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Population densities and economic injury levels of grape leafhopper

WHEN THE GRAPE integrated control project was started in 1961, the grape leafhopper, *Erythroneura elegantula* Osborn, was believed to be the primary pest of vineyards in the San Joaquin Valley. Also, it was believed that chemical treatments to control this insect were responsible for the increase of secondary pests such as spider mites. The basic aim of these studies was to determine what levels of leafhoppers could be tolerated without need of chemical treatments.

Evidence to date indicates that grapevines can tolerate fairly high numbers of leafhoppers without any reduction in total yield or sugar content. Trials with Thompson Seedless grapes destined for wine or raisin production have shown that up to 20 nymphs per leaf in the first brood, and up to 10 nymphs per leaf in the second brood, can be safely tolerated. Toleration of these levels of infection reduces operating costs by eliminating unnecessary insecticide applications, and also reduces or retards resistance to pesticides and biological disruptions.

These trials have shown that excessive leafhopper spotting occurs from populations that do not otherwise affect yield, sugar content, or any qualitative characteristic (other than appearance). Both the adults and nymphs of this insect feed on the leaves and drop excrement onto the berries to produce the undesirable spotting.

California standards for table grapes state that berries are damaged when leafhopper residue materially affects the appearance. This determination is a subjective one made by an inspector and thus depends upon individual appraisal. In this project, "excessive spotting" was defined as more than 75 spots per square centimeter on white table grapes and more than 100 spots on colored table grapes. The berries most exposed to leafhopper droppings (those on the upper shoulders of bunches) were chosen for this purpose and the spots were counted with a hand lens. Fruit from some trials had spotting above the proposed levels without failing the inspection standards when moved through normal commercial channels. Some inspectors, and some table grape growers, might well object to the levels adopted, however.

The spotting is obviously related to the numbers of leafhoppers, but as yet no simple technique has been devised for the measuring of this relationship as a guide for establishing economic injury levels. Some of the problems include: (1) Only the nymphs are easily counted while at times the flying adults cause most of the spotting. (2) Nymph counts do give a measure of the future adult population, but there is great variation in the length of time adults live, and in the amount of spotting they produce. (3) Comparable nymph populations have been found to produce more spotting in July and early August than in late August and September. (4) The spotting is not always proportional to the nymph populations. That is, six nymphs per leaf may produce more than twice as much spotting as three nymphs per leaf. (5) While spotting keeps accumulating from the time the second brood nymphs begin hatching until harvest, the spotting is concurrently being reduced by berry growth and weathering processes.

Attempts were made to correlate spotting with leafhopper populations by multiplying weekly counts of the number of nymphs per leaf by the number of days of fruit exposure, and by accumulating these figures from the beginning of the second brood until harvest. For example, three nymphs per leaf over seven days of fruit exposure added up to 21 nymph-days. These trials indicate excessive spotting will not occur until about 250 nymph-days of exposure have accumulated, but the extreme variation of various trial results limits the usefulness of this concept. There were examples of excessive spotting with as few as 150 nymph-days and non-excessive spotting with as many as 500 nymph-days.

In general, table grape growers have relied on preventive chemical control programs with little regard to leafhopper numbers. As long as effective materials were available, this approach worked well. However, this type of control program is now breaking down because leafhoppers have developed resistance to the more commonly used insecticides and repeated treatments have become necessary. Moreover, many vineyards which have been under preventive programs are now infested with spider mites, a pest even more serious than leafhoppers. Fortunately, however, total reliance on chemical pest control is not necessary in all table grape vineyards. There are alternate methods which not only insure quality fruit but which also help to relieve resistance and biological disruption problems.

Numerous studies have shown that Thompson Seedless grapes cultured for table purposes under commercial conditions frequently need not be treated for grape leafhopper. Close checks of fruit from these vineyards revealed no loss of quality, although some spotting was obvious. Population studies indicate that in contrast to its development on Ribier and Emperor grapevines, leafhopper development on Thompson Seedless is often retarded, particularly during the second and third broods. In the past, preventive pest control programs have not considered the possibility of varietal differences in susceptibility to leafhoppers. Thompson Seedless vines have been found to be more susceptible than Emperor and Ribier to the ravages of pesticide-induced spider mite outbreaks.

In areas where the leafhopper egg parasite, *Anagrus epos* Girault, is active early in the season, the number of treatments has been greatly reduced by taking advantage of the ability of this parasite to effectively search out and destroy leafhopper eggs. The parasite is not equally effective on all table grape varieties, but its activity can reduce the number of treatments which otherwise would be necessary for the harvesting of quality fruit.

Unfortunately *Anagrus* is not active much of the season in some table grape areas of the Valley. Attempts to alleviate this situation by planting blackberries to provide overwintering refuges for the parasite have not been entirely successful. Further studies are needed to improve the parasite output of these cultivated refuges.

Except for taking advantage of the differences in grapevine susceptibility to leafhoppers as discussed, few changes in control practices are foreseen in those table grape areas where natural parasite refuges do not occur. Until cultivated refuges are made more effective, leafhopper control programs must be based on the efficient use of chemicals.

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Effects of ROAD DUST ON SPIDER MITES

INTEGRATED CONTROL

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Many field observations have caused speculation by both growers and researchers regarding the coincidence of higher spider mite populations on plants with foliage covered with fine road dust. This association occurs more commonly near roads or avenues which are heavily traveled. These investigations indicated that road dust alone did not stimulate or affect the mites in a manner which might result in higher populations.

THESE STUDIES were limited to the Pacific spider mite and to the initial, or immediate, effects of road dust found on a plant leaf surface. A possible variable in studies conducted over longer periods of time is the effect of the dust on the condition of the plants which the mites are inhabiting.

Before the actual experiments, the size and density of the dust particles found on typical roadside plants had to be determined. Normal dust levels were established from leaf samples from the University vineyards. Leaves were collected in July from vines near roads which were heavily traveled, and from vines in the middle of a row, to obtain a level resulting from normal cultivation. The samples of 20 leaves each were then brought into the laboratory, and the dust from the leaves was washed off in a quart of water. The leaves were weighed before and after the washing in order to determine the approximate amount of dust washed off. The dust, then in suspension, was collected by filtration. The filter paper was also weighed before filtration and again after the dust had been scraped off and collected. The dust was then screened through various mesh-sized screens, then categorized, and weighed. These procedures established the basic dust levels to be used for the tests.

Three experiments

The investigation was conducted in three separate experiments with control groups. The first experiment was to determine if the size of the dust particles had any effect on the spider mites. From the leaf samples, it was known that the 200- to 325-mesh-sized dust and the 325- and smaller mesh-sized dust were the most abundant sizes found on the leaves. The leaves and their petioles were removed from a lima bean plant. The petiole was then placed into a glass vial of distilled water. The leaf portion was cut down to an area of 2 square inches. Separate leaf sections were then dusted with the appropriate amount of the dust of each mesh size. A vacuum chamber was employed to ensure that the amount of dust which settled on each leaf was as close as possible, by weight, to the actual amount of dust of this size found on a leaf in the field. The control samples were leaf sections free of any dust.

Adult female and male mites were then placed onto the surfaces and their progress was observed during the next few days. The results were interpreted in terms of the egg laying rates of the mites placed in the various situations. No significant differences could be found between the mites placed onto surfaces with the 200 to 325 mesh dust, those with the 325 and smaller mesh dust, and the control.

The second experiment was conducted in the same manner except that equal amounts of dust of the various mesh sizes were used. Each leaf section was dusted with a certain amount of particles of only one mesh size. The control was again free of dust. Again no significant differences were noted.

Dust types

The same procedures were used in the third experiment. However, dust collected from different areas of the San Joaquin Valley was used to determine any possible influence of the type of dust in a particular location, or dust exposed to the influence of different cultural and control methods. One of the dust samples collected for this phase of the experiment was from an area with a history of spider mite problems. Another sample was taken from an area with relatively few mite problems. Equal amounts of the various types of dust were applied to the testing surfaces with each surface receiving only one type of dust. The results again showed that there were no significant differences.

From these results, it seems that the road dust alone does not cause a direct stimulus to which we might attribute the greater populations of spider mites. In field conditions, the dust on a leaf surface may act as a deterrent to the predators and parasites of the spider mite. Other conditions such as humidity which is important in the environment of the mite, could be a major factor. It was not possible under laboratory conditions to reproduce the actual conditions found in the field. Therefore, only the dust factor was simulated in the environmental testing. The effects of this type of dust on the physiology of the plants which the mites were inhabiting poses a complex problem yet to be investigated, One or a combination of many factors may be contributing reasons for the occurrence of these greater mite populations.

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