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Mites

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Mites are not actually insects, but belong to the related class Arachnida, which also includes spiders, scorpions, and ticks. The major morphological differences between mites and insects are found in the number of major body parts and the number of legs. The head, thorax, and abdomen, which are separate for insects, are fused into a single continuous body region for mites. And, except for the initial mite developmental stage, mites have eight legs, whereas insects have six.

The mites of primary concern to raisin growers are spider mites and predatory mites. Spider mites belong to the family Tetranychidae, feed on grape leaves, and are the mites that most commonly cause economic damage in raisin vineyards. Predatory mites belong to the family Phytoseiidae and feed on spider mites and other mite species.

Other mites that can be found in raisin vineyards are the grape erineum mite (*Colomerus vitis* [Pagenstecher]), the grape rust mite (*Calepitrimerus vitis* [Nalepa]), and the tydeid mites (*Homeopronematus anconai* [Baker] and *Pronematus ubiquitous* [McGregor]). Erineum and rust mites feed on grape leaves but rarely cause serious damage. Tydeid mites feed mainly on pollen, and may play an important ecological role by serving as alternative prey for predatory mites. You can find details on these mite species in *Grape Pest Management* (see References at the end of this chapter).

DESCRIPTION

The most common spider mites in raisin vineyards are the Pacific mite (*Tetranychus pacificus* McGregor) (Plate 25.1) and the Willamette mite (*Eotetranychus willametti* [McGregor]) (Plate 25.2). On occasion, twospotted spider mite (*Tetranychus urticae* Koch) is found, but it is rarely of economic importance. Spider mites are quite small; adult females are about 0.5 mm long. The color of Pacific mite adult females ranges from amber to reddish, with relatively large dark food spots along the sides of the body. Willamette mite adult females are cream colored to pale yellow with small, dark food spots along the sides of the body. The male of each species has a pointed abdomen. Males are about half the size of females. Spider mite eggs are about 0.1 mm long, spherical, and transparent. Pacific mite eggs can be distinguished from Willamette mite eggs by the fine hairlike papilla that projects from the Willamette mite egg; Pacific mite eggs have no such papilla. Pacific mites produce webbing, whereas Willamette mites usually do not.

The most common and effective predatory mite found in raisin vineyards is the western predatory mite (*Galendromus* [= *Typhlodromus,* = *Metaseiulus*] *occidentalis*) (Plate 25.3). Adult females are about the same size as female spider mite adults, and are pear shaped. The western predatory mite's coloration ranges from amber to reddish, with a shiny luster and no food spots. Its eggs are about 0.1 mm long, oval, and transparent.

LIFE HISTORY AND ECOLOGY

Spider mites overwinter under the bark of grapevines as mature, mated females. After bud break in the spring, they move to the undersides of new foliage and begin feeding. Spider mites hatch as six-legged larvae and molt first into eight-legged protonymphs and then into deutonymphs before reaching adulthood. Generation time of Pacific mite is about 10 to 14 days in the cooler days of spring and about 6 to 8 days in the heat of midsummer. Distribution of Pacific mite on the leaf tends to be aggregated; they prefer folds and depressions on the leaf. Distribution of Willamette mite is more diffuse; the mites disperse throughout the leaf. Willamette mite is better adapted to cool temperatures and is therefore more active in the early spring than Pacific mite. As temperatures rise in the late spring and early summer, Willamette mite will be found on the cooler areas of the vine (i.e., shaded leaves in the canopy interior and on the north side of the vine row). Pacific mite thrives on the warmer areas of the vine (i.e., the top and the south side of the vine row).

Predatory mites overwinter as mated adult females under bud scales. In spring they emerge and search for food, and will feed on spider mites, tydeid mites, and mite eggs. Newly hatched predators (larvae) prefer to feed on spider mite eggs, whereas older immatures (protonymphs and deutonymphs) and adults attack all stages of spider mites. Adults are less active than juveniles and can often be found resting at the confluence of the veins on the leaf underside. Generation time for the western predatory mite is about the same as for spider mites, and depends in part on how much food is available.

DAMAGE

Spider mites feed by piercing leaf tissue and sucking out the contents of leaf cells. Damage appears as small chlorotic (yellow) spots on the upper leaf surface. Because of the aggregated distribution of Pacific mite, this yellowing begins on isolated areas of the leaf and spreads gradually outward (Plate 25.4). Prolonged feeding will cause chlorotic areas to bronze and ultimately turn necrotic (leaf burn) (Plate 25.5). Because of the diffuse distribution of Willamette mite, feeding causes more uniform leaf yellowing (Plate 25.6), but it rarely causes leaf burn. Willamette mite does not usually cause economic damage because it tends to feed on shaded leaves, which contribute little to carbohydrate accumulation. In contrast, Pacific mite prefers to feed on sun-exposed leaves, and prolonged feeding can significantly affect the vine's rate of photosynthesis and stomatal conductance. This can translate into a delay in sugar accumulation, later harvests, and reduced raisin grades, and may result in lower yields in subsequent years.

MONITORING FOR PRESENCE OF MITES

Begin checking for mites in early to mid-May and continue to check weekly until the end of July. Treatment decisions should be based on the presence of Pacific mite. Sample leaves from the parts of the vine that are more exposed to direct sunlight (the top and south side), where Pacific mite is more prevalent. Take at least 30 leaves in total from at least 10 different vines in a representative area; weak areas should be sampled separately. It is best to mark these vines and come back to them each week; if you take samples randomly, you will have to increase the number of samples in order to compensate for greater variability. With practice you will be able to distinguish the differences between spider mites and predatory mites with the naked eye, but initially it is best to use at least a 10× hand lens. Look for spider mites and predatory mites along the leaf veins. Predatory mites will be moving about searching for prey or resting in leaf vein angles.

Record the samples in tabular fashion (Figure 25.1). For each leaf sampled, record the presence or absence of Pacific mite in column 3 and western predatory mite in column 4. To determine the percentage Pacific mite infestation, divide the number of leaves with Pacific mite by the total number of leaves sampled. Divide the number of leaves with western predatory mite by the number of leaves with Pacific mite to get the predator-to-prey ratio. Follow the pattern of percentage infestation and predator-to-prey ratio over the season. Low predator-to-prey ratios (from 1:12 to 1:25) early in the season should not be a cause for concern if the Pacific mite infestation is under 50 percent. Even if Pacific mite infestation exceeds 50 percent as time goes on, there may be no need to treat if the predator-to-prey ratio increases as well (say, from 1:12 to 1:8 or 1:5). Once the predator-to-prey ratio reaches 1:2, the Pacific mite population will usually crash. On the other hand, if Pacific mite infestation exceeds 50 percent while the predator-to-prey ratio is low and remains static, treatment may be warranted. Pacific mite treatment thresholds and predator-to-prey ratios are also discussed in *Grape Pest Management* (see References).

CULTURAL CONTROLS

Spider mites are often more of a problem where grapevines are stressed. Water stress as a result of the low water-holding capacity of sandy soils, poor water infiltration due to surface sealing or crusting, or poor root penetration on shallow or compacted soils can make vines more susceptible to mite damage, as can severe nematode infestations. Dust can also exacerbate spider mite problems. Good soil and water management can go a long way toward minimizing spider mite damage.

Weak areas in the vineyard can be improved by irrigating more frequently or by installing a drip irrigation system. When replanting, vines in weak areas can be grafted onto a vigorous rootstock (e.g., 'Freedom' or 'Harmony'). If water infiltration is a problem, apply gypsum if indicated or add organic matter (e.g., cover crops, manure, or compost). If a compaction layer is reducing infiltration, it can be broken up by subsoiling

Date: Vineyard:			
Vine No.	Leaves Sampled	Leaves with Pacific Mite	Leaves with Western Predatory Mite
1	3		
2	3		
3	3		
4	3		
5	3		
6	3		
7	3		
8	3		
9	3		
10	3		

Leaves Infested = ______%* Predator:Prey Ratio = ______%-

$$\text{*Percentage of leaves infested} = \frac{\text{number of leaves with Pacific mite}}{\text{total leaves sampled}}$$

$$\text{Predator:prey ratio} = \frac{\text{number of leaves with predatory mite}}{\text{number of leaves with Pacific mite}}$$

Figure 25.1 Sample table for recording presence or absence of Pacific mite and western predatory mite

after harvest but before postharvest irrigation. Minimize cultivation from May through July. Cover crops or resident vegetation can be maintained through early July by means of periodic mowing. Be cautious, however, since this practice may increase competition for water and nutrients between the vines and the ground cover—more frequent irrigation or nitrogen fertilizer application may be necessary. Mowing instead of tilling not only increases water infiltration, but has an additional benefit of reducing dusty conditions. If the cover crop is turned under in early July, there are still 5 to 8 weeks to prepare the ground for harvest. Dust can also be reduced by oiling roadsides.

BIOLOGICAL CONTROLS

Other predators of spider mites that can be found in raisin vineyards are the sixspotted thrips (*Scolothrips sexmaculatus* [Pergande]) (Plate 25.7), the spider mite destroyer (*Stethorus picipes* Casey) (Plate 25.8), and minute pirate bugs (*Orius* spp.) (Plate 25.9). When present, these predators can contribute to spider mite control, but because they do not overwinter within the vineyard their presence is less consistent than that of the western predatory mite.

Natural population levels of predators should be conserved as much as possible. Predatory mites can also be conserved through the use of selective materials when treating for leafhoppers, caterpillars, and spider mites. See the *UC IPM Pest Management Guidelines* (see References) for details. The use of sulfur dust on spider mites and predatory mites is controversial. Two field studies conducted in the 1980s showed that heavy use of sulfur dust increased the density of Pacific mite, and suggested the suppression of predatory mites as the cause. Laboratory studies indicate, however, that the western predatory mite has a certain level of resistance to sulfur. A recent study by this author confirmed that sulfur dust increased numbers of Pacific mite, but, contrary to other studies, that it had no effect on predatory mites. Judicious use of sulfur is therefore advisable. There may be an advantage to using alternative fungicides (DMIs, strobilurines, etc.) during April and May.

Besides conserving natural predators, raisin growers can purchase and make inundative releases of the western predatory mite. The optimum release numbers of predators and optimum frequency of their release for cost-effective spider mite control have yet to be determined. One study found no effect on Pacific mite by an initial release of 2,000 predatory mites per acre, but another study found a 50 percent reduction in Pacific mite density with a release of 30,000 predators per acre. Releases should probably begin early, when spider mites are under 10 percent infestation as measured by presence-or-absence sampling methods. The insectaries that supply predatory mites should ensure that the predators have adequate resistance to commonly used materials such as sulfur. Insectaries ensure this either by periodically introducing “wild” predators into their colonies or by periodically treating their colonies (e.g., periodically dusting them with sulfur). The western predatory mite is available from numerous commercial insectaries throughout the nation.

CHEMICAL CONTROLS

If chemical treatment for Pacific mite is warranted, use a material that has a minimal impact on predatory mites. Also, beware of using the same material year after year, as that may encourage the buildup of spider mite resistance. Chemical treatments should be timed for maximum effectiveness. They should not be timed according to the time of the year, since spider mite population buildup can vary from early May to late July. Rather, Pacific mite and predatory mite populations should be carefully monitored as outlined above, and treatments applied only when justified by the counts. Keep in mind the predator-to-prey ratios previously discussed, and if predators are not abundant, treat at 50 percent infestation (using presence-absence sampling). Thorough coverage is imperative when you are using contact pest control material such as horticultural (summer) oils and insecticidal soaps. See the *UC IPM Pest Management Guidelines* (see References) for a list of currently registered materials.

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