periods showed that the average number of droppings began to increase at dawn and reached a peak in the early evening (graphs 1 and 2). After this peak was reached, the number declined rapidly and remained at a low level during the night.

During the observation periods, the daily curve for the number of droppings tended to change gradually in shape as the season progressed. These changes are indicated in the curves of July 23 to 25 in graph 1 and September 5 to 7 in graph 2. In mid-summer (July 23 to 25), the number of droppings increased during the morning hours, reached a peak and then decreased in the early afternoon. This decline was followed by an increase in the late afternoon or early evening. Later in the season (September 5 to 7), the trend showed a gradual increase in the number of droppings in the morning and a peak was reached in the late afternoon. This seasonal change in the shape of the curve appeared to be correlated with the trend toward cooler morning temperatures.

The greatest variations in the number of droppings from hour to hour during the 24-hour period, tended to occur at temperatures of 80° F and above. The maximum rate of droppings often came several hours after the highest temperature occurred. The curve in graph 3 shows an increase in the rate of feeding at temperatures up to 87° and 90° F, but a decrease occurred at higher temperatures.

Light

Light may also play a role on the feeding rate of the leafhoppers. In the vineyard—within the range of temperatures that occurred in the daylight and darkness (50° to 76° F)—the rate of droppings per hour was greater, on the average, during the light period. The effect of light was also demonstrated in the laboratory. Ten leafhoppers were confined in wire screen cages, from July 16 to July 24, 1963, in a constant temperature cabinet with light provided by a fluorescent lamp for periods of 15 out of every 24 hours. The top of the cage was enclosed by using a detached grape leaf with the petiole immersed in a weak Hoagland's solution. Instead of a moving strip of paper on the bottom of the cage, a paper card disk was used and held in place with small magnets. The cards were changed every three hours except during the dark periods.

The results showed that the average numbers of droppings per hour per adult leafhopper in the dark and light periods were: 70° F–1.2, 2.9; 80° F–1.8, 3.9; and 90° F–2.3, 5.3, respectively. From August 26 to September 5, 1963, droppings were also collected on a strip of paper moving continuously beneath and closing the bottom of the cage. The average numbers of droppings per hour, per adult leafhopper in the dark and light period in this test were: 80° F–dark, 0.75 and light, 0.78; 90° F–dark, 1.8 and light, 3.1.

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SURVEYING leafhopper populations

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Rapid and accurate surveying for grape leafhopper population levels is essential to a decision for necessity of insecticide treatment within an integrated pest control program. These Tulare County studies indicate that counting the nymphs on only two leaves per acre gives as accurate an estimate of the population as did counting the nymphs on fifty leaves. It was also found that the leaves could be selected from vines along the avenues, rather than from vines scattered throughout the vineyard.

To survey leafhopper populations in a standard vineyard planted with vines 8 ft apart in rows 12 ft wide and approximately 640 ft long, the following procedures are suggested:

(1) Choosing the vine—Walk along each end of the block. At every fifth row, go in to the third vine and select one leaf for examination. Avoid the outside rows and the two end vines, since these usually show higher-than-normal populations.

(2) Locating the leaf for examination—First brood, select one of the basal leaves on the cane. The second through sixth leaves give highest counts. Second brood, select a mid-cane leaf.

(3) Choosing the leaf—Look for evidence of feeding damage as a guide in selecting leaves for nymphal counts. Before beginning the counts on any particular day, examine a few leaves to determine which ones are likely to give the highest counts. However, once the counts are begun, never discard any leaf which has been selected, even if no nymphs are found.

(4) How often to count—Two or three counts for the first brood and additional counts every 10 days to two weeks beginning with the second brood, are sufficient. Should populations appear to be changing rapidly, additional counts may be necessary. Climbing populations always are reflected in the counts of nymphs, which are small at first. These young nymphs do little damage; therefore, a few days delay in counting or treating does little harm.

(5) Averaging counts—For any block, count a minimum of 15 leaves. Total the number of nymphs, and divide by the number of leaves examined to obtain the average number of nymphs per leaf. Keep figures separate for each block.

The system described was developed for use in vineyards ranging from 10 to 40 acres in size and takes two to three minutes per acre. On larger commercial acreages, a slightly different system has been used, successfully. Because it is faster to drive between sample locations instead of walking, three leaves were examined at every thirtieth row at each end of the block rather than one leaf every fifth row. Using this system, an average of only one leaf was examined per acre rather than two. No block less than 20 acres in size is suitable for this method. Mite populations can also be checked while walking from the truck to the sample location by selecting a three-leaf sample from the fifteenth vine from the end of the row. One man can survey 500 to 1,000 acres per day with this system. The number of nymphs per leaf greatly influences the amount of time needed for counting.

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