

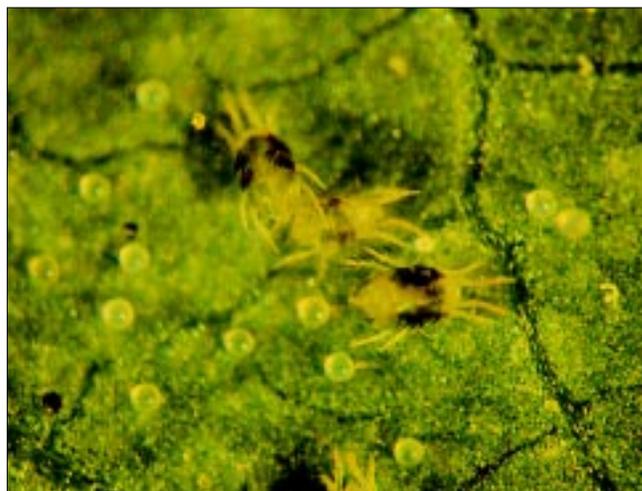
Orchard IPM Series HG/Orchard/06

## Web Spinning Spider Mites

Twospotted Spider Mite (*Tetranychus urticae*)

McDaniel Spider Mite (*Tetranychus mcdanieli*)

by Diane G. Alston and Michael E. Reding



Twospotted spider mite adults and eggs.

### Do You Know?

- ◆ Spider mites feed on a wide range of hosts, including most fruit trees, many field and forage crops, ornamentals, and weeds.
- ◆ Adult and immature mites feed on leaves causing white speckling, bronzing, and defoliation.
- ◆ Tree vigor and fruit color, size, and production can be reduced.
- ◆ Spider mites can be highly destructive during hot summer months, but this is often due to the use of nonselective chemicals that kill predatory mites.
- ◆ Use of miticides is only recommended when infestations are severe and predatory mite numbers are low.
- ◆ The western predatory mite and proper ground cover management are essential for good biological control.
- ◆ 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 one of the most 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 a very short period of time. 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 to attack fruit trees in



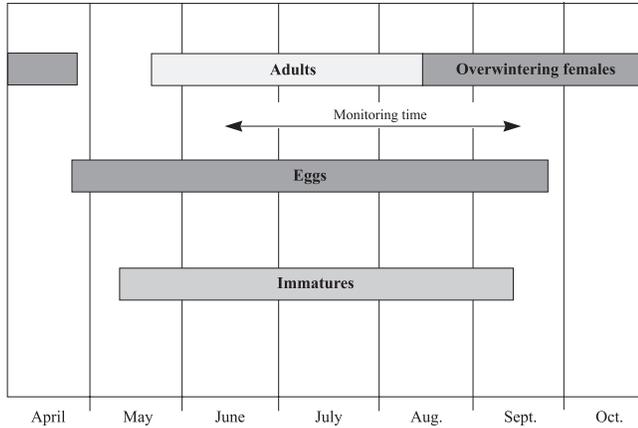
Spider mite injury to pear can cause rapid leaf burn and fruit russetting.



*Typhlodromus occidentalis* is an important mite predator of spider mites in Utah.

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.

## Spider Mite Life History



Arrow indicates time when monitoring should occur. Count the number of mite infested leaves every 1-2 weeks.

## Hosts

Twospotted spider mite attacks 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:

- |                        |                          |
|------------------------|--------------------------|
| <b>apple</b>           | plum                     |
| <b>pear</b>            | prune                    |
| <b>cherry</b>          | strawberry               |
| <b>peach/nectarine</b> | cane and bramble berries |
| apricot                |                          |

## Life History

### Adult—Overwintering and Damaging Stage

- ◆ **Size and shape:** female— $1/60$  inch long and oval; male—slightly smaller with a pointed hind end
- ◆ **Color:** overwinters as orange female without spots; turns from orange to green once feeding begins; 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:** overwintering female found under and on ground cover plants, under bark scales at the base of trees, and under surface debris
- ◆ **When:** emerges when the weather begins to warm in early spring
- ◆ Begins feeding on ground cover host plants (see Table 1) then moves up into trees as the ground cover vegetation dries out in mid-summer or

**Table 1. Occurrence of Spider Mites on ground cover vegetation in Utah orchards**

Common Name of Plant	Plant 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
Green foxtail	
Hoary cress (Whitetop)	r
Knotweed	r
Morning glory	r
Orchardgrass	
Prickly lettuce	r
Puncture vine	r
Red fescue	
White sweetclover	r

\* x indicates that only adult mite stages were found; r indicates that the species was a reproductive host because mite eggs, immatures, and adults were found; blank indicates that no mites were observed.

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 female lays up to 100 to 150 eggs in a 4- to 6-week period
- ◆ In trees, mites are first found on root suckers or 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
- ◆ One generation may take only 7 to 10 days to complete 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:**  $\frac{1}{150}$  inch in diameter, spherical, and translucent when first deposited, becoming opaque
- ◆ **Where:** primarily on the undersides of leaves (ground cover and fruit tree hosts)
- ◆ 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. All 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

## Host 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! On pear, 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.

## 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 to outbreak levels in just a few days. 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 the 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” for chemical treatment when necessary
- ◆ Ensures proper timing of miticide treatments when necessary
- ◆ Reduces the likelihood of mite resistance problems

## Presence-Absence Sampling Method

Scouting for mites can be done at the same time as western tentiform leafminer sampling 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 for each block.

**Table 2: Web Spinning Spider Mites and Predatory Mite Presence-absence Sampling Method Look-up Tables\***

**Twospotted and McDaniel Spider Mites  
*Tetranychus urticae* and *T. mcDanieli***

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	—

**Predatory Mite  
*Typhlodromus occidentalis***

Number of leaves out of 10 with at least one mite present*	Estimated number of mites per leaf
1	0.1
2	0.3
3	0.5
4	0.8
5	1.1
6	1.5
7	2.1
8	3.0
9	4.6
10	—

\* **Note:** For each tree sampled, determine the number of leaves out of 10 with at least one mite present.

**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, it may be necessary to divide it into more blocks for sampling purposes.
- ◆ Scout designated orchard blocks every 1–2 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 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 Mite Sampling Form)
- ◆ Use the look-up table to estimate the number of

mites per leaf for both spider mites and predatory mites (see Table 2).

- ◆ 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.

**Management**

Relying primarily on **biological and cultural control** for spider mite management should be the goal of every orchard pest manager. In most situations, chemical control is not necessary and will often 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 described above, the following are the steps to follow to determine if economic thresholds for spider mites have been exceeded:

### Apple

- ◆ If the average number of 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 mites per leaf is 5 to 10 and there is less than 1 predator per leaf, resample in 2-5 days. If the predator to pest ratio is at least 1:10, resample in 1 week.
- ◆ If the average number of mites per leaf is more than 10 and there is less than 1 predator per leaf, consider applying a miticide treatment (see Chemical Control section below).

### Pear

- ◆ If the average number of 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 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 section below.)

### Stone Fruits

- ◆ No thresholds have been developed for web spinning spider mites or stone fruits in Utah; use apple thresholds as they are likely to be the most similar.

## Biological Control

### Mite Predators

The western predatory mite, *Typhlodromus occidentalis*, 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. *Zetzellia mali*, a smaller yellow 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.

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.

## 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:

- ◆ amitraz (Mitac)
- ◆ carbaryl (Sevin)
- ◆ dicofol (Kelthane)
- ◆ esfenvalerate (Asana)
- ◆ fenbutatin-oxide (Vendex)
- ◆ formetanate hydrochloride (Carzol)
- ◆ lime-sulfur
- ◆ methidathion (Supracide)
- ◆ methomyl (Lannate)
- ◆ oxamyl (Vydate)
- ◆ permethrin (Ambush and Pounce)
- ◆ sulfur

## 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 russeting 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, above). Keep in mind that aggressive weed and ground cover control should be maintained in young

orchards that are less than three 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 cause high populations of spider mites and low populations of predator mites.

## Chemical Control

There are few effective miticide choices for fruit trees because of the loss of some products for health concerns and because spider mites have developed resistance to most types of miticides and insecticides used in orchards. However, predators are still sensitive to many chemicals, especially pyrethroids and carbamates. 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 and McDaniel spider mites, the following materials are recommended:

- ◆ abamectin (Agri-Mek)—apple and pear only
- ◆ clofentezine (Apollo)
- ◆ hexythiazox (Savey)—pear only
- ◆ fenbutatin-oxide (Vendex)
- ◆ insecticidal soap
- ◆ summer-weight oil

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 one 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. Avoid applying a miticide on the same schedule as codling moth sprays, which would mean sprays that are 14 to 21 days apart. This schedule could result in eliminating predators while allowing spider mites to build back up between sprays creating a need for 3 to 4 sprays to maintain control throughout the season.

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### Acknowledgment:

V. P. Jones, University of Hawaii for development of binomial sampling table for European Red Mites and Web Spinning Spider Mites

# Spider and Predatory Mite Sampling Form

## Presence-absence Sampling Method

(Mid-June to Mid-September)

Orchard Block \_\_\_\_\_ Scout \_\_\_\_\_ Date \_\_\_\_\_  
 Stage of Bud development \_\_\_\_\_

Tree	Spider Mites		Predatory Mites	
	Number of leaves out of 10 with at least 1 mite per leaf	Estimated number of mites per leaf (from look-up table)	Number of leaves out of 10 with at least 1 mite per leaf	Estimated number of mites per leaf (from look-up table)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Total number of mites per leaf				
Average number of mites per leaf for 10 trees (divide above sum by 10)				

**Instructions**

1. Choose one or several representative orchard blocks of each fruit type for sampling. For orchard-specific pest control, all orchards should be sampled.
2. Randomly select 10 trees scattered throughout a 2- to 5-acre block.
3. On each sampling date, collect 10 leaves from each of the 10 trees (100 leaves total). Select leaves from inside the canopy as well as from the edges.
4. Keep leaves from each tree separate in order to identify “hot spots”
5. Using a 10-20x hand lens, count the number of leaves from each tree infested with each type of mite (spider and predatory). Note: It is not necessary to count the number of mites.
6. Record the number of mite-infested leaves per tree on the sampling form.
7. Use the look-up table to estimate the number of spider and predatory mites per leaf.
8. Total the estimated mite densities for all trees and divide by 10 to obtain an average.

**Treatment Thresholds\***

Apple—Treat if average number of mites per leaf is >10 and there is <1 predator per leaf.  
 Pear—Treat if average number of mites per leaf is > 5 and there is < 1 predator per leaf.

\*See bulletin (HG/ORCHARD/06) for more complete information.

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