Mite Populations on Grapes

effect of sulfur dust treatments on predatory mites and red spider mite

Leslie M. Smith

The annual rise and fall of populations of the Pacific mite—*Tetranychus pacificus* McG—and the Willamette mite—*Tetranychus willamettei* McG—on grapes has puzzled growers and entomologists for years. In the fall of 1949 the last explanatory link was supplied.

The Pacific and Willamette mites are plant-feeders and do serious damage to grapes in California. Growers north of Fresno are aware that the Willamette mite often appears in great numbers on the vines in the early spring, just as the buds open. They lay eggs and increase in numbers and seriously damage or even kill the young, expanding leaves. By mid-May, they disappear and are not seen again until the following March.

The Pacific mite appears on the new shoots in the spring about 10 days later than the Willamette mite, but in such low numbers that they are very difficult to find. They breed and multiply rapidly but do not reach destructive abundance until June, and in most vineyards their injury is not apparent until July or August. They continue to injure the leaves until the latter part of September, when the adult females seek hibernating quarters under the grape bark, close to the living tissue. Those which linger on the leaves are killed by predaceous mites.

Field observations made during the past 10 years indicate that in the vineyards north of Fresno the Pacific mite is highly resistant to sulfur dust, whereas the Willamette mite is killed by sulfur dust—except in vineyards around Fresno and to the south, where the Willamette mite appears to have developed a strain which is resistant to sulfur. In this district the Willamette mite does not disappear in May but continues to live and breed on the grape throughout the summer, and seriously damages mature leaves by fall.

Applications of sulfur dust for the control of mildew, in vineyards north of Fresno, cause the disappearance of the Willamette mite in mid-May.

During the winter of 1948–49 several vineyards were found in Sonoma and San Joaquin counties wherein the Willamette mite occurred under the bark in enormous numbers, estimated at about 7,000 mites per vine in extreme cases. Their bright yellow bodies were packed gregariously together in solid patches often approximating a square inch in area—easily visible to the unaided eye. At the same time in other near-by vineyards, no Willamette mites could be found.

Two questions immediately arise: *1*, Where did such great numbers of Willamette mites come from, since they disappeared last May?—and *2*, Why are they so abundant in some vineyards and apparently absent in others close-by?

Late in the summer of 1949 studies conducted in a vineyard in Contra Costa County supplied the needed explanation. In this vineyard a heavy population of Pacific mite was being decimated by large numbers of a species of predatory mite—*Iphidulus* sp.—which feeds on red spider mites.

By the middle of August, the Willamette mite was found in the vineyard under observation. Individuals of this species were intermingled with Pacific mites, living together in a common colony. Predaceous mites were abundant. Throughout the latter half of August, the population of Pacific mites was rapidly declining while the population of Willamette mites was rapidly increasing. A count of motile stages on a sample of 20 leaves, collected on August 17, 1949, is given in the accompanying table.

Abundance of Mites on Grape Leaves

Number	Total red spider mites, Microscope count	Willamette mites, estimated	Pacific mites by subtraction	Predatory mites
1	342	100	242	0
2	579	50	529	0
3	697	200	497	27
4	469	250	219	121
5	73	28	45	9
6	164	0	164	20
7	756	500	256	15
8	451	75	376	17
9	54	0	54	4
10	260	100	160	6
11	350	100	250	0
12	64	30	34	15
13	81	25	56	18
14	268	50	218	35
15	405	175	230	6
16	289	150	139	19
17	415	100	315	5
18	16	5	11	27
19	108	20	88	23
20	225	80	145	10

The number of Willamette mites could only be estimated since the young Willamette and Pacific mites could not be identified with a binocular microscope. These figures represent an average per leaf of 303 Pacific mites, 101 Willamette mites, and 19 predatory mites; or one predatory mite for each 21 red spider mites. Each predatory mite is believed to eat five or more red spider mites daily, so about a week from this count red spider mites might be near extinction.

Even in the presence of such overwhelming numbers of predators, the Willamette mites continued to increase. Leaves carrying all three mites were studied under a microscope. It was found that the predatory mites pursued, overtook and killed the Pacific mites. They likewise pursued the Willamette mites but could not overtake them. In every contest of this sort observed, the Willamette mites outdistanced the predators and escaped.

Thus it is possible for the Willamette mite to increase in the late summer under predatism which nearly exterminates the Pacific mite. This explains why the Willamette mite enters hibernation in far greater numbers than the Pacific mite and is able to appear in damaging numbers in the early spring.

The predaceous mite—*Iphidulus* sp.—was the dominant predator on the red spider mites during these observations. Many other species of mites and predaceous insects prey upon red spider mites, and in localized areas in occasional years they may be important in control.

The *Iphidulus* mite is the commonest and most consistently present of all the predators. This species overwinters in a dormant condition under bark of grape vines. It suffers a heavy winter mortality so that it normally has little control value in the spring months. But by mid-summer it is often capable of exterminating a heavy population of Pacific mite. By fall, it is usually abundant in most vineyards and a good control of red spider mites.

The graph on the next page indicates how the population of Willamette mites increases while the population of Pacific mites decreases. These two mites are so

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Nitrogen Fertilizer

California deciduous fruit orchards respond in variety of ways due to individual conditions

E. L. Proebsting

Nitrogen is the only fertilizer applied to a substantial acreage of deciduous fruit orchards in California. Usually the first limiting nutrient in the production of those orchards is nitrogen. Only a part of the total deciduous acreage has reached a level where response to nitrogen fertilizer is obtained.

These conditions are due, not only to soil variation, but to varying requirements of different species, and to variations in climate and in cultural practices. It has been found that the same variety of apricot in the Santa Clara Valley makes a much greater response to nitrogen and must be fertilized more carefully than on the same soil type in the Sacramento Valley, where the light intensity and temperatures are greater.

Trials in several sections of the state have shown marked differences in the response of different species on the same soil and with the same cultural treatment. The peach is perhaps the first species to show response in a given environment, and a high percentage of the peach acreage of the state receives some nitrogen. The prune is usually the last among the stone fruits to respond, and the percentage of prune orchards receiving nitrogen is much smaller than that of peaches. The other stone fruits are intermediate in behavior. Apples and pears have seldom shown response to nitrogen; walnuts are higher in the scale of response.

Various sources of nitrogen have been used in field trials during the past 25 years. In most cases there has been little or no difference in response to a given amount of nitrogen, provided suitable allowance was made for the characteristics of the material. For example, an early winter application of nitrate to a sandy soil in a region of high winter rainfall would not be suitable because of leaching. Availability, convenience of use, and cost may well determine the choice of the source of fertilizer.

Experimental work has been done in several orchards to study the relative advantages of various times of applying nitrogen fertilizers. It was found that nitrogen was less effective when applied in early fall than in any other season.

One of the facts developed is that a late spring application has not been effective in increasing the size of stone fruits. Growth curves for peaches and apricots were not modified by this practice, and cherries and prunes reached the same final size whether they received a spring dressing or not. Size seemed to vary in accordance with the ratio of fruits to leaf area.

The great diversity of soils, species, and other factors has resulted in extreme variations in response. No experimental basis for rate of use has been developed, and correlation of response to soil analyses has been poor. This is to be expected, since nitrate at a given moment reflects only the difference between production and utilization, and total nitrogen does not indicate the rate of availability.

Curves of leaf nitrogen show seasonal differences in the same trees, and usually show too steep a drop throughout the season to be used as an index of nitrogen status within wide limits.

Field trials remain the most accurate method of diagnosis, but are slow and require supervision.

E. L. Proebsting is Professor of Pomology and Pomologist in the Experiment Station, Davis.

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similar in appearance that the Willamette mite may have been mistaken in past years for the Pacific mite. The substitution of Willamette mites for the other species is so gradual that it appears to the unaided eye to be a continuous infestation of Pacific mites.

An approximation of the overall average fluctuations in populations, based on numerous observations over a 10-year period is shown by the graph. It applies to the area north of Fresno, where most of the observations were made.

Actually the curves vary from year to year by being displaced slightly earlier or later. Each district may vary from its neighbors; and finally each vine may pass through cycles of infestation, earlier or later than its neighbors.

The predatory mite may overcome and practically exterminate the Pacific mite at any time after May. When the Pacific mites are nearly extinct on a vine or in a vineyard, the hungry predatory mites become cannibalistic and in about two days reduce their own population almost to zero. The few surviving Pacific mites then multiply rapidly and reach a second peak of abundance in the same year. In some vineyards, in 1949, this cycle was repeated three times.

Sulfur dusting in the spring is responsible for the disappearance of the Willamette mite in May—north of Fresno. Growers who dust more often or more frequently are probably free from Willamette mite damage. Those who put on less sulfur probably allow a few Willamette mites to survive and these are able to establish thriving colonies in the late summer, after the sulfur dust has been dissipated from the vines.

Leslie M. Smith is Associate Professor of Entomology and Associate Entomologist in the Experiment Station, Davis.

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