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insect answers

Spider Mites on Red Raspberry

L. K. Tanigoshi, T. A. Murray, and B.S. Gerdeman

For several decades, the twospotted spider mite, *Tetranychus urticae*, was the only economically important spider mite species reported on red raspberry in Washington state. Researchers in the Pacific Northwest have shown that serious economic levels of this species can occur when growers use certain insecticides against pests such as root weevils and worms before harvest. When using insecticides known to kill the spider mite destroyer, *Stethorus punctum picipes*, growers remove an important predator population.

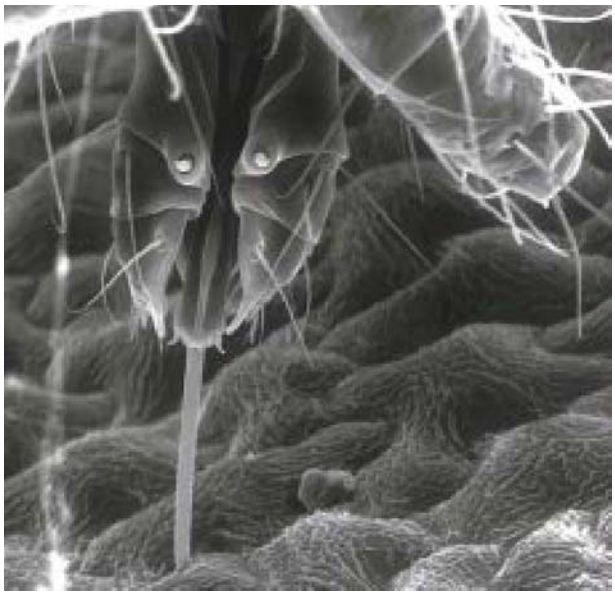

Figure 1. The piercing stylets of the McDaniel spider mite inserted into the upper leaf surface of an apple leaf.

Four species of spider mites now occur in red raspberry in Washington state. Yellow spider mite, *Eotetranychus borealis carpini*, was first reported in 1992; European red mite, *Panonychus ulmi*, in 1995 from Whatcom and Skagit counties; and the McDaniel spider mite, *Tetranychus mcdanieli*, in 1997 from Clark County. Growers can manage serious spider mite infestations in red raspberry using selective pesticides known to be safe to natural enemies. If growers do not control spider mites, defoliation in early fall will induce fruiting buds to develop prematurely, subjecting primocanes to winter injury, and causing indirect economic damage.

Biology and Life History

Spider mites damage both leaf surfaces of red raspberry by inserting their "piercing-sucking" mouthparts into foliage tissues and removing plant juices (Figure 1). They inject salivary toxins, enzymes, and hormone-like substances into the feeding puncture. Red raspberry responses to spider mite feeding include chlorotic (yellow or white) stippling on leaf surfaces, reduced bud formation, reduced yields, dropping of leaves, and even death of the plant (Figures 2–3).

Female mites lay eggs mostly on the underside of leaves. Larvae hatching from eggs look like small adults with three pair of legs. The

Figure 2. Severe economic injury to red raspberry showing defoliation, dieback of fruiting canes, and injury to primocanes.

Figure 3. Buildup of late season yellow spider mite populations during harvest.

Figure 4. Adult female twospotted spider mite.

larva is followed by two nymphal stages that look like smaller adults and possess four pair of legs. The rate of development increases with increasing temperature, decreasing the time from egg to adult. Hot dry conditions favor spider mite outbreaks.

Economic Importance

Twospotted spider mite. Mature females have a pale yellow-green or red oval body with pale legs. They have a dark green food spot on either side of the body, which gives the mite its name (Figure 4). All life stages spin a continuous thread of silk called webbing over the foliage they have colonized (Figure 5). Spinning of the webbing plays a role in spider mite dispersal, migration, and deposition of eggs. The webbing protects the spider mites from predators, pesticides, and water loss.

The twospotted spider mites overwinter as orange-colored adult females within the soil, in basal fruiting canes, and plant debris. They commonly emerge from April to May and begin to feed on older or mid-shoot leaves on fruiting canes before dispersing to the upper canopy in July to August. As these overwintering females feed they take on the species' normal yellow-green hue and two characteristic dark-colored food spots. The stylet shaped mouthparts common to all spider mite species pierce and suck plant juices. This type of feeding activity produces small, yellowish spots on the upper leaf surface. Leaf margins appear dried and turn reddish brown.

Generally five to six overlapping generations occur per year in western Washington. Summer females each lay about 130 eggs during a 30-day life span on red raspberry. Field populations increase rapidly after harvest through early September. They can cause extensive bronzing, drying, withering, and defoliation of primocane foliage by late August. Leaf quality declines in response to cooler fall temperatures, shorter day length, and spider mite feeding. Spider mite females change to orange overwintering forms and begin to migrate from the leaves to overwintering sites.

Figure 5. Twospotted spider mites form very dense webbing on leaves and fruits.

Yellow spider mite. Mature females are about a third smaller in length than the twospotted spider mite. They are pale yellow or greenish and have two or three pair of small dark food spots on the body (Figure 6). This species produces very little webbing. It overwinters as bright yellow females without food spots, in soil crevices and along the basal bark tissue of primocanes. Early colonies are small and occur along the undersurface of leaf midribs and veins. Feeding symptoms on the upper leaf surface appear as a more concentrated yellowish brown coloration along the secondary and tertiary veins (Figure 7). This species emerges and disperses earlier than the twospotted spider mite. It reaches the distal primocane foliage along the top trellis wire of red raspberry in April to May. Populations of this species remain on primocane foliage later in the season than the twospotted spider mites that have begun their diapause phase.

Summer females lay about one-third as many eggs, yet they produce a generation or two more than do the twospotted spider mite females. Research data indicate yellow spider mite prefers cooler spring and fall temperatures. Effects of twospotted spider mite and yellow spider mite on red raspberry physiology under greenhouse conditions showed infested plants responded equally to both species. Under field conditions, both species may cause the same level of economic damage, although plants appear to tolerate higher densities of yellow spider mites. This species

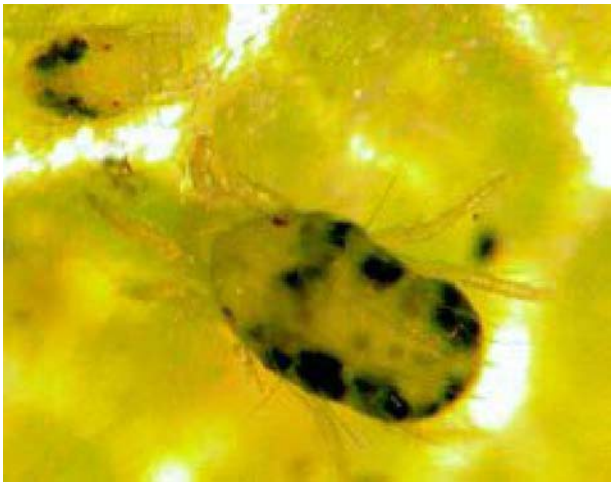

Figure 6. Adult female yellow spider mite.

Figure 7. Characteristic yellow spider mite bronzing of upper leaf tissue between major veins.

commonly coexists with the twospotted spider mite in Whatcom, Skagit, Clark, and Cowlitz counties, Washington.

European red mite. Adult females are brick red colored. Distinct white tubercules are located at the base of several white bristles on their back (Figure 8). This species differs from the other three species because it overwinters in the egg stage, and the adults commonly inhabit both leaf surfaces.

Feeding symptoms by this mite appear uniformly distributed between secondary veins on the leaf's upper surface. The injured tissues remain whitish colored compared with the yellow-brown "bronzing" hues caused by the other spider mite species (Figure 9).

We assume they overwinter in red raspberry fields as eggs placed on roughened bark and at the base of primary buds of dormant fruiting canes. The occurrence of this species on red raspberry in northwestern Washington is not widespread. We know very little about the developmental biology and economic importance of European red mite on red raspberry, although its occurrence has been observed in Whatcom County for several years. Why this common tree fruit species is becoming more widespread is unclear.

McDaniel spider mite. This species was described from red raspberry in Michigan in 1931. It is common on tree fruits in drier areas of central Washington. In 1997, it was reported on red raspberry in Clark County in southwestern Washington. The population dynamics, feeding and webbing behaviors of this species are very similar to those of the twospotted spider mite. Rather than displaying two large food spots, the female McDaniel spider mite shows three or four diffuse food spots along the margins of the abdomen (Figure 10). Uncontrolled summer populations first colonize fruiting and primocane foliage along the upper trellis wire. The foliage first shows yellow-white stippling as feeding symptoms. Webbing that commonly harbors upward of 300 to 500 motile stages per leaflet quickly covers the foliage. This infestation

Figure 9. Uniformly distributed stippling injury caused by European red mite feeding on red raspberry foliage.

Figure 8. Adult female European red mite.

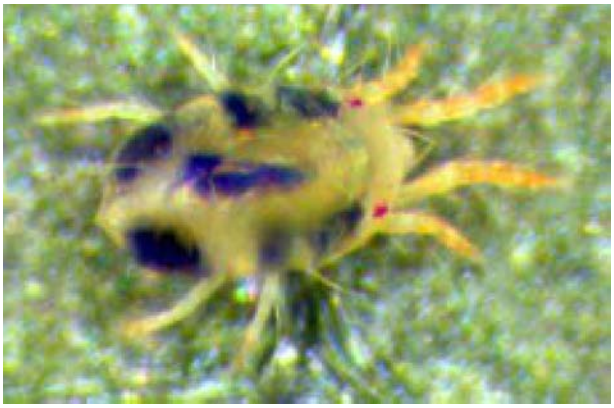

Figure 10. Adult female McDaniel spider mite.

Figure 11. Severely bronzed and defoliating foliage of commercial red raspberry caused by the McDaniel spider mite.

level causes foliage to appear yellow-brown, to dry out, and to defoliate prematurely (Figure 11). Fruits exposed to sunlight become flaccid and misshapen.

Population Management

Reasons remain somewhat unclear for the dramatic species shift in recent years from the common twospotted spider mite to a complex of four species. Research and extension studies conducted in commercial red raspberry fields between 1987 and 1994 with organophosphate and pyrethroid insecticides, concluded the use of these broad-spectrum insecticides harm or kill important spider mite predators. Moreover, postharvest spider mite outbreaks and spider mite species shifts first reported in 1992 continue to cause problems.

Current population trends for the twospotted spider mite and yellow spider mite in northwestern Washington indicate peak numerical increases after harvest in mid- to late August. By September, twospotted and McDaniel spider mite populations decline as a result of predation by the common predatory mite, *Neoseiulus fallacis* (Figure 12). Yellow spider mite continues feeding on primocane foliage through September. Overwintering females appear in response to short day length.

Figure 12. Several predatory mites, such as *Neoseiulus fallacis*, are important natural enemies of spider mites on red raspberry.

The variation in spider mite infestation peaks, cumulative feeding damage effects, and plant responses to foliage feeding has confounded efforts to define a common treatment threshold. The factors that cause spider mite dynamics to vary from field to field and from year to year are not well understood in red raspberry. Canadian research suggests "heavy" twospotted spider mite feeding during and after harvest can reduce yield by 25% the following season. For years, 25 twospotted spider mites per leaflet has been proposed for a treatment threshold for small fruits. Red raspberry appears to tolerate significantly greater densities of yellow spider mite than of twospotted spider mite.

Good integrated mite management builds on cultural practices. Integrated management practices that reduce dust on foliage and fruit minimize harmful effects to arthropod predators and potential for severe spider mite outbreaks (Figure 13). Good farming practices improve the health and vigor of the plant to better withstand mite feeding impacts. Good practices do not guarantee supplemental chemical control will not be needed either before or after harvest. Newer miticides are more selective for the spider mite pests and safer to predatory mites. Good farming practices in orchard integrated control of spider mites can incrementally shift an orchard away from a miticide-based program.

Consult the following Extension publications for current recommendations: EB1491, *Pest Management Guide for Commercial Small Fruits* and the 2003 *PNW Insect Management*

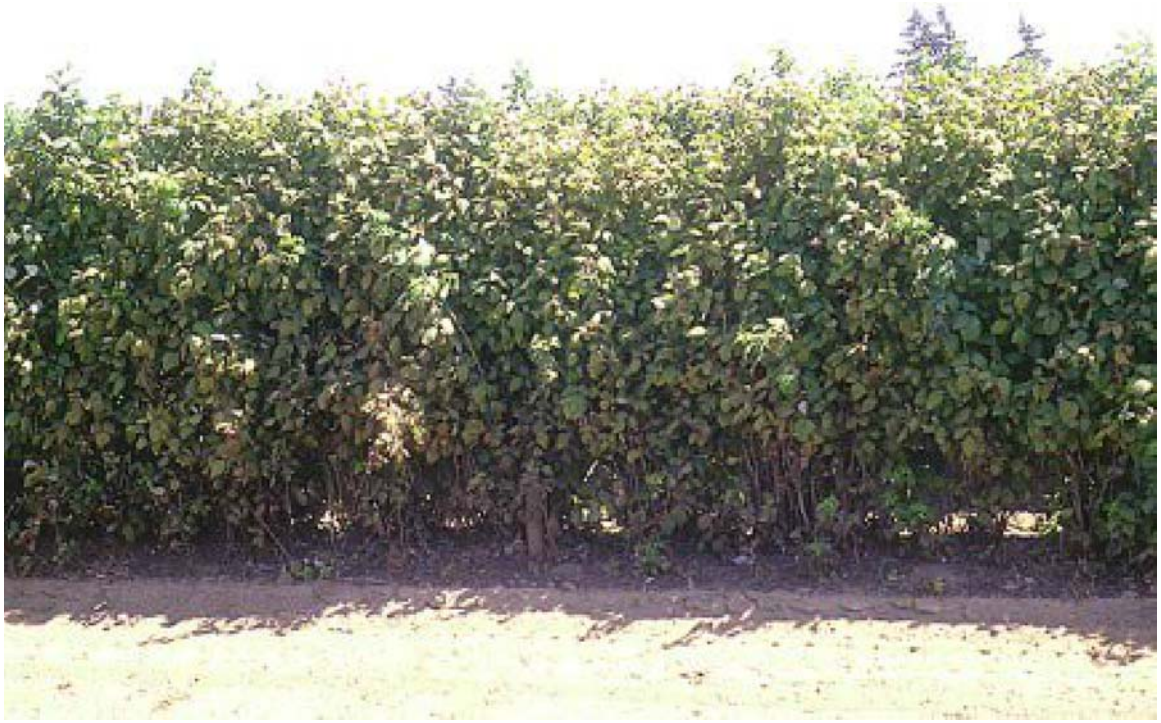

Figure 13. Managing roadside dust on foliage will reduce the potential for spider mite flare-ups to damaging levels.

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Use pesticides with care. Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

Lynell K. Tanigoshi, Ph.D., Washington State University Extension entomologist, WSU Vancouver; ***Todd A. Murray***, MSc, WSU Extension IPM specialist, Whatcom County; ***Beverly S. Gerdeman***, Ph.D., WSU research associate in entomology, WSU Vancouver.

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