out of a greenhouse through doors or greenhouse 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. Weeds should be eliminated inside the greenhouse, and also from areas immediately outside for as far as is reasonably feasible, 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 the prepupal and pupal stages of thrips.

Exclusion

The best control is to prevent thrips from coming into the greenhouse. Where thrips invasion from outside is likely, microscreening may be more cost effective than frequent insecticide applications. When using this method of control, it is important to start each crop cycle with a clean greenhouse and thrips-free plants.

Table 1.

Stage	Approximate duration at Temp. 68-98°F
Egg	2 - 4 days
1 instar	1 - 2 days
2 instar	2 - 4 days
Prepupal stage	1 - 2 days
Pupal stage	1 - 3 days
Adults	30 - 45 days

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 adult thrips. Microscreening with 1,000 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 on greenhouse structures, request Biological Resource Engineering FACTS 186, Insect Screening for Greenhouses (Ross and Gill, 1994), from a local Maryland Cooperative Extension office. Information on microscreening is available in Ball Publishing's (Chicago, IL) *IPM Scout Manual* (in press).

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, you can detect thrips using a white or yellow 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 onset of an infestation. These should be placed just above the crop canopy, at about one per 500 square feet, as well as near doors, vents, and over thrips-sensitive cultivars to monitor the movement of thrips. Recent research has shown that light- to medium-blue sticky cards catch more thrips than yellow ones. If you want to monitor only for adult thrips, use the light-blue sticky cards. If you wish to monitor a wider

range of flying greenhouse pests such as aphids, whiteflies and fungus gnats, then 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

Insecticides that are registered for thrips on crops in the greenhouse are shown in Table 2.

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 infestation. 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, you will have to monitor your sticky cards on a weekly basis. Note whether the number of adults caught is decreasing. Also, check plants for presence of 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, the insecticides should be applied 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, then rotating insecticides among different chemical classes may help to delay the development of insecticide resistance. You should 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

Two predatory phytoseid mites, *Amblyseius* (=*Neoseiulus*) *cucumeris* and *Iphiseius* (=*Amblyseius*) *degenerans*, appear to be well suited to immature thrips control on greenhouse crops. Similar to thrips they prefer small niches, where contact between predator and prey is likely even without specific searching. These predators are pollenphagous (pollen feeding) when thrips populations are low. More questions remain to be

Table 2.

Chemical Name	Trade Name	Chemical Class	Reentry Interval
acephate	Orthene TT-&O,PT-1300	Organophosphate	24 hr
azadirachtin	Azatin EC	Botanical	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
bendiocarb	Turcam 76 WP, Dycarb 76 WP	Carbamate	12 hr
bifenthrin	Talstar F	Pyrethroid	12 hr
chloropyrifos	DursGuard	Organophosphate	12 hr
cyfluthrin	Decathlon 20 WP	Pyrethroid	12 hr
diazinon	Knox Out GH	Organophosphate	12 hr
fenoxycarb	Precision, PT 2100 Preclude	Insect Growth Regulator	12 hr
horticultural oil	Ultra-Fine SunSpray	Miscellaneous	12 hr
methiocarb	Mesurol 75 WP	Carbamate	24 hr
naled	Aire Mate GH-18	Organophosphate	24 hr
nicotine	Fulex Nicotine	Botanical	4 hr
pyrethirns and rotenone	Pyrellin EC	Botanical	12 hr
Saccharopolyspora spinosa	Conserve	Bacteria	12 hr
sulfotepp	Fulex Dithio	Organophosphate	4 hr

answered on the best timing and frequency of releases, and usefulness of these predators on various crops and on various thrips species. These mites 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 young (1st instar) larvae of thrips. 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. The limitation is that these mites are susceptible to many insecticide sprays and growers must use biological control for other pests, or be selective in pesticides used, selecting insect growth regulators, or using biorational chemicals that have minimal impact on predators. The pathogen *Beauveria bassiana* GHA strain (BotaniGard ™) does not effect phytoseid mites and could possibly used in combination with beneficial mite releases. The predatory mites can be supplied in shaker bottles. Growers shake the mites and a grain carrier onto the crop. The predatory mites can also be applied in paper sachets. The sachets are hung on plants or on marker stakes. 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. For releases made during the short days of winter the best choice would be to release *I. degenerans* or obtain *A. cucumeris* from biological suppliers that carry selections that do not go into diapause in the short days of winter. If using predaceous mites for controlling western flower thrips it is essential that this is combined with INSV monitoring plants or use of on-site INSV serological testing kits.

The release rates for *A. cucumeris* range from 90-270 per square yard of growing area for floriculture crops. If using mite sachets we have found that 60 sachets (with 50 mites per sachet) placed in 3,000 square feet generally provides good control for 5-6 weeks. The sachets should be replaced as the plant material is removed and replaced with another crop.

There are about 70 species of predatory true bugs in the genus *Orius*, minute pirate bugs. Three species are generally available from commercial insectaries for thrips control. These include *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 are able to attack all stages of thrips, as well as adult thrips species. 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 *Beauveria bassiana* in combination with insecticides to improve control of thrips.

The entomopathogenic fungus, *Metarhizium anisopliae*, is probably one of the more promising biological controls for thrips control. When spores land on a thrips, they break through the insect's exterior to the inside, using enzymes and mechanical force. The insect dies within a few days. Presently, there are no commercially available formulations of this pathogen.

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