

THRIPS

Integrated Pest Management for Home Gardeners and Landscape Professionals

Thrips, order Thysanoptera, are tiny, slender insects with fringed wings. They feed by puncturing the epidermal (outer) layer of host tissue and sucking out the cell contents, which results in stippling, discolored flecking, or silvering of the leaf surface (Figures 1 and 2). Thrips feeding is usually accompanied by black varnishlike flecks of frass (excrement) (Figure 2). Pest species are plant feeders that discolor and scar leaf, flower, and fruit surfaces, and distort plant parts or vector plant pathogens. Many species of thrips feed on fungal spores and pollen and are often innocuous. However, pollen feeding on plants such as orchids and African violets can leave unsightly pollen deposits and may reduce flower longevity. Certain thrips are beneficial predators that feed on other insects and mites.

Thrips can readily move long distances floating with the wind or transported on infested plants, and exotic species are periodically introduced. For example, myoporum thrips causes severe galling of *Myoporum laetum* and *M. pacificum* (Figure 3). Originally from New Zealand, this thrips was introduced into Southern California and spread to most areas of the state where its hosts are grown. See *Pest Note: Myoporum Thrips* for more information.

IDENTIFICATION

Most adult thrips are elongate, slender, minute (less than 1/20 inch long), and have long fringes on the margins of both pairs of their long, narrow wings (Figures 4 and 5). Immatures (called larvae or nymphs) are oblong or slender and elongate and lack wings. Most thrips range in color from translucent white or yellowish to dark brown or black. A few species are brightly colored, such as the distinctive reddish-

orange larvae of the predatory thrips, *Frankliniopsis orizabensis* and *F. vespiformis*.

Feeding results in various tissue responses, including scar formation and distorted growth. Behavior, body appearance, and host plants help to distinguish among thrips species (Table 1 and Figure 11). For example, three dark spots on each forewing distinguish the adult predaceous sixspotted thrips from pest thrips. Adults of western flower thrips and onion thrips are noticeably larger than avocado and citrus thrips adults, so mature body size helps to distinguish them when they occur together on the same host plant. Nonprofessionals may be able to identify thrips using the resources listed in References. However, thrips can be positively identified to species only by an expert. Fortunately, most thrips are susceptible to some of the same controls, such as exclusion and certain insecticides.

It is more important to distinguish among thrips species in situations where integrated pest management methods are used. For example, each species of natural enemy preys on and helps to control only certain species of thrips or other pests. Certain thrips occur on many different plants but damage only a few of the plant species on which they are found. Identifying the species of thrips may reveal that it is harmless in certain situations and no control action is needed. For example, avocado thrips and greenhouse thrips superficially scar avocado fruit skin. Citrus thrips and western flower thrips are also found in avocado but do not damage avocados. Citrus thrips occur on many species of plants but damage only blueberries and citrus.



Figure 1. Silvering caused by greenhouse thrips feeding. (J.K. Clark)



Figure 2. Black feces and white feeding scars from western flower thrips. (J.K. Clark)



Figure 3. Myoporum shoots galled by myoporum thrips. (D. Rosen)



Figure 4. An adult, egg, and two larvae of Cuban laurel thrips. (J.K. Clark)

PEST NOTES

University of California

Agriculture and Natural Resources

Statewide Integrated Pest Management Program

Publication 7429

May 2014

LIFE CYCLE

Thrips hatch from an egg and develop through two actively feeding larval stages and two nonfeeding stages, the prepupa and pupa, before becoming an adult (Figure 5). Late-instar larvae change greatly in appearance and behavior and are called prepupae and pupae, even though thrips do not have a true pupal stage.

Females of most plant-feeding species lay their elongate, cylindrical to kidney-shaped eggs on or into leaves, buds, or other locations where larvae feed. The pale prepupae and pupae of most species drop to the soil or leaf litter or lodge within plant crevices or galls. Greenhouse thrips pupate openly on lower leaf surfaces; while pupae (and eggs) of some gall-making species, such as Cuban laurel thrips and myoporum thrips, occur on leaf surfaces but are enclosed within distorted plant tissue. Thrips have several generations (up to about eight) a year. When the weather is warm, the life cycle from egg to adult may be completed in as short a time as 2 weeks.

DAMAGE

Thrips feeding on plants can damage fruit, leaves, and shoots and very noticeably affect plants' cosmetic appearance. However, thrips rarely kill or threaten the survival of trees and shrubs. Herbaceous ornamentals, and certain vegetable crops, are more susceptible to serious injury from thrips feeding and thrips-vectored viruses, especially when plants are young.

Thrips feeding can stunt plant growth and cause damaged leaves to become papery and distorted, develop tiny pale spots (stippling), and drop prematurely. Infested terminals may discolor and become rolled. Petals may exhibit "color break," which is pale or dark discoloring of petal tissue that was killed by thrips feeding before buds opened. On some plants thrips can cause severe stunting to the early season flush of terminal growth. Cuban laurel thrips create tightly rolled, podlike leaf terminals on *Ficus* and form galled foliage from midsummer through fall.

Myoporum thrips can create tightly bunched and twisted terminal growth that resembles a gall, within which large numbers of thrips can survive and reproduce (Figure 3).

Western flower thrips is primarily a pest of herbaceous plants; but high populations can damage flowers on woody plants, such as roses. Rose petals may develop dark streaks and spots from feeding injury that occurred before the buds opened, or the flower buds may deform and fail to open. Western flower thrips also vectors *Impatiens necrotic spot virus* and *Tomato spotted wilt virus*, which can severely damage or kill certain vegetable crops and herbaceous ornamentals.

Thrips cause brown to silvery, scabby scarring on the avocado and citrus fruit surface but do not harm the internal quality or flavor of the fruit. Where thrips lay eggs on grapes, fruit may develop dark scars surrounded by lighter "halos." Thrips feeding on apples, nectarines, and raspberries can deform or scar developing fruit. Citrus thrips feeding severely distorts blueberry shoot tips and foliage, reducing fruit yield.

In many thrips species, by the time their damage is observed, such as after buds open, the thrips may no longer be present. Some abiotic disorders, pathogens, and certain other invertebrates can cause damage resembling that of thrips. For example, various true bugs and mites also stipple foliage; and some true bugs produce dark fecal specks. Before taking control action, look carefully for the insects themselves to be certain that pest thrips are present and the cause of the damage.

MANAGEMENT

Thrips are difficult to control. If management is necessary, use an integrated program that combines the use of good cultural practices, natural enemies, and the most selective or least-toxic insecticides that are effective in that situation.

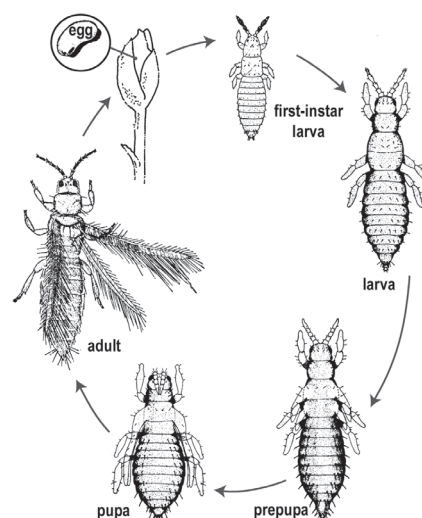


Figure 5. Life cycle and stages of thrips.

Monitoring

If thrips are a suspected cause of plant damage, thrips adults and larvae can be monitored by branch beating or gently shaking foliage or flowers onto a light-colored sheet of paper, beating tray, or small cloth (Figure 6). For thrips that feed in buds or unexpanded shoot tips, clip off several plant parts suspected of harboring thrips, place them in a jar with 70% alcohol (ethanol), and shake vigorously to dislodge the thrips. Strain the solution through filter paper so thrips can more readily be seen. Watch the online video demonstration of this technique at <https://www.youtube.com/watch?v=j0v6RfRKjHM&feature=youtu.be>.

Adult thrips can also be monitored by hanging bright yellow sticky traps in or near host plants (Figure 7).



Figure 6. Shaking foliage over paper to dislodge and detect thrips. (D. Rosen)

Be aware that the presence of thrips does not mean that damage will result from their feeding. Large numbers of thrips in traps, or adults in flowers feeding on pollen, do not necessarily indicate that control action is needed. Plants suspected of being infected by thrips-vectored viruses can be reliably diagnosed only by sending properly collected samples from symptomatic plants to a laboratory that tests for plant pathogens.

Biological Control

Predatory thrips (Table 2), green lacewings, minute pirate bugs, mites, and certain parasitic wasps help to control plant-feeding thrips. To conserve and encourage naturally occurring populations of these beneficials, avoid creating dust and consider periodically rinsing dust off of small plants, avoid persistent pesticides, and grow a diversity of plant species.

Where thrips are a problem, learn whether that pest has specific natural enemies important in its control. For example, a minute pirate bug, *Macrotracheliella nigra*, and green lacewing larvae are important predators of Cuban laurel thrips. *Euseius* species mites are important predators of citrus thrips (Figure 8). With greenhouse thrips in Southern California up to 50% of its eggs are killed by a tiny wasp, *Megaphragma mymaripenne*. After feeding inside during its larval stage then pupating, the emerging adult parasite leaves a relatively large round hole in the tiny thrips egg. Conversely, when a greenhouse thrips emerges from an unparasitized egg, part of the egg shell is often visible at the side of the egg blister. *Thripobius semiluteus* parasitizes greenhouse thrips larvae. Thrips parasitized by this wasp's larvae become swollen around the head and turn black, in contrast to the pale color of unparasitized greenhouse thrips larvae (Figure 9). Unlike healthy black mature thrips, the black parasitized larvae are smaller and do not move.

There is little research-based information on the effectiveness of releasing thrips natural enemies in gardens and landscapes. Releasing purchased

natural enemies, in most situations, is unlikely to provide satisfactory thrips control.

Cultural Control

Thrips species that feed on many different plant species often move into gardens and landscapes when plants in weedy areas or grasslands begin to dry in spring or summer. Avoid planting susceptible plants next to these areas, and control nearby weeds that are alternate hosts of pest thrips. Grow plants that are well-adapted to conditions at that site. For example, plants adapted to grow in full sun can be stressed when planted in shady conditions and may be more susceptible to thrips damage. Provide appropriate cultural care to keep plants vigorous and increase their tolerance to thrips damage. Keep plants well irrigated, and avoid excessive applications of nitrogen fertilizer, which may promote higher populations of thrips. Old, spent flowers can harbor thrips, so their removal and disposal is sometimes recommended. However, the general benefit of this practice in landscapes is unknown; and old blossoms also commonly shelter beneficial predators of thrips.

Investigate the availability of resistant cultivars. For example, western flower thrips more often damages fragrant, light-colored, or white roses. Rose cultivars, with sepals that remain tightly wrapped around the bud until just before blooms open, have fewer thrips problems. Where Cuban laurel thrips is a problem on Indian laurel fig you can plant *Ficus microcarpa*, "Green Gem," which is mostly resistant to this pest.

Pruning. Prune and destroy injured and infested terminals when managing a few small specimen plants in the landscape. Avoid shearing plants, which is the clipping of dense foliage to maintain an even surface on formal hedges or creating specific shapes (topiary). Shearing stimulates thrips-susceptible new growth. Prune by cutting plants just above branch crotches and nodes instead of shearing off terminals.



Figure 7. Covering a yellow sticky trap with clear plastic so thrips it captures can be examined later. (J.K. Clark)



Figure 8. *Euseius* predatory mite eating a citrus thrips larva. (J.K. Clark)



Figure 9. Adult parasitic wasp (right), black parasite pupae, and yellow greenhouse thrips larvae. (J.K. Clark)

Prune during specific times of the year to help control certain thrips. Prune off galled, rolled terminals of Indian laurel fig during winter to greatly reduce thrips damage the next summer. Relatively few Cuban laurel thrips can survive the winter outside of the protection provided by the leaves they gall. Instead of pruning avocado during February through April, January pruning may reduce thrips scarring of fruit. January pruning can induce additional avocado growth flush during May fruit set and reduce thrips scarring of fruit. When succulent foliage is abundant in spring thrips tend to remain and feed on leaves and not move to fruit. Pruning the interior of citrus trees can increase predaceous mite populations in the exterior canopy, thereby reducing fruit scarring by citrus thrips.

Row Covers. Row covers, hot caps, and other types of cages with a fine mesh can exclude thrips and other insects from vegetables and other young herbaceous plants (Figure 10). Apply row covers before crops emerge or to pest-free plants during planting. Plants are normally covered or caged only while they are young and most susceptible to damage. Once plants become larger or temperatures get warmer, remove covers to provide enough growing space and to prevent overheating. Drip or furrow irrigation is generally necessary when using row covers.

Any type of covering that excludes insects but allows light and air penetration can be used. With sturdy crops that do not grow too tall, floating row covers (vented polyethylene, spun-bonded polyester, point-bonded polypropylene) can be placed on top of beds with no frames or hoops. The crop itself lifts the fabric as it grows. For plants that grow upright or have sensitive tips that might be damaged when pushing against covers, use hoops, plastic tunnels, or wire strung between posts to hold up covers. Wood, wire, or plastic frames covered with muslin, nylon, or other fine mesh can be used for several years.

Reflective Mulch. Mulch or mesh that reflects light interferes with certain flying insects' ability to locate plants. If the plants are initially pest-free, and relatively small in comparison with the surface area that is covered with reflective material, reflective mulch can delay or reduce the extent to which young plants become infested by winged aphids and adult leafhoppers, thrips, and whiteflies. In flower and vegetable crops that are especially sensitive to insect-vectored viruses, the cost and effort of using reflective mulch may be justified; because the mulch can be significantly more effective than insecticides in preventing or delaying infection of small plants. As plants grow larger, reflective mulch becomes increasingly less effective and other management methods may be needed. Reflective mulch ceases to repel insects by the time the plant canopy covers more than about half of the soil surface.

Silver or gray is the most effective color for synthetic reflective mulch or mesh, but white also works. Some organic mulches (e.g., straw) and living mulches (e.g., interplanting the crop with buckwheat, *Fagopyrum esculentum*) may also repel certain pests, but this is not as well documented. Commercially available synthetics include aluminum-metalized polyethylene and silver-embossed polyethylene plastic films. If handled carefully, these may be used for more than one season. Aluminum foil is also effective and may be suitable for a small garden; but it is expensive and difficult to reuse because it is delicate to handle.

Synthetic mulch application methods include:

- Transplant seedlings through holes in the mulch.
- Apply the mulch before plants emerge from the soil and leave a narrow, mulch-free strip along the planting row.
- Lay lightweight material that allows light and air penetration over the top of a crop that is sturdy enough to lift the material as it grows.

In addition to temporarily repelling certain flying insects, mulch may improve growth of certain crops by increasing light levels, keeping soil warmer overnight, reducing weed growth, and conserving soil moisture. Mulch can also have negative effects. It can increase crop susceptibility to root diseases, prevent the use of overhead watering, and make it more difficult to know whether you are maintaining proper soil moisture in the rooting zone of a plant. Most recyclers will not accept plastics with soil on them; therefore, plastic mulches typically are disposed of in landfills. Investigate which material and methods are likely to work best in your situation.

Chemical Control

Although thrips damage is unsightly, it does not usually warrant the use of insecticides in gardens and landscapes. Feeding injury typically does not become apparent until after tissue grows and expands. Thus, by the time

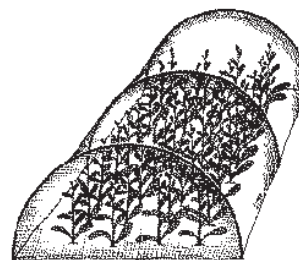


Figure 10. Wires or plastic hoops hold up screening that excludes insects from small plants.

damage is noticed on ripening fruit or distorted terminals, the thrips that caused the damage are often gone. No pesticide application will restore the appearance of injured tissue; plants will remain damaged until leaves drop, injury is pruned off, or new unblemished fruit is produced. Where plant viruses are a problem, insecticides typically do not kill thrips fast enough to prevent the transfer of virus from thrips to plants. Using row covers or other methods to prevent thrips infestation is the most effective way to prevent infection by thrips-vectored viruses.

Thrips can be difficult to control effectively with insecticides, partly because of their mobility, feeding behavior, and protected egg and pupal stages. Improper timing of application, failure to treat the proper plant parts, and inadequate spray coverage when using contact materials are common mistakes that can prevent potentially effective insecticides from actually providing control. Before using a pesticide, learn more about the biology of your pest species and the characteristics of available products by reading the label and consulting the *Active Ingredients Database* in the online version of this Pest Note at www.ipm.ucanr.edu. Often you will learn chemical control cannot be effective until the next season, when new plant growth develops. Certain products are available only by hiring a professional applicator. If insecticides are used, combining their use with appropriate cultural practices and other methods usually improves the pest control.

Insecticides Most Compatible with IPM. Contact insecticides that do not leave persistent residues can be effective for greenhouse thrips and other species that feed openly on plants. These products have low toxicity to people, pets, and pollinators and relatively little adverse impact on biological pest control; because they do not leave toxic residues that would kill natural enemies migrating in after their application. Contact insecticides include azadirachtin (AzaMax, Safer Brand BioNeem), insecticidal soaps (Safer), narrow-range oil (Bonide Horticultural Oil, Monterey Horticultural Oil), neem oil (Green Light Neem, Schultz Garden Safe Brand Neem Oil), and pyrethrins, which many products combine with piperonyl butoxide (Ace Flower & Vegetable Insect Spray, Garden Tech Worry Free Brand Concentrate). To be effective, contact sprays must be applied to thoroughly cover buds, shoot tips, and other susceptible plant parts where thrips are present. On plants with a history of unacceptable damage, begin treatment early when thrips or their damage is first observed. Unless directed otherwise by the product label, periodically repeat the application as long as pest thrips and susceptible plant parts are both present.

Spinosad (Captain Jack's Deadbug Brew, Green Light Lawn & Garden Spray with Spinosad 2, Monterey Garden Insect Spray) is generally more effective against thrips than the products above. Spinosad lasts 1 week or more and moves short distances into sprayed tissue (has translaminar activity) to reach thrips feeding in protected plant parts. Adding horticultural oil to the spray mix can increase its persistence within plant tissue. This insecticide is a fermentation product of a naturally occurring bacterium, and certain formulations are organically acceptable. Spinosad can be toxic to certain natural enemies (e.g., predatory mites, syrphid fly larvae) and bees when sprayed and for about 1 day afterward; do not apply spinosad to plants that are flowering.

Insecticides More Toxic to Thrips and Beneficial Insects. Systemic insecticides are absorbed by one plant part

(e.g., roots) and moved (translocated) to other plant parts. Trunk spray or injection of an effective, systemic, neonicotinoid insecticide can provide relatively rapid control. With soil drench or injection, there is a longer time delay between neonicotinoid application and insecticide action. Neonicotinoids vary in effectiveness for thrips control. For example, dinotefuran (Safari), available to professional applicators, can provide good control of thrips. Imidacloprid (Bayer Advanced Tree & Shrub Insect Control, Merit) commonly fails to provide satisfactory thrips control, and imidacloprid generally is not recommended for thrips.

Neonicotinoids have low, moderate, or severe adverse impact on natural enemies and pollinators varying with the product, situation, and the species and life stage of invertebrate. Neonicotinoid insecticides can translocate to flowers and may harm natural enemies and pollinators that feed on nectar and pollen. Delay systemic insecticide application until after plants have completed their seasonal flowering, unless the product label directs otherwise. Where the roots of nearby plants grow near treated plants, those other plants may also take up some of the soil-applied insecticide. Delay soil application, when possible, until after the nearby plants are also done flowering.

To avoid tree injury and potential spread of pathogens on contaminated tools, use a soil application or trunk spray whenever possible, instead of injecting or implanting trees with insecticide. Injecting or implanting trunks or roots injures trees, and it is difficult to repeatedly place insecticide at the proper depth. If injecting or implanting multiple trees, prevent the potential spread of pathogens on contaminated tools; before moving to work on each new tree, scrub any plant sap from tools or equipment that penetrate trees and disinfect them with a registered disinfectant (e.g., bleach). Avoid methods that cause large wounds, such as implants placed in holes drilled in trunks. Do not implant or inject roots or trunks more than once a year.

Insecticides to Avoid. The systemic organophosphate acephate (Lilly Miller Ready-to-Use Systemic, Orthene) is available for ornamental, nonfood plants. Avoid using it. Acephate can be highly toxic to natural enemies and pollinators and can cause spider mites to become abundant and damage plants after its application.

Avoid foliar sprays of other organophosphate insecticides (e.g., malathion), carbamates (carbaryl), or pyrethroids (e.g., bifenthrin, cyfluthrin, fluvalinate, and permethrin). These materials are highly toxic to natural enemies and pollinators, can cause spider mite outbreaks, and are not particularly effective against most thrips. Because their use in landscapes and gardens can run or wash off into storm drains and contaminate municipal wastewater, these insecticides are being found in surface water and are adversely affecting non-target, aquatic organisms.

Greenhouse Thrips Management

Greenhouse thrips can infest many plant species but primarily is a pest of evergreen, broadleaved perennials. It occurs mainly on the underside of leaves and on fruit clusters or other plant parts that touch each other. Greenhouse thrips is sluggish and the adults tend not to fly. Individuals feed in groups and populations usually begin in a limited part of the plant and spread slowly. If the underside of leaves on susceptible plants are regularly inspected to allow early detection and removal of new infestations, pruning off colonies can be effective.

Greenhouse thrips is readily controlled with thorough application of contact sprays such as horticultural oil, natural pyrethrins (plus piperonyl butoxide), or insecticidal soaps to the underside of infested leaves. Repeat applications may be necessary. Keep in mind that greenhouse thrips have natural enemies in the landscape (discussed above). Assess whether spraying is warranted and select materials that are least toxic to natural enemies.

Table 1. Some Common Pest Thrips and Their Host Plants.

Thrips			Appearance ¹		
Common Name	Scientific Name	Host Plants	Primary Damage	Adults	Larval Body
avocado thrips	<i>Scirtothrips perseae</i>	avocado	scabby brown scars on fruit	3 red spots atop head, brown lines separating segments on pale yellow abdomen	pale yellow
bean thrips	<i>Caliothrips fasciatus</i>	bean, occasionally other legumes	brown, distorted leaf and seedling terminals	blackish body with white wing bands	yellow to orangish
citrus thrips	<i>Scirtothrips citri</i>	blueberries and citrus, generally not damaging to its many other hosts	scabby silvery scars on citrus fruit; distorted blueberry leaves and shoots	light orangish yellow to white body	light orangish yellow to white
Cuban laurel thrips	<i>Gynaikothrips ficorum</i>	laurel fig or Indian laurel, <i>Ficus microcarpa</i>	rolled, podlike, dark-scarred terminals; galls	blackish body	yellowish to white
greenhouse thrips	<i>Heliethrips haemorrhoidalis</i>	mostly perennials with thick, broad leaves, including avocado, azalea, hypericum, laurel (English and Grecian), photinia, and rhododendron	leaves bleached with black excrement on undersides; scabby fruit	black body with pale wings	white to yellowish
myoporum thrips	<i>Klambothrips myopori</i>	<i>Myoporum laetum</i> , <i>M. pacificum</i>	leaves swollen, curled, and distorted; terminals galled	black body	early instars are white to yellowish, pupae are orangish
onion thrips	<i>Thrips tabaci</i>	vegetables including garlic, onion, and pepper; many herbaceous ornamentals where it's usually not damaging	stippled and scarred petals, leaves, and other plant parts; distorted terminals	yellow to dark brown body	yellow to orangish
toyon thrips	<i>Liothrips illex</i>	Christmas berry or toyon	crinkled, undersized, sometimes blackened terminal leaves	black body with pale wings	yellow
western flower thrips	<i>Frankliniella occidentalis</i>	many herbaceous ornamentals (impatiens, petunia); vegetables (cucurbits, pepper); fruits (grape, strawberry); some shrubs and trees (rose, stone fruit)	stippled and scarred petals, leaves, and other plant parts; distorted terminals, vectors tospoviruses affecting herbaceous plants	thick, bristlelike hairs at the tip of the abdomen; abdomen extends beyond wing tips at rest; individuals vary greatly in color	yellow to orangish

¹ Color does not reliably distinguish among thrips, which can be accurately identified to species only by an expert examination of microscopic characters.

Table 2. Some Common Beneficial Predatory Thrips.

Thrips		Appearance		
Common Name	Scientific Name	Where observed	Adults	Larvae
banded-wing thrips	<i>Aeolothrips spp.</i> ¹	among pest mites and thrips	black body, white wings with black bands	yellow body
black hunter thrips	<i>Haplothrips mali</i> ²	among mites, scales, and pest thrips	dark brown or entirely black body with long abdomen, white wings, much more active than similar-looking greenhouse thrips	dark, reddish-brown body
<i>Franklinothrips</i> or vespiform thrips	<i>Franklinothrips orizabensis</i> , <i>F. vespiformis</i> ¹	among lace bugs, mites, and pest thrips	mostly black body, with pale or white areas; distinctly narrow where abdomen meets thorax	yellow to orange body, swollen abdomen with red or dark orange band, body more stout or oval-shaped than most thrips
sixspotted thrips	<i>Scolothrips sexmaculatus</i> ³	in colonies of mites	3 dark blotches on each forewing, body pale to yellowish	yellow to whitish body
Predatory thrips can sometimes be distinguished from pest species because predators are seldom seen at high levels as can be common with certain pest thrips.				

Families: ¹ Aeolothripidae; ² Phlaeothripidae; ³ Thripidae

Figure 11. Pest Thrips and Their Damage. (All photos taken by J.K. Clark unless otherwise noted.)**REFERENCES**

- Bethke, J. A., and L. Bates. 2013. *Pest Notes: Myoporum Thrips*. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 74165. Available online at www.ipm.ucanr.edu/PMG/PESTNOTES/pn74165.html.
- Dreistadt, S. H., J. K. Clark, and M. L. Flint. 2001. *Integrated Pest Management for Floriculture and Nurseries*. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 3402.
- Dreistadt, S. H., J. K. Clark, and M. L. Flint. 2004. *Pests of Landscape Trees and Shrubs: An Integrated Pest Management Guide*. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 3359.
- Flint, M. L. 1998. *Pests of the Garden and Small Farm: A Grower's Guide to Using Less Pesticide*. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 3332.
- Hoddle, M. S., L. A. Mound, and D. Paris. 2008. *Thrips of California 2012* (CD-ROM). Australia: The University of Queensland. Available online at http://keys.lucidcentral.org/keys/v3/thrips_of_california/Thrips_of_California.html.
- Hodges, A., S. Ludwig, L. Osborne, and G. B. Edwards. 2009. *Pest Thrips of the United States: Field Identification Guide*. USDA-CSREES Regional Integrated Pest Management Centers. Available online at https://firstdetector.org/pdf/chili_thrips_deck.pdf.
- Moritz, G., C. A. O'Donnell, and M. Parrella. 2009. *Pest Thrips of North America - associated with domestic and imported crops*. Centre for Biological Information Technology, The University of Queensland. DVD ISBN 978-1-86499-940-2.

AUTHORS: J. A. Bethke, UC Cooperative Extension (UCCE), San Diego Co.; S. H. Dreistadt, UC Statewide IPM Program, Davis; and L. G. Varela, UC Statewide IPM Program and UCCE Sonoma Co.
(Revised from a previous edition by P. A. Phillips, UC Statewide IPM Program, Ventura Co. (retired) and C. A. O'Donnell, UC Davis.)

LINE DRAWINGS: Fig. 5 Adapted from Anonymous. 1952. The Yearbook of Agriculture: Insects. U.S. Dept. Agric. and McKenzie, H. L. 1935. Calif. Agric. Exp. Sta. Circ. 337; Fig. 10: C. Dewees.

TECHNICAL EDITOR: M. L. Flint
EDITOR: K. Beverlin

This and other Pest Notes are available at www.ipm.ucanr.edu.

For more information, contact the University of California Cooperative Extension office in your county. See your telephone directory for addresses and phone numbers, or visit http://ucanr.edu/County_Offices/.

University of California scientists and other qualified professionals have anonymously peer reviewed this publication for technical accuracy. The ANR Associate Editor for Pest Management managed this process.

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

This material is partially based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project Section 3(d), Integrated Pest Management.

Produced by UC Statewide
Integrated Pest Management Program
University of California, Davis, CA 95618-7774



University of California
Agriculture and Natural Resources

WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original, labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Pesticides applied in your home and landscape can move and contaminate creeks, rivers, and oceans. Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

Do not place containers containing pesticide in the trash or pour pesticides down the sink or toilet. Either use the pesticide according to the label, or take unwanted pesticides to a Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Household Hazardous Waste Collection site nearest you. Dispose of empty containers by following label directions. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

ANR NONDISCRIMINATION AND AFFIRMATIVE ACTION POLICY STATEMENT

It is the policy of the University of California (UC) and the UC Division of Agriculture & Natural Resources not to engage in discrimination against or harassment of any person in any of its programs or activities (Complete nondiscrimination policy statement can be found at <http://ucanr.edu/sites/anrstaff/files/183099.pdf>).

Inquiries regarding ANR's nondiscrimination policies may be directed to Linda Marie Manton, Affirmative Action Contact, University of California, Agriculture and Natural Resources, 2801 Second Street, Davis, CA 95618, (530) 750-1318.