



**Vegetable Research Highlights:**

Organic asparagus; organic vegetable cover crop rotations; mulches, staking, and shading for tomato and pepper; onion nitrogen and crop rotation management; introduction of the updated 2016 Utah Vegetable Production and Pest Management Guide; and biochar application to enhance production and disease suppression.



# Diseases

## Tomato Spotted Wilt Virus (TSWV)

This month, cases of tomato spotted wilt virus (TSWV) have been reported in Emery and Sevier counties. TSWV is a major pathogen of tomatoes, peppers, peanuts, and tobacco.

**Transmission:**

In Utah, TSWV is transmitted by western flower thrips and onion thrips. Thrips must acquire the virus when they are young (larvae) in order to transmit the virus as adults. Because adults do not transfer the virus to their progeny and thrips nymphs cannot fly, adults need to lay eggs on infected plants for the virus to be transferred to the young thrips.



Whitney Cranshaw, Colorado State University, Bugwood.org



Whitney Cranshaw, Colorado State University, Bugwood.org

Western flower thrips larva (top) and onion thrips larva (bottom) can carry TSWV and transmit the virus to susceptible plant hosts as adults.

**Identification and Damage:**

Many weeds, landscape plants, and native plants can be infected with TSWV. Symptoms vary among different hosts but commonly occur as stunted growth, which is generally more severe in young infected plants. Other symptoms include: chlorotic or necrotic rings on leaves, and fruits; necrosis of plant foliage; discolored seeds; and reduced quantity and quality of plant products.



Don Ferrin, Louisiana State University Agricultural Center, Bugwood.org

A healthy tomato plant (left and right) next to a tomato plant infected with TSWV (middle); note the stunted growth and necrotic/chlorotic (brown/yellow) leaves of the infected plant.



Edward Sikora, Auburn University, Bugwood.org



Paul Bach, University of Kentucky Research and Education Center, Bugwood.org

TSWV leaf necrosis on tomato leaves (left and right); note both the necrotic (brown) and chlorotic (yellow) rings and spots (left).



William M. Brown, Jr., Bugwood.org



David B. Langston, University of Georgia, Bugwood.org

Chlorotic/yellow (left) and necrotic/brown (right) rings and spots on tomato fruit infected with TSWV.



Gerald Holmes, California Polytechnic State University at San Luis Obispo, Bugwood.org

Necrotic symptoms of TSWV on the stem tissue of a tomato host.



**Management:**

Infected plants need to be removed. Control thrips (if present) and weeds to prevent TSWV from spreading within a tomato field or garden.

**For more information on managing Western Flower Thrips and Onion Thrips, search the internet for (or click the text below):**

[USU Western Flower Thrips](#)

[USU Onion Flower Thrips](#)

**For a more extensive list of ornamental and weed hosts of TSWV, search the internet for (or click the text below):**

[Cornell Vegetable MD Tomato Spotted Wilt Virus](#)

**For more information on TSWV, search the internet for:**

[Utah Pests Tomato Diseases to Watch for in 2012](#)

[APS Net Tomato Spotted Wilt Virus](#)

[UC Davis IPM Tomato Spotted Wilt Virus](#)

## Insects

### Watch for Root and Seed Maggots

With the recent cool, wet weather in many areas of Utah, conditions are favorable for root and seed maggots, namely cabbage maggots, onion maggots, and seedcorn maggots.

**Damage:**

Maggots cause damage by burrowing into the seeds and roots of many vegetable crops. They can destroy the seed germ and cause rot in plant tissues. Seeds attacked by maggots may not emerge, causing reduced plant stands. Maggot damaged roots cause wilting, reduced growth, lighter green plant parts, and potentially plant death. Later maggot larvae that feed on host plants can provide openings for other diseases, reducing crop quality and storability.

**Susceptible plants:**

- **cabbage maggot host plants** cauliflower, Brussels sprouts, radish, cabbage, broccoli, collards, kohlrabi, turnip, cress, beet, and celery
- **onion maggot host plants** onion, beans, alfalfa, strawberry, wheat

- **seedcorn maggot host plants** asparagus, cabbage, turnip, radish, onion, beet, spinach, potato, sprouting corn seeds, beans, peas, and alfalfa



Cabbage maggot damage on a young cabbage plant; note the chlorotic (yellowing) leaves.



Onion maggot levels of injury on green onion hosts.



Corn seed damage from a seedcorn maggot; note that the maggot is still present inside of the seed.

**Management:**

Any practice that speeds up germination, plant emergence, and overall plant health will help reduce crop losses from maggots. When possible, wait to plant susceptible plants until soils warm up to 70°F (see link below for "estimating soil temperature"). Use row covers early in the season to prevent flies from laying their eggs on the soil near the base of the plants.

For more information on the description, life history, damage, monitoring, and management of root and seed maggots, see the new **2016 Vegetable Production Guide** here: [utahpests.usu.edu/IPM/files/uploads/Publications/UT-veg-guide-2016.pdf](http://utahpests.usu.edu/IPM/files/uploads/Publications/UT-veg-guide-2016.pdf)

### Root and Seed Maggot References in the 2016 Vegetable Guide:

#### Brassica Chapter

- Cabbage maggot, pg. 40
- Seedcorn maggot, pg. 41
- Pesticide tables on pg. 43-46

#### Onion Chapter

- Onion maggot, pg. 99
- Seedcorn maggot, pg. 99-100
- Pesticide tables on pg. 106, 109

#### Sweet Corn Chapter

- Seedcorn maggot, pg. 177-178
- Pesticide tables pg. 192-194

### For more information, search the internet for:

[MSJ Estimating Soil Temperature](#)

[Virginia Tech Cabbage and Seedcorn Maggot](#)

[Purdue University Seedcorn Maggot](#)

## Flea Beetles

### Description:

Flea beetles are active leaf-feeders that populate many Utah gardens and crop fields. Their leaf-feeding habits can quickly defoliate and kill plants when high populations are present. Susceptible plants include: eggplant, cole crops (e.g. broccoli, cauliflower, cabbage, kale), and seedlings of tomatoes, potatoes, peppers, turnips, radishes, and corn.



Flea beetles have metallic bodies and enlarged hind legs (left) that allow them to jump when disturbed. Some flea beetles are striped (right).

### Life History:

Flea beetles overwinter as adults and typically emerge to feed on weeds and other available plants in mid-to late spring. After several weeks of feeding, adults will lay eggs in the soil at the base of host plants. Larvae hatch from the eggs and begin feeding on the roots of the host plant. The larval stage lasts for about a month, after which, larvae pupate and emerge as the second generation of adults in late spring to mid-summer. Depending on the species of flea beetle, a third generation may occur before winter.



Flea beetle damage occurs as shallow pits and small, rounded, irregular holes in the foliage, cotyledons, and stems of host plants.

What can you do before resorting to chemical control? Use monitoring, cultural, physical, and biological control practices.

### Monitoring:

- Check seedlings, especially in the spring, at least two times a week until 4 to 5 true leaves have formed. For seedlings, consider treatment if 1-5 flea beetles per plant are found. For mature plants, consider treatment when populations are high on more susceptible plants such as leafy greens and ornamentals.
- Use yellow or white sticky traps to detect the presence and quantity of flea beetles. Place sticky traps around susceptible host plants just after planting but before seedlings emerge. Use these until plants are well established or until harvest. Replace traps when adhesive is covered with insects or is no longer sticky.

### Cultural/Physical Controls:

- Avoid peak activity by planting early or late. Promote early maturity (to avoid flea beetle flight peaks) and increase plant tolerance by planting under protective covers and/or into soil-warming mulches.—or— Plant in late May to avoid early-season larval injury and heavy feeding by overwintering adults. Late spring plantings also allow soil temperatures to warm and provide better conditions for plants to outgrow and compensate for flea beetle injury.



- *Plant a living mulch or companion plant with susceptible crops.* Living mulches and companion plants help to confuse, repel, or block pests from finding host plants. Some companion plants for flea beetle control include: bunching green onions, dill, and marigolds.
- *Plant highly attractive trap crops every 55 yards between rows of cabbage, broccoli, or cauliflower (or as a border around the field).* Plant trap crops 2-4 weeks before the cash crop. Attractive trap crops include Chinese southern giant mustard, radish, daikon, pac choy, and pacific gold mustard. Once flea beetles have congregated in the trap crop, and before they move to the cash crop, spray or physically destroy them. Reseeding of the trap crop may be necessary to retain effectiveness (especially when the pest destroys the first planting). Trap crops are less effective when trying to protect crops that are as attractive as the trap crop (e.g. Nappa cabbage, gai choy, choy sum).
- *Interplant a trap crop, such as radishes (e.g. Chinese Daikon and Snow Belle), at 6-12 inch intervals among cole crops.* This has been shown to reduce flea beetle damage in broccoli crops.
- *Use row covers such as Reema™ to provide a barrier to adult flea beetles and cover seedlings.* For maximum protection, place row covers at or before plant emergence. Row covers can be removed after flea beetle populations subside. Row covers are most effective when combined with a planned crop rotation where susceptible crops are followed by non-susceptible crops each subsequent year.

### Biological Control:

- *Commercial formulations of Entomopathogenic nematodes are available.* Nematodes applied to the soil can attack flea beetle larvae and reduce root feeding and prevent the next cycle of adults from emerging.

### Alternative Insecticides:

- Botanicals: Neem, pyrethrins, and combinations of the two
- Insecticidal soap (may only provide partial control)
- Garlic, onion, and mint extracts (may only suppress or repel pests)
- Diatomaceous earth: Bonide, Garden Safe, Desect
- Kaolin clay: Surround (may degrade fruit yield and quality)



Powder treatments (e.g. kaolin clay or diatomaceous earth) may provide some protection against flea beetle feeding.

Flea beetle damage is most severe in the spring. Thus, monitoring for their presence early in the season can indicate whether insecticides are necessary. Seedlings are less tolerant of flea beetle damage and may require a treatment if there are 1-5 flea beetles per plant or defoliation reaches 10-30%.

Because flea beetles are highly mobile and can rapidly reinvade plantings, it may be necessary to apply insecticides more than once during the plant's susceptible period.

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

**For more information, search the internet for (or click the text below):**

[USU Flea Beetles on Vegetables](#)

[University of Vermont Flea Beetles Management](#)

[ATTRA Flea Beetle Organic Control Options](#)

[Washington State University Organic Management of Flea Beetles](#)

**Precautionary Statement:** Utah State University Extension and its employees are not responsible for the use, misuse, or damage caused by application or misapplication of products or information mentioned in this document. All pesticides are labeled with ingredients, instructions, and risks. The pesticide applicator is legally responsible for proper use. USU makes no endorsement of the products listed herein.

### Vegetable IPM Advisory

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