

Web Spinning Spider Mites

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Two spotted spider mite adult, immature and



egg

Spider mite injury to a tart cherry leaf; note stippling and debris caught in webbing on the leaf surface



Spider mite injury to pear can cause rapid and severe leaf burn. Image courtesy of E. Beers, Washington State



University.

The western predatory mite is the most important predator in Utah orchards; it is teardropped-shaped and moves



quickly

Zetzellia mali is a secondary predator, mostly of European red mite and rust mites, but will also feed on spider mite eggs. Image courtesy of TFREC, Washington State University.

Quick Facts

- Spider mites feed on a wide range of plants, including fruit trees, field and forage crops, ornamentals, and weeds
- Adult and immature mites feed on leaves causing white stippling, bronzing, and defoliation
- Tree vigor and fruit color, size, and production can be reduced
- Spider mite populations can increase rapidly during hot summer months
- Presence of the western predatory mite, avoidance of non-selective pesticides, and proper ground cover management are essential for good biological control
- Use of miticides is only recommended when infestations are severe and predatory mite numbers are low
- Mite monitoring is essential to management; presence-absence sampling is recommended

Mites are small arthropods that are more closely related to spiders and ticks than to insects. Mites in this group are web spinners, hence the name “spider” mites. They are an important and destructive group of pests to agricultural crops worldwide. However, the spider mite’s status as a pest is often created by poor pest management practices, such as broad spectrum pesticide applications and improper management of orchard ground covers. These practices shift the balance toward high spider mite densities and low natural enemy densities. During hot summer months, the spider mite’s high reproductive rate can cause population explosions in only 1 to 2 weeks. In addition, its small size makes detection, identification, and monitoring particularly difficult. Twospotted and McDaniel are the two most important web spinning species of spider mites (Order Acari, Family Tetranychidae) to attack Utah fruit orchards. However, twospotted spider mite tends to have a higher reproductive rate during hot summer conditions. For that reason, when both species occur together, twospotted spider mite often out competes McDaniel spider mite. Although they are different species, their life histories, monitoring methods, and management techniques are similar enough to discuss together.

Hosts

Twospotted spider mite attack hundreds of plants including many field and forage crops, horticultural crops, ornamentals, and weeds. The host range of McDaniel spider mite is not as broad as that of twospotted spider mite, although it does attack most deciduous fruit trees, some field and forage crops, and many weeds. The following is a list of fruit hosts:

- Apple
- Plum
- Pear
- Prune
- Peach/Nectarine
- Apricot
- Cane and Bramble Berries

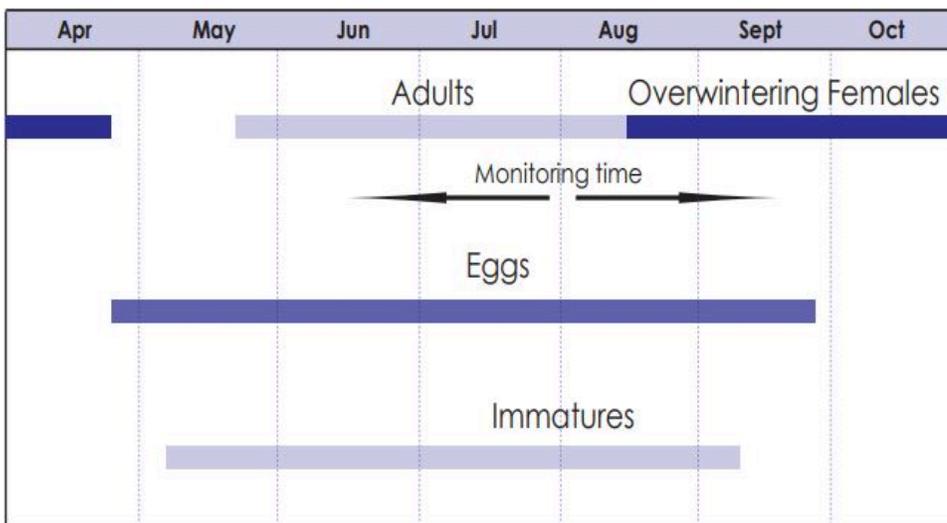


Table 1. Occurrence of spider mites on ground cover plants in Utah orchards (Alston 1994).

Plant Common Name	Mite Host Status
Alfalfa	x
Apple root sucker	r
Bittersweet nightshade	
Cheatgrass	
Common burdock	x
Common dandelion	r
Common lambsquarter	x
Common mallow	r
Curly dock	
Field bindweed	r

Plant Common Name	Mite Host Status
Green foxtail	
Hoary cress (whitetop)	r
Knotweed	r
Morning Glory	r
Orchardgrass	
Prickly lettuce	r
Puncture vine	r
Red fescue	

*x indicates that only adult mites were found; r indicates that the plant was a reproductive host on which mite eggs, immatures, and adults were found; blank indicates that no mites were observed

Life History

Adult—Overwintering and Damaging Stage

- **Size and shape:** female 1/60 inch (0.42 mm) long and oval; male slightly smaller with a tapered hind end
- **Color:** overwinters as orange female without spots; turns from orange to green once feeding begins in the spring; summer adult has two distinct dark spots on the back behind the eyes (twospotted spider mite) or multiple dark spots on the back (McDaniel spider mite), and is yellow to green turning brown with age; has two red eyes
- **Where:** winter-form female resides under bark at the base of trees, and under organic matter (duff) on the soil surface
- **When:** emerges when the weather begins to warm in early spring
- Begins feeding on ground cover host plants (see Table 1); moves up into trees as the orchard floor vegetation dries out in early to mid summer or following a major disturbance to the cover, such as herbicide application, mowing, or cultivation
- Egg laying starts a few days after feeding begins
- Overwintering females lay 30 to 50 eggs in a 25-day average life span
- Summer-form female lays up to 100 to 150 eggs in a 4- to 6-week period
- In fruit trees, mites are first found on root suckers, water sprouts, or on leaves in the lower center or at the top of the tree canopy, spreading to the canopy periphery
- Utah orchards can have eight or more generations a year; summer generations overlap
- A generation may be completed in as few as 10-14 days during hot summer periods
- When leaf quality begins to decline from excessive mite feeding or when conditions change to cooler temperatures and shorter days in the fall, orange overwintering females once again begin to accumulate in protected sites

Egg

- **Size, shape, and color:** 1/150 inch (0.2 mm) in diameter, spherical, and translucent when first deposited, becoming opaque
- **Where:** primarily on the undersides of leaves
- Red eye spots of the larva appear just before hatching
- First generation eggs laid in the spring may take 3 weeks to hatch, depending on temperatures
- Egg hatch in the summer may take only 1 to 2 days

Immature—Damaging Stage

- There are three stages of immatures: larva, protonymph, and deutonymph. Each immature stage goes through three phases including active feeding, a resting period when the outer skin of the body takes on a silvery color, and a molt when the skin is shed. Immature stages congregate on the undersides of leaves on fruit trees, ground cover, and weed hosts, but can also be found on upper surfaces when population densities are high or mites are migrating to new sites.

Larva

- **Size:** about the same size as the egg
- **Color:** translucent when first hatched, turning pale green to straw color with characteristic black spots forming on the back
- **Shape:** round with three pairs of legs

Protonymph

- **Size:** larger and more oval shaped than the larva
- **Color:** deeper green
- **Shape:** oval with four pairs of legs
- Two dark spots are more pronounced

Deutonymph

- **Size:** slightly larger than the protonymph
- **Shape:** male can be distinguished from the female by its smaller size and more pointed abdomen

Dispersal

Mites primarily move from overwintering to feeding sites in the spring and among host plants by crawling. However, mites are able to “balloon” on air currents by holding onto a thin thread of silk (webbing) produced by their spinnerets, or without the aid of silk by just rearing up on their head or back and into the air.

Crop Injury

Peak injury to trees typically occurs in late June through mid September when weather conditions are hot and dry. Mite infestations often begin as “hot spots” within an orchard that spread to neighboring trees if weather conditions are favorable and predatory mites are unable to suppress the infestation. The following are the common characteristics of mite feeding and injury:

- Mites feed by piercing leaf tissue with their mouthparts and sucking up plant fluids
- Photosynthetic activity of trees is reduced
- Light to moderate feeding causes white speckling or stippling of leaves
- Heavy feeding causes leaves to bronze or turn brown, dry up, and drop prematurely (pears are especially sensitive to mite injury; even low to moderate infestations can result in rapid leaf burn and defoliation)
- Mite feeding on the surface of pear fruit can cause russetting
- Mite webbing and feeding on the surface of tart cherries can cause scarring and shriveling of fruit
- Infested leaves and twigs may be covered with fine webbing
- Tree vigor and fruit color, size, and production can be reduced
- If injury occurs early enough in the season, there may be insufficient reserves for normal fruit set and production the following year
- High mite populations in the summer can cause early senescence (leaf color change and drop); stressed trees are more susceptible to winter injury and mortality

Timing Control

In most situations, spider mites in Utah fruit orchards can be managed without the use of miticides. Some exceptions include mites on pear or on all tree types during extreme hot and dry periods when mites have a tendency to reproduce rapidly and reach outbreak levels within 1 to 2 weeks. Because biological and cultural controls play a dominant role in integrated mite management and because mite infestations often begin as “hot spots,” the use of a reliable sampling method is critical to the success of an integrated program. A fairly reliable and easy-to-use sampling method for mites is

called presence-absence, or binomial, sampling. Rather than counting the number of mites on leaves, which is difficult because of their small size, presence-absence sampling requires only that the scout determine whether or not pest or predator mites are present on each leaf sampled. The following are reasons to use presence-absence sampling:

- Determines mite densities quickly and easily
- Eliminates unnecessary miticide treatments
- Conserves beneficial predatory mite populations, which can provide adequate biological control of spider mites
- Allows identification of mite “hot spots” that can be targeted with chemical control when necessary
- Ensures proper timing of miticide treatments when necessary
- Reduces the likelihood of mite populations developing resistance to miticides

Presence-Absence Sampling Method

Scouting for mites can be done at the same time as for western tentiform leafminer in apples and cherries. Select representative orchard blocks of each fruit type to include in the scouting program. Sampling all orchard blocks will improve your ability to make specific mite management recommendations.

How to Sample:

Randomly select 10 trees scattered throughout a 2- to 5-acre block to sample. If the orchard block is larger than 5 acres, divide it into two 5 acre sub-blocks for sampling purposes.

- Scout designated orchard blocks every 1 to 2 weeks from mid-June through mid-September; during hot periods, sample every week
- On each sampling date, collect 10 leaves from each of the 10 trees (100 leaves total); because spider mites are found in the lower center and at the top of tree canopies first, spreading to the periphery over time, leaves should be selected from inside the canopy as well as from the edges
- Leaves from each tree should be kept separate from leaves of other trees, which will enable you to identify “hot spots;” either place leaves from each tree in a separate bag to count at the end of collection, or count infested leaves from each tree immediately after collecting
- Using a 10–20X hand lens, count the number of leaves from each tree infested with each type of mite (spider and predatory); it is not necessary to count the number of mites on each leaf
- Record the number of mite-infested leaves per tree on the sampling form (See the Spider and Predatory Mites Sampling Form)
- Use the look-up table (Table 2) to estimate the number of mites per leaf for both spider mites and predatory mites
- Total the estimated mite densities for all 10 trees and divide by 10 to obtain an average for the trees sampled in the block, note any trees with substantially higher spider mite densities than the block average as these may indicate hot spots
- The same leaves can be used to monitor for western tentiform leafminer in apple and cherry

Twospotted and McDaniel Spider Mites

Number of leaves out of 10 with at least one mite present*	Estimated number of mites per leaf
1	0.1
2	0.4
3	0.7
4	1.1
5	1.7

Number of leaves out of 10 with at least one mite present*	Estimated number of mites per leaf
6	2.4
7	3.5
8	5.2
9	8.8
10	--

Predatory Mite

Number of leaves out of 10 with at least one mite present*	Estimated number of mites per leaf
1	0.1
2	0.4
3	0.7
4	1.1
5	1.7
6	2.4
7	3.5
8	5.2
9	8.8
10	--

Management

Relying primarily on biological and cultural control for spider mite management should be the goal of every orchard pest manager. In many situations, chemical control is unnecessary and may only make the mite problem worse. Use of miticides will eliminate the beneficial predatory mites, which are capable of keeping spider mite populations below economically damaging levels. Another reason to avoid chemical control is that populations of twospotted and McDaniel spider mites have developed resistance to miticides. The following sections will describe the various components of a good mite management program.

Treatment Thresholds

Using the presence-absence sampling method the following are the steps to follow to determine if economic thresholds for spider mites have been exceeded (Jones 1990):

Apple and Stone Fruits:

- If the average number of spider mites per leaf is less than 5 and no predators are present, resample in 1 week. If the predator to pest ratio is at least 1:5, wait 2 weeks to resample
- If the average number of spider mites per leaf is 5 to 10 and there is less than 1 predator per leaf, resample in 2 to 5 days; if the predator to pest ratio is at least 1:10, resample in 1 week
- If the average number of spider mites per leaf is more than 10 and there is less than 1 predator per leaf, consider applying a miticide treatment (see Chemical Control below)

Pear:

- If the average number of spider mites per leaf is less than 5 and less than 1 predator per leaf is present, resample in 2 to 5 days; if the predator to pest ratio is at least 1:5, resample in 1 to 2 weeks
- If the average number of spider mites per leaf is 5 or greater and predator to pest ratio is at least 1:5, resample in 1 week. If predator to pest ratio is less than 1:5, consider applying a miticide treatment (See Chemical Control below)

Biological Control

Mite Predators: The western predatory mite, *Typhlodromus occidentalis* (Family Phytoseiidae), is common and the most important mite predator in Utah fruit orchards. Several other species of predatory phytoseiid mites do occur, but their role in biological control of spider mites is usually minimal. The western predatory mite is teardrop-shaped (narrower at the head), translucent to yellow in color, and can move quickly. It primarily eats the eggs and immature stages of spider mites, but can be cannibalistic if spider mite prey is scarce. *Zetzellia mali* (Family Stigmaeidae), a smaller yellow to orange predatory mite, can often be found in unsprayed orchards or in those orchards that receive fewer insecticides. However, *Z. mali* predominantly attacks European red mite and apple rust mite. Other predators that feed on spider mites include a small black lady beetle, *Stethorus picipes*; some predatory bugs; thrips; and lacewings. But in Utah orchards, *Typhlodromus occidentalis* provides the most consistent and highest level of mite biological control. *Zetzellia mali* is a secondary predator, mostly of European red mite and rust mites, but will also feed on spider mite eggs. In order to encourage the survival of predatory mites in sufficient numbers, it is crucial to adopt sound, biologically based pest management practices.

The following are recommendations for encouraging predatory mites:

- When applying dormant, delayed dormant, and pre-bloom treatments for control of other pests, do not direct sprays at the lower trunk and surrounding ground cover where predators overwinter
- In most situations, do not control populations of eriophyid mites, such as rust mites and leaf blister mites, because they serve as an early season food source for predators; the exception is pear trees and orchards where large populations of eriophyid mites are present and significant injury occurred the previous season

Chemical Control

Avoid Nonselective Chemicals: To maintain adequate predator populations, chemicals that are toxic to beneficial predators should be avoided. If carbaryl (Sevin) is used for fruit thinning, use minimum registered dosages and confine the spray to the periphery of trees. Use post-bloom miticides only when absolutely necessary to prevent economic injury (see Treatment Thresholds above). Avoid using the following chemicals after bloom as they can significantly reduce predator numbers:

- bifenthrin (Brigade, Capture)
- carbaryl (Sevin)
- dicofol (Kelthane)
- esfenvalerate (Asana)
- fenbutatin-oxide (Vendex)
- formentanate hydrochloride (Carzol)
- lambda-cyhalothrin (Warrior)
- lime-sulfur
- methidathion (Supracide)

- oxamyl (Vydate)
- permethrin (Ambush and Pounce)
- sulfur
- zeta-cypermethrin (Mustang Max)

Important Role of Rust Mites

To successfully maintain predator mite populations in orchard trees and on ground cover vegetation, a prey source must be available. Rust mites on apple, pear, cherry, and plum play an important role as an alternate food source for predator mites in trees. Alternate prey can be critical in maintaining predators when spider mite densities are low. In fact, minimal spider mite numbers and moderate to high predator mite numbers have been observed in Utah orchards throughout the summer season because of the alternate rust mite prey. For that reason, rust mites should not be controlled on trees unless they are causing significant injury. Keep in mind that pear rust mites can cause substantial fruit russetting if populations are high enough. Therefore, their populations should be monitored carefully and considered in the overall mite management program.

Re-establishing Predator Mites

The most important predator mite, *Typhlodromus occidentalis*, occurs naturally in Utah orchards. If *Typhlodromus* populations are eliminated through the use of nonselective chemicals (see list above), it may be possible to hasten their re-establishment rather than waiting for natural colonization. However, as long as nonselective chemical use is continued, *Typhlodromus* populations will not thrive and provide mite control. To successfully re-establish *Typhlodromus*, a source of prey, such as rust mites or spider mites, must be available in the orchard. The following are some suggestions for re-establishing *Typhlodromus* in the orchard:

- Cut shoots containing both *Typhlodromus* and a prey source from one orchard tree and place them in trees of another orchard
- To facilitate mite dispersal into the trees, position shoots so that there is leaf-to-leaf contact; because the movement of *Typhlodromus* between trees is limited, at least one shoot should be placed in each tree
- *Typhlodromus occidentalis* can also be purchased from commercial suppliers and released into trees; researchers have developed strains of *Typhlodromus* with tolerance to some of the common orchard insecticides; make sure to choose a reliable supplier and select a strain that is appropriate for your area

Ground Cover Management

The type and density of vegetation growing on the orchard floor can play an important role in orchard mite management. Studies in Utah orchards found that certain broad leaf weeds and apple root suckers enhanced the movement of spider mites from ground cover plants into trees (see Table 1).

Establishing a healthy grass ground cover has proven successful in displacing most broad leaf weeds that serve as reproductive hosts for spider mites and preventing build up of problem spider mite densities. Because ground cover plants are an important source of food for spider mites in spring and early summer, they can also assist with building up predator mite populations that feed on the spider mites. Therefore, allowing a low level of weeds may improve the availability of early season spider mite prey for predator mites, and thus improve the synchrony of predator and prey as they move into trees later in the season. However, the availability of rust mites in trees as an enticement for predator mites to move into trees early in the season can prevent the need for early season spider mite populations on ground cover (see Important Role of Rust Mites). Keep in mind that aggressive weed and ground cover suppression should be maintained in orchards less than 3 years old to prevent competition for water and nutrients until the orchard is well established.

Ground cover management practices such as mowing, herbicide application, cultivation, and irrigation can also strongly influence the movement of mites. When there are abundant spider mites on ground vegetation, especially during mid-June to September, minimize mowing, cultivation, and herbicide treatments because large numbers of spider mites may be driven up into orchard trees. This can also occur when the ground cover dries out during the hot summer months. Adding a miticide to an herbicide for control of weeds and mites on the orchard floor is an expensive option that is not

usually cost effective. In addition, if cultivation is used to reduce weeds on the orchard floor or a well-traveled dirt road is nearby, the dust produced may increase populations of spider mites and lower populations of predator mites.

Chemical Control

Miticides and nonselective orchard chemicals should be avoided in favor of biological and cultural practices that allow predators to maintain spider mite populations below economically damaging levels. But if summer applications are required for control of twospotted or McDaniel spider mites, the following materials are recommended:

- abamectin (Agri-Mek)
- acequinocyl (Kanemite) - apple and pear only
- bifentazate (Acrامة)
- clofentezine (Apollo)
- dicofol (Kelthane) - apple and pear only
- etoxazole (Zeal)
- fenbutatin-oxide (Vendex) - not on apricot
- fenpyroximate (FujiMite) - apple and pear only
- hexythiazox (Onager, Savey)
- insecticidal soap (M-Pede, Safer's, others)
- propargite (Omite) - nectarine only
- pyridaben (Nexter)
- spiroticlofen (Envidor)
- sucrose octanoate esters (SucraShield)
- summer-weight oil (horticultural mineral oil, canola oil, soybean oil, others)

Use lower label rates if predators are present. To avoid selecting for resistance, rotate different types of miticides. Once a miticide is applied, mite densities should be monitored 1 week later. A second application may be required in 7 to 10 days following the first application if a large number of eggs and hatching larvae are present.

References and Further Reading

- Alston, D. G. 1994. Effect of apple orchard floor vegetation on density and dispersal of phytophagous and predaceous mites in Utah. *Agriculture, Ecosystems and Environment* 50: 73-84.
- Jones, V. P. 1990. Sampling and dispersion of the twospotted spider mite (Acari: Tetranychidae) and the western orchard predatory mite (Acari: Phytoseiidae) on tart cherry. *Journal of Economic Entomology* 83: 1376-1380.

Related Research

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