



## Onion Thrips (*Thrips tabaci*)

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### What You Should Know

- Onion thrips are the most injurious insect pest to onions in Utah.
- Immature and adult thrips prefer to feed on young leaves in the inner neck of plants.
- Moderate to severe thrips feeding causes reduced bulb size.
- Insecticides are a major tool for their control, but thrips are prone to develop resistance.
- Long-term, sustainable management of thrips includes crop cultural practices, onion varietal resistance, biological control, and insecticide resistance management.

Onion thrips, *Thrips tabaci* (Order Thysanoptera, Family Thripidae), is a key insect pest in most onion production regions of the world. Immature and adult thrips feed with a punch-and-suck behavior that removes leaf chlorophyll causing white to silver patches and streaks (Fig. 1). Thrips populations increase rapidly under hot, arid conditions and can lead to economic crop loss. The early bulb enlargement stage of onion growth is the most sensitive to thrips feeding. Insecticides have been the primary tactic for their management; however, repeated applications often lead to resistance in the thrips population, suppression of natural enemies, and



Fig. 1. Thrips feeding injury appears as white to silvery patches and streaks on leaves.<sup>1</sup>



Fig. 2. Adult onion thrips have fringed or hairy wings and 7-segmented antennae.<sup>2</sup>

unsustainable management. Life history characteristics of onion thrips that enhance their pest status include a short generation time, high reproductive potential, asexual reproduction by females (parthenogenesis), and occurrence of protected, non-feeding life stages. Recent research has shown that the majority of onion thrips on a plant are in the non-feeding egg stage (60-75% of total population on an onion plant during late June to August), and thus, not exposed to insecticides and other suppressive tactics. Multi-pronged pest management strategies that boost onion plant health and tolerance to thrips, in addition to suppressing thrips densities, have proven the most sustainable and economically viable.

### HOSTS

Onion thrips have a broad host range that includes grasses and broadleaves. They are pests of agricultural crops, home gardens, landscapes, and greenhouses. Primary vegetable hosts include onion, garlic, leek, cabbage, cauliflower, bean, tomato, cucumber, and asparagus. Common field crop hosts include alfalfa, small grains, and cotton. They may cause damage to bedding plants and some flowers.

## LIFE HISTORY

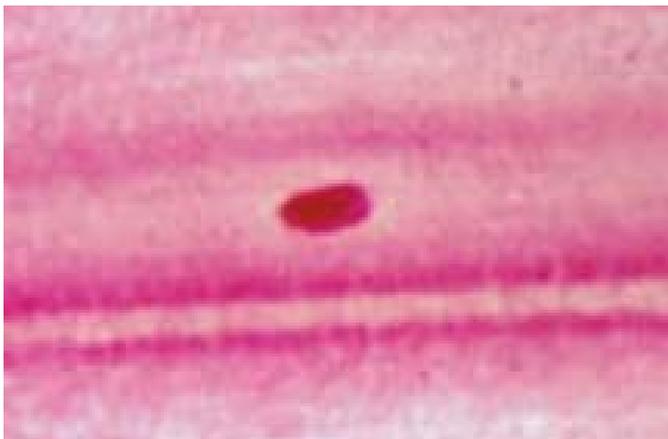
A complete generation requires 3-4 weeks during the summer months. Five to eight generations may occur each year.

### Adult - Overwintering, Dispersal, and Feeding Stage

- About 0.06 inch (1.5 mm) long; elongate, yellow and brown body with two pairs of fringed (hairy) wings (Fig. 2).
- Mouthparts are beak-like and antennae are 7-segmented.
- Spend the winter in protected sites under plants and debris in onion, alfalfa and small grain fields, and other plant habitats.
- In the spring when temperatures warm, adults fly to new onion fields.
- Parthenogenic (asexually reproducing) females; males are extremely rare.
- Feed on young leaves in center of onion neck and insert eggs individually into leaves.
- Fly readily when disturbed.
- Adult life span is about 1 month; pre-oviposition period (time before egg-laying begins) is 1 week and females will lay eggs for about 3 weeks.

### Egg - Protected, Non-Feeding Stage

- White to yellow; kidney-bean shaped; microscopic in size.
- Develop within leaf tissue with one end near the leaf surface (Fig. 3).
- Hatch in 5-10 days.



**Fig. 3.** Onion thrips egg stained pink with acid fuchsin within onion leaf.<sup>1</sup>

### Larva - Feeding and Non-Feeding Stages

- Instars I and II (0.02-0.04 inch; 0.5-1.0 mm in length) are active, feeding stages.



**Fig. 4.** Young larva is white to pale yellow in color with elongate body.<sup>3</sup>

- White to pale yellow; elongate and slender body (Fig. 4).

- Resemble adult, but without wings.

- Antennae are short and eyes are dark in color.
- Feed on new leaves in the center of the onion neck.
- Crawl quickly when disturbed.
- Require 10-14 days to develop.
- Instars III and IV (0.04-0.05 inch; 1.0-1.2 mm long) are inactive, non-feeding stages.
  - Also called pre-pupa and pupa.
  - Pale yellow to brown; body more stout than younger instars.
  - Antennae are bent to head; wing buds are visible.
  - Found in the soil, at the base of the onion plant neck, or underneath bulb scales.
  - Lasts 5-10 days.

## HOST INJURY

### Feeding Injury

Thrips prefer to feed on the newly emerged leaves in the center of onion necks. Under crowded conditions, they will move toward leaf tips to feed. Both adult and larval thrips feed within the mesophyll layer using a punch-and-suck motion. The mouthparts are beak-shaped with one enlarged mandible (tooth). The beak and mandible is thrust forward to puncture the leaf epidermis and sap released from injured plant cells is sucked up. Removal of chlorophyll causes the feeding area to appear white to silvery in color. Areas of leaf injury can occur as patches and streaks (Fig. 1). When feeding injury is severe, leaves take on a silvery cast and can wither (Fig. 5). Tiny black "tar" spots of thrips excrement are evident on leaves with heavy feeding injury.

### Plant and Bulb Damage

Water loss through the damaged leaf surface may cause stress and reduced plant growth. Feeding sites may allow entry of diseases, but under dry summer conditions typical of Utah, this is an uncommon concern. Onions are most sensitive to thrips injury during the rapid bulb enlargement phase that occurs in July and early August in northern Utah. Yield reduction due to reduced bulb size is the primary crop loss caused by onion thrips. Accelerated plant maturity and senescence due to thrips injury (Fig. 5) may truncate the bulb growth period. Following harvest and during storage, thrips may continue to feed on onion bulbs, causing scars that reduce quality and aesthetic appearance of bulbs.



**Fig. 5.** Heavy thrips feeding injury causes onions to wither and senesce early.<sup>1</sup>

## Vector Viruses

Onion thrips can vector plant viruses. Within the last 10 years, the introduction of iris yellow spot virus (IYSV, a tospovirus) into Utah and other western states has caused significant economic losses to the onion industry. IYSV causes lesions on onion leaves and flower scapes. Lesions are straw- to tan- colored, and spindle- to diamond-shaped (Fig. 6). Under some conditions, the disease may spread rapidly causing plants to senesce early and dramatically reduce bulb size. Onion thrips can also vector other viruses, such as tomato spotted wilt virus (TSWV) and impatiens necrotic spot virus (INSV), and although these can be economically important to greenhouse and nursery plants, they are not a concern on onions.



**Fig. 6.** Iris yellow spot virus (IYSV) spindle-shaped lesions on onion leaf.<sup>4</sup>

## OTHER PEST THRIPS ON ONION

Other species of pest thrips are found on onions in Utah. Of these, the western flower thrips (WFT), *Frankliniella occidentalis*, is the most common. Thrips surveys conducted in Utah onion fields since the 1990s have found WFT numbers to be 10 to 100 times lower than onion thrips. WFT is slightly longer (0.08 inch or 2.0 mm) and darker yellow than onion thrips (Fig. 7). Viewed through a microscope, WFT can be distinguished from onion thrips by its 8-segmented antennae and longer setae (hairs) on the segment just behind the head (prothorax). WFT reproduces sexually; males and females are common. WFT densities in onion are higher in the late summer, especially on plants that have bolted and produced seed. In Utah, WFT are much less important to onion crop damage than onion thrips.



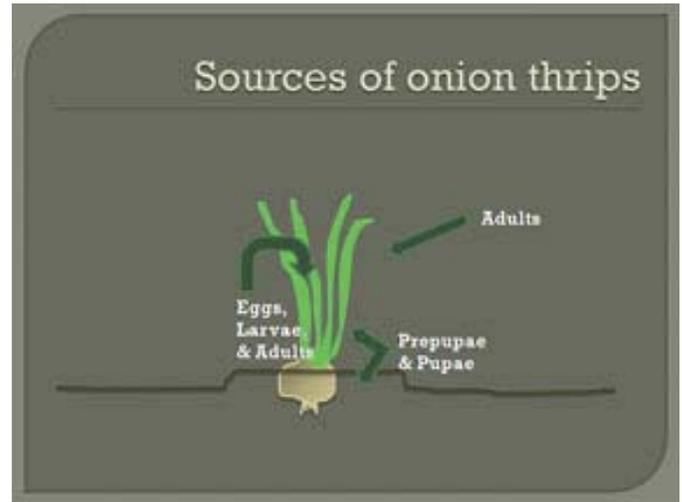
**Fig. 7.** Western flower thrips adult is darker yellow in color and slightly longer than onion thrips; also, it has 8- rather than 7- segmented antennae.<sup>2</sup>

## SAMPLING AND THRESHOLDS

Thrips sampling is important to optimize management strategies and to inform the grower about thrips population pressure over time. Sampling should begin when plants have at least 4-5 leaves or by mid June. An effective sampling method for pest management decisions is *in situ* counts – open the neck of onion plants and quickly count thrips adults and larvae before they disperse or hide. The majority of thrips will be at the base of youngest leaves in the lower center of the neck (Fig. 8). New York guidelines recommend sampling 5 plants each in 10 different areas of a field for a total of 50 plants per field (Rueda and Shelton 1995). This intensity of sampling could require 45-60 min per field depending on field size and amount of walking time. For feasibility, inspect a reasonable number of plants across different areas of each field. In the early to mid season, thrips numbers tend to be higher near field borders where adults infest first. If this is the case, insecticide sprays could be targeted to borders to slow spread to the entire field.



**Fig. 8.** Thrips prefer to hide in the lower neck of onion plants.<sup>1</sup>



**Fig. 9.** Sources and location of onion thrips on onion plants.<sup>1</sup>

To optimize use of insecticides or other controls, an action threshold can inform the grower when thrips populations are reaching levels that will cause economic yield loss. Economic yield loss occurs when the number of thrips exceeds a point where profits gained by controlling the pest will exceed costs of control measures. Costs of insecticides and value of the onion crop will vary; however, practical action thresholds have been developed based on average costs and values. In the early summer (June to early July) and for highly susceptible onion varieties (e.g., red onions), a threshold of 15 thrips per plant should prevent economic loss during the early bulb growth stage and prevent rapid build-up of populations. In mid to late summer (July and August) and for more thrips-tolerant onion varieties (many yellow and white varieties), an action threshold of 30 thrips per plant has proven effective. Another reason for a lower action threshold earlier in the summer is the contribution of the thrips egg load to population growth. Research in Utah has found thrips egg densities may range from 40-330 per onion plant during June to August and comprise 60-75% of the total thrips population. Longer-term, sustainable population suppression may require early intervention to prevent thrips counts from exceeding economic thresholds and becoming a chronic pest problem for the season.

## MANAGEMENT

Key thrips population management strategies include 1) cultural practices to increase onion plant tolerance and reduce attractiveness to thrips, 2) begin thrips suppression in the early summer before a reservoir of eggs builds up in plants, and 3) use of long-term suppressive strategies that target all life stages of onion thrips (Fig. 9).

## Crop Cultural Practices

Crop management practices that keep onion plants healthy and non-stressed will increase the crop's immunity to thrips feeding injury. Cultural practices should be the first line of defense against onion thrips.

- *Field location.* Avoid planting onions adjacent to grain and alfalfa fields. Adult thrips overwinter in these crops and their close proximity can increase thrips migration into onions. Increased survival of overwintering thrips may occur following mild, dry conditions in winter and spring. Small grains and alfalfa are common rotational crops for onions, so it may be difficult to implement this recommendation. Plant younger fields upwind, relative to prevailing winds, from older fields. This applies to fields planted with transplants as well. Adult thrips in more mature fields will tend to fly downwind to infest less mature fields.
- *Seedling transplants.* Inspect onion transplants for thrips infestation, and discard infested transplants. Transplants are propagated in warmer climates where thrips were likely exposed to more and different insecticides. Thrips strains on transplants may be more resistant to insecticides than strains already residing in Utah. Introducing new strains may increase insecticide resistance problems.
- *Nitrogen management.* Fertilize onions with adequate, but not excessive amounts of nitrogen. Recommendations for Utah are 150-200 lb of nitrogen per acre for the season depending on soil type and other factors. Deliver nitrogen in multiple applications throughout the onion growth period. Most local growers apply between 200-300 lb of nitrogen per acre. Moderate, consistent availability of nitrogen has been associated with a healthy onion crop and reduced onion thrips densities.
- *Mulches.* Straw or other mulch placed on the plant bed has been shown to reduce thrips populations

and improve onion growth. Benefits of mulch for the crop include weed suppression, reduced soil moisture loss, reduced soil erosion, and enhanced soil organic matter. Effects of mulch on thrips may include increased biological control through enhancement of predator populations, creation of a barrier for pre-pupae and pupae (resting life stages) to access soil, and reduced temperatures, which slow thrips development and population increase.

- *Trap crops and inter-cropping.* Other crops that are highly attractive to onion thrips include carrot, crucifers, cucurbits, and some flowers (carnation, chrysanthemum). Using a trap crop involves planting small strips or patches of the alternative crop within an onion field to attract thrips. The trap crop is disked under or sprayed with an insecticide when thrips populations increase. Inter-cropping, or mixed planting, of carrots and onions has been shown to reduce onion thrips populations on onions by attracting them to the carrots. Thrips injury to carrots is not as economically damaging as injury to onions. In this case, both crops can be harvested.
- *Sprinkler irrigation.* Overhead sprinkler irrigation has been shown to reduce thrips populations on onion plants. The physical action of water washing thrips from plants and water droplets standing on leaf surfaces are inhibitory to thrips. Thrips prefer warm and dry conditions. In addition, water applied through sprinklers may cause a crust to form on the soil surface and reduce the ability of pre-pupae and pupae to seek shelter in the soil.
- *Pre-planting and post-harvest sanitation.* Remove or destroy volunteer onion plants and debris. Onion plant matter left on the soil surface can harbor thrips during the winter to survive and spread the following year.

## Onion Varietal Tolerance

There is no known “true resistance” in onions to thrips. However, some onion varieties can tolerate effects of thrips feeding with only mild yield loss. Varieties with tolerance to thrips require fewer insecticide applications. Reduced insecticide use lowers control costs, slows development of resistance to insecticides in the thrips population, and may encourage biological control through preservation of natural enemies. Onion varieties with an open neck growth and dark, glossy leaves are less attractive to thrips than varieties with tight necks and lighter green leaves. Dr. Whitney Cranshaw, Colorado State University (Cranshaw 2004), found the following relative susceptibilities of some onion varieties to thrips feeding injury in Colorado research trials:

- Highly tolerant: ‘White Keeper’.
- Moderately tolerant: ‘El Charro’, ‘Snow White’, ‘Vega’, ‘X 201’, ‘Zapotec’.
- Susceptible: ‘Blanco Duro’, ‘Brown Beauty’, ‘Brown Beauty 20’, ‘Colorado 6’, ‘Sweet Perfection’, ‘Tango’,

‘Valdez’, ‘White Delight’.

- Highly susceptible: ‘Early Red Stockton’, ‘Mambo’, ‘Red Baron’, ‘Redman’.

## Insecticides

Insecticides are the most common tactic for onion thrips management. Despite their ease of use and availability of numerous classes or modes of action, rapid development of resistance to insecticides has been a key problem. The main reasons lay in the life history characteristics of onion thrips: reproduction by parthenogenesis (eggs develop without male fertilization so females pass all of their genes to their offspring), high reproductive potential, and short generation time. Widespread resistance across the western U.S. to organophosphate (e.g., azinphosmethyl, diazinon, methyl parathion) and synthetic pyrethroid (e.g., cypermethrin, permethrin) insecticides has been documented.

- *Resistance management.* To prolong the effectiveness of insecticides, it is important to limit the number and frequency of insecticide applications, rotate insecticide classes or modes of action between applications, and apply insecticides with thorough coverage. Sprays applied with high pressure and high water volume penetrate better into the inner neck where thrips reside.
- *Toxicity to thrips life stages.* Insecticides vary in their toxicity to thrips life stages. Most insecticides are effective in killing the early larval stages (Instars I and II) because the young stages are small and actively feeding. Some insecticides are active against adults and only a few have ovicidal (egg) activity. Adults have a thicker cuticle (external covering) than larvae and fly quickly when disturbed, so they are more difficult to kill than larvae. Eggs are laid within the leaf so are not accessible except to systemic insecticides that are absorbed through the leaf. Older larvae (Instars III and IV) are non-feeding and seek protection in the soil or at the base of onion plants, escaping contact by most insecticides.

Insecticides grouped by class (i.e., mode of action) that are effective in reducing thrips on onions and registered in Utah as of March, 2008:

### *Botanical*

pyrethrins + diatomaceous earth (Diatect – conventional and organic formulations\*)

### *Carbamate*

methomyl (Lannate)

oxamyl (Vydate)- Section 24(c) label for Utah

### *Insect Growth Regulator*

azadirachtin (Azatin, Neemix\*)

pyriproxyfen (Esteem)

### *Microbial*

spinosad (Success, Entrust\*)

spinetoram (Radiant)

*Organophosphate*  
diazinon (Diazinon)  
malathion (Malathion)  
methyl parathion (PennCap-M)

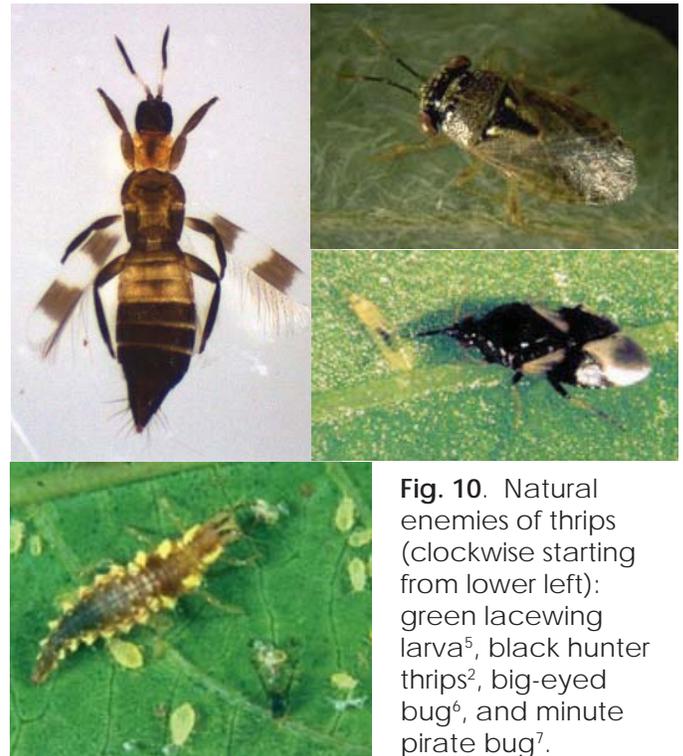
*Particle Barrier/Repellent*  
kaolin clay (Surround\*)

*Suffocant/Disruptant*  
insecticidal soap (Safer's\*)  
stylet oil (JMS\*)

*Synthetic Pyrethroid*  
cypermethrin (Ammo)  
lambda-cyhalothrin (Warrior)  
permethrin (Ambush, Pounce)  
zeta-cypermethrin (Mustang)

\*OMRI approved for organic production.

All brands are registered trademarks. Examples of brands may not be all-inclusive, but are meant to provide examples of products registered on onions in Utah. The availability of insecticides changes rapidly. *Always check the label for registered uses, application and safety information, and protection and pre-harvest intervals.*



**Fig. 10.** Natural enemies of thrips (clockwise starting from lower left): green lacewing larva<sup>5</sup>, black hunter thrips<sup>2</sup>, big-eyed bug<sup>6</sup>, and minute pirate bug<sup>7</sup>.

## Biological Control

Predators of onion thrips can be numerous, but are not usually in abundance until late summer, after the majority of thrips feeding injury has occurred. In onion fields without applications of toxic insecticides and with enhanced cultural practices (e.g., mulches, high organic matter, trap crops, inter-cropping), adequate densities of predators may be present to provide effective suppression of thrips during the summer. The primary predators that feed on thrips in onions in Utah include the black hunter thrips (*Aelothrips* sp.), big-eyed bug (*Geocoris* spp.), minute pirate bug (*Orius* spp.), and green lacewing (*Chrysoperla* spp.) larvae (Fig. 10).

## Thrips Management in the Home Garden

Thrips will infest onions, garlic, and other vegetables in the home garden, but small-sized plots are generally not at risk for significant yield loss. Thrips in the home garden are best managed with cultural practices and natural biological control. The following are generally adequate to keep thrips from noticeably reducing onion growth and bulb size in the home garden: add compost to enhance organic matter and soil tilth; use mulches; plant onions and garlic in small plots surrounded by a diversity of other plants, including garden crops, herbs, and cultivated and wild flowers; apply a stiff spray of water from a hose to wash thrips from plants when they are observed; and avoid using broad-spectrum, toxic insecticides to preserve natural enemies that keep onion thrips populations low.

## ADDITIONAL READING

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<sup>1</sup>Images courtesy of Diane G. Alston, Utah State University.

<sup>2</sup>Images courtesy of Adam Thompson, Utah State University.

<sup>3</sup>Image courtesy of New York State Agricultural Experiment Station and Cornell University.

<sup>4</sup>Image courtesy of C. Kent Evans, Utah State University.

<sup>5</sup>Image courtesy of R. Bessin, University of Kentucky.

<sup>6</sup>Image courtesy of University of Idaho.

<sup>7</sup>Image courtesy of D. Gillespie, Washington State University.

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