Western Flower Thrips

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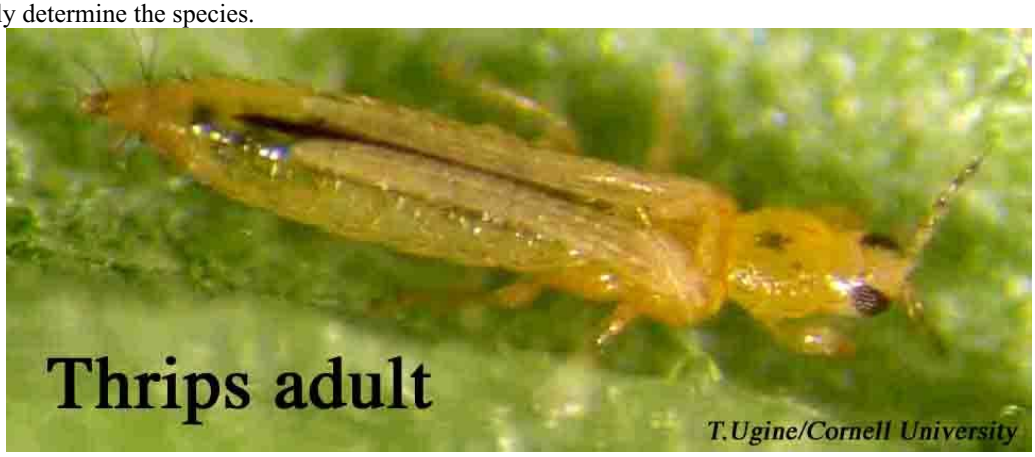
Introduction. Several species of thrips can infest greenhouse floral crops, but the most severe and common pest in recent years has been the western flower thrips (WFT), *Frankliniella occidentalis*.

Damage. Feeding by these tiny insects causes plant cells to collapse, which may eventually result in distorted leaves or flowers if the damage was done while the thrips were feeding within buds and terminals, or scarred, silvery patches and flecking if the damage is to open foliage or petals. The damaged patches on expanded leaves and petals will also have tiny greenish-black fecal specks that are left by the thrips. They also damage the appearance of African violets by spreading pollen over the flowers as they feed on and break open the pollen sac. The thrips' feeding can also transmit one of the two incurable tospoviruses that cause severe damage to greenhouse plants, if the thrips are carrying the virus. Both the thrips and the viruses have a very wide host range including flowers, vegetables, and many weeds. The most dramatic virus problems in U.S. greenhouses have been due to Impatiens Necrotic Spot Virus (INSV). This virus is usually the one causing problems on impatiens, New Guinea impatiens, begonia, cyclamen, cineraria and gloxinia, as well as many other plants. Tomato Spotted Wilt Virus (TSWV) is being found less often than INSV, and is likely to be introduced to the greenhouse by thrips that have matured on outdoor weeds. TSWV has also been found fairly often in tuberous dahlias. ELISA tests are available at labs to detect and differentiate these two viruses; QTA-Tospo kits (Agdia, Inc, Elkhart, IN) will tell whether you have a tospovirus, but not which one. One viruliferous western flower thrips adult can infect a plant after feeding on it for only 30 minutes. Western flower thrips acquire the virus as first instar larvae, and retain it for the remainder of their lives. Because the immature stages usually remain on one plant and do not move to other plants, most of the spread of the virus is by the adult stage as they fly or are carried by wind currents.

Identification. Thrips are tiny insects; adults are 1-2 mm in length, with narrow bodies and fringed wings. Colors of western flower thrips can vary from straw-yellow to brown. Some fairly uncommon thrips species can be identified by using a handlens and noting differences in color, shape, size, and other characters, but is not possible to accurately identify which flower thrips (i.e., Frankliniella sp.) species is infesting a crop while in the greenhouse, even with a handlens. Differences in tiny morphological structures in the adult female flower thrips are used to tell one species from another. Therefore, adult flower thrips must be inspected under a compound microscope to accurately determine the species.



Biology. Control of western flower thrips is extremely difficult due to several biological characteristics of this species. Eggs of this species are inserted into leaf, stem, or petal tissue, and are thus protected from insecticides. The egg stage lasts from 2-1/2 to 4 days. The eggs hatch into larvae, which usually remain protected in flower buds or terminal foliage. This is the stage that can acquire INSV. The insect passes through two larval stages, both of which feed in these protected areas. The first larval stage lasts 1 to 2 days, the second larval stage lasts 2 to 4 days. Toward the end of the second larval stage, the insect stops feeding and usually drops into the soil or leaf litter to pupate. The insect passes through two "pupal" stages (prepupal and pupal), during which no feeding and little movement occurs. The prepupal stage lasts 1 to 2 days, and the pupal stage lasts 1 to 3 days. While in the pupal stage in the soil, the insect escapes exposure to insecticides directed at the foliage. The adults, which can survive from 13 to 75 days and lay 40 to 250 eggs (depending on temperature, host plant), are also primarily found feeding in protected areas of the plant such as flowers and terminals. The pest's rapid developmental time (egg to adult in 10 to 15 days at fluctuating temperatures between 76 and 86°F) and reproductive rate, in these protected areas, can allow an undetected infestation to quickly become a major problem. At cool temperatures, immature development takes much longer (at 54°F, egg to adult development takes 57 days) and an infestation may escape detection because most of the population may be in immature stages with very few adults. They fly readily (although they are not strong fliers) and can be carried on wind currents, or on clothing, to greenhouses near an infestation. They can fly from a sprayed to an unsprayed area, or can move into or out of a greenhouse through doors or vents. Flight activity may be greatly reduced at cool temperatures (ca. 55°F or lower). Effective chemical control is further

complicated by the problem of insecticide resistance. Resistance to certain organophosphate, carbamate, and synthetic pyrethroid insecticides has been documented in certain western flower thrips populations.

Management. Thrips control should start at the end of the previous crop or season, to avoid harboring a sizeable population between crops. In extreme cases, it may be justified to keep some or all greenhouse ranges empty for a time, to greatly reduce or thoroughly eliminate a thrips infestation before the next crop cycle begins. This is best done in the winter, when thrips movement from outdoors is not a problem. All plant material, including all weeds, must be eliminated from the greenhouse, so there is absolutely no food for the thrips. Then, the greenhouse should be kept warm so that the soil temperature is about 60F for about two weeks, to cause any thrips pupae in the soil to finish their develop and emerge as adults into a greenhouse without food. This fallow period procedure is undoubtedly very expensive, but may be justified in extreme cases.

For virus management, keep plants which are propagated from cuttings separate from plants grown from seed. The disease frequently enters the greenhouse within vegetatively propagated plant material. Inspect incoming plant material for tell-tale signs of thrips feeding injury. If the thrips may be entering from outside sources, consider screening the vents. Use yellow (or blue) sticky traps to monitor for Western flower thrips in the greenhouse. Count and change traps weekly, noting upward population trends that signal the need for treatment. More than 10 thrips per trap per week is a threshold value some growers have found useful, but growers should evaluate this threshold under their own conditions, because the threshold will be affected by many factors including the trap color, size, location, number of traps per sq. ft., crop, and presence of INSV or TSWV, to name a few. Greenhouse workers should avoid wearing yellow or blue so that thrips are less likely to be spread on workers' clothing. Avoid spreading the pest by moving from a greenhouse with a noticeable thrips infestation into one that is not yet infested. This may require a change in the usual movement patterns of greenhouse workers. Likewise, avoid moving plants that are infested into an uninfested greenhouse, or vice versa. Eliminate weeds, which may harbor thrips and/or the virus (they don't always show virus symptoms). Because thrips prefer flowers and their populations tend to "explode" with the onset of flowers, flower removal, whenever feasible, can remove a substantial portion of a thrips infestation.

Schedule insecticide treatments to best target the susceptible stages of the thrips' life cycle. For many, though not all insecticides, it is effective to use a 5-day treatment interval for 2-3 treatments, in order to have an effect on thrips that will hatch from eggs or emerge from pupae soon after the initial insecticide application. Read and follow all label directions. Ideally, insecticides should be applied with equipment that produces very small spray particles (<100 microns). Spray particles of this size are best because they will penetrate deep into the protected areas of the plant where the thrips are found, and can provide the most efficient use of insecticide if coverage is thorough. Rotating the use of insecticides from different chemical classes may be an effective way to delay the problem of insecticide resistance. However, it is best to maintain the use of an effective insecticide for more than one generation of a pest before rotating to another insecticide. Given the duration of the lifecycle of western flower thrips, an effective insecticide should be used, as needed, for 3 to 4 weeks before switching to an insecticide from another class of chemicals.

Immediately discard plants showing distinctive TSWV/INSV symptoms. Discarding a few may prevent an epidemic through all the susceptible plants in the greenhouse. Generic symptoms of TSWV/INSV include yellow or brown ring spots, round brown spots, brown or black stem sections, and black or brown necrosis at the base of the leaf. Many other symptoms are possible: submit unusual symptoms to a lab for diagnosis, or use a QTA-Tospo kit. These viruses have a very large host range; of the major greenhouse crops; only roses are not known to be affected by TSWV. There have been no significant tospovirus problems encountered as yet on zonal geranium or poinsettia crops. Keep in mind that plants may act as reservoirs of the virus. Flowering pot plant crops such as cyclamen or holiday cactus might serve to carry the disease over from the fall to the following bedding plant season, as might weeds left under the benches, or just outside the greenhouse. Use indicator plants to monitor for TSWV/INSV and thrips feeding. Use petunias or use fava beans.

Research on biological control of western flower thrips is being conducted in many laboratories world-wide. An insect-killing fungal pathogen, *Beauveria bassiana*, is available in the U.S. as BotaniGard or Naturalis-L. Two commercially available species of tiny predaceous mites, *Neoseiulus cucumeris* and *Iphiseius degenerans*, are available for thrips control. Because these mites can only kill first instar thrips, there must be many more mites than thrips for control to be successful. Such high populations of these predaceous mites may be achieved by weekly releases, or by the use of "slow-release" bags or sachets, or possibly by providing a source of pollen as food for the mites. Another predaceous mite, *Hypoaspis miles*, can be released and established in the soil/growing medium. *Hypoaspis* is a general predator of arthropods in the soil, including thrips pupae. *Hypoaspis* does not usually travel to the foliage. Some growers have reported success with the combination of *Hypoaspis* and *Neoseiulus cucumeris*. Research with the predaceous minute pirate bug (*Orius spp.*) is also being done, but success with *Orius* is crop-specific and more often reported from certain greenhouse vegetables than ornamentals. However, recommendations for biological control of thrips on commercial flower crops have yet to be fully developed.