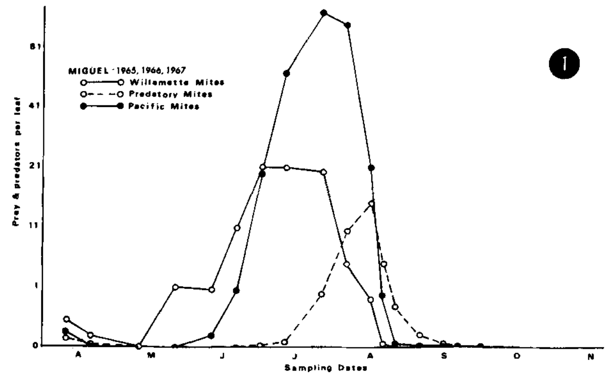
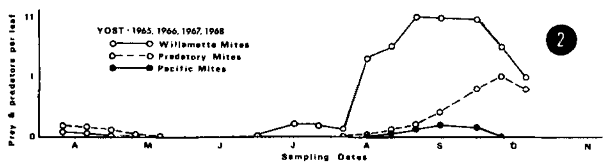
Correcting imbalances –

SPIDER MITE POPULATIONS in SOUTHERN SAN JOAQUIN VINEYARDS

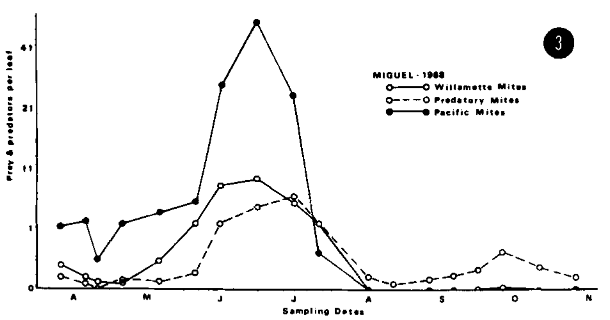
GRAPH 1. TYPICAL PREDATOR AND PREY POPULATION TRENDS IN THE MIGUEL THOMPSON SEEDLESS VINEYARD IN BIOLA, FRESNO COUNTY, 1965, 1966, AND 1967—HISTORY OF MANY PESTICIDE TREATMENTS PRIOR TO JULY, 1964, BUT NONE SINCE



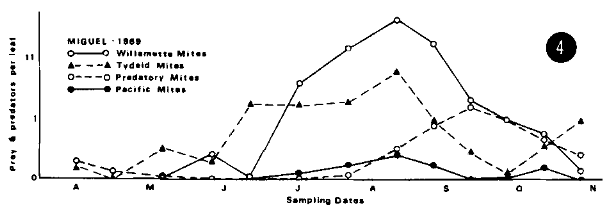
GRAPH 2. TYPICAL PREDATOR AND PREY POPULATION TRENDS IN THE YOST, THOMPSON SEEDLESS VINEYARD IN BIOLA, FRESNO COUNTY, 1965, 1966, 1967, AND 1968—NO HISTORY OF PESTICIDE TREATMENTS



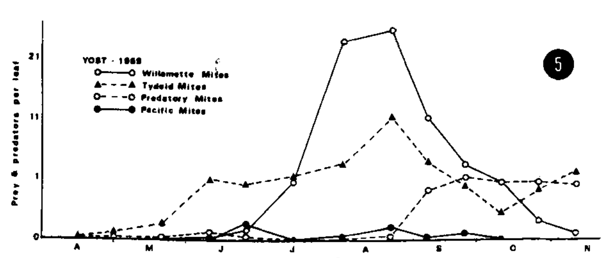
GRAPH 3. PREDATOR AND PREY POPULATION TRENDS IN THE MIGUEL, THOMPSON SEEDLESS VINEYARD IN BIOLA, FRESNO COUNTY, 1968—MANY TREATMENTS PRIOR TO JULY, 1964, BUT NONE SINCE



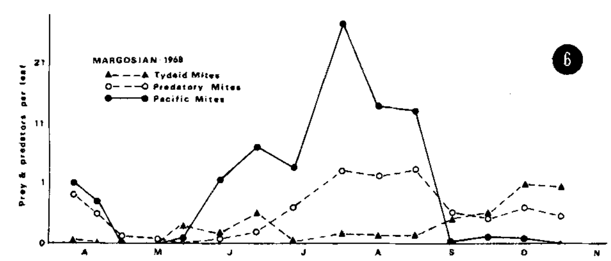
GRAPH 4. PREDATOR AND PREY POPULATION TRENDS IN THE MIGUEL, THOMPSON SEEDLESS VINEYARD IN BIOLA, FRESNO COUNTY, 1969—MANY TREATMENTS PRIOR TO JULY, 1964, BUT NONE SINCE



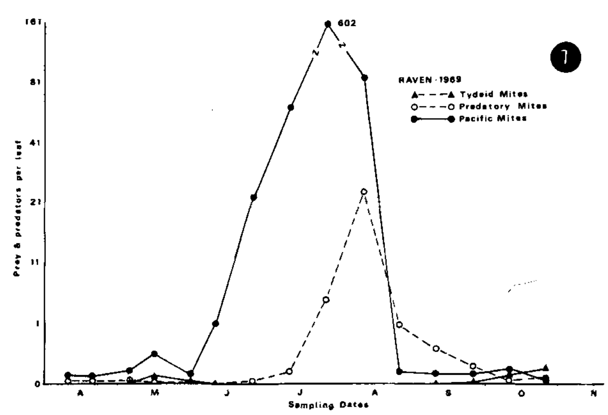
GRAPH 5. PREDATOR AND PREY POPULATION TRENDS IN THE YOST, THOMPSON SEEDLESS VINEYARD IN BIOLA, FRESNO COUNTY, 1969—NO HISTORY OF PESTICIDE TREATMENTS



GRAPH 6. PREDATOR AND PREY POPULATION TRENDS IN THE MARGOSIAN, THOMPSON SEEDLESS VINEYARD IN MONMOUTH, FRESNO COUNTY, 1969—HISTORY OF ONLY OCCASIONAL TREATMENTS



GRAPH 7. PREDATOR AND PREY POPULATION TRENDS IN THE RAVEN, THOMPSON SEEDLESS VINEYARD IN MONMOUTH, FRESNO COUNTY, 1969—HISTORY OF MANY TREATMENTS, BUT NONE SINCE 1966



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TESTS HAVE BEEN conducted for several years with the support of the table grape, raisin, and wine industries, on pest management practices for spider mites and associated pests in the southern San Joaquin Valley. A major part of this effort has emphasized the correction of a spider mite imbalance in vineyards. Willamette mite (*Eotetranychus willamettei* Ewing) and Pacific mite (*Tetranychus pacificus* McGregor) had become difficult and expensive to control, and over-emphasis on chemical control programs was making the situation worse. Grape growers in Fresno County alone had been spending approximately one million dollars annually for spider mite control, and considerable vineyard damage still occurred. Moreover, it was observed that vineyards with histories of little or no pesticide use had few, if any, spider mite problems.

Occasional treatment

It was also evident that occasional treatments for other pests of grapes did not disrupt the natural control of spider mites in vineyards. This finding was important because in certain areas of the Valley large acreages of grapes are often needlessly treated for grape leafhoppers (*Erythroneura elegantula* Osborn), usually as a preventive measure. Research has shown that decisions to treat should be based on present need—not on anticipated need. Whether treatment is necessary depends on varietal susceptibility (e.g., Thompson Seedless vines are less favored by grape leafhoppers than Emperor vines), economic population levels, and on the activity of the grape leafhopper egg parasite, *Anagrus epos* Girault.

It was believed that as spider mite imbalances in vineyards were corrected, large acreages would need treatment for grape leafhoppers only occasionally, and would need no controls for spider mites. This would result in savings for the growers and a reduction in the use of pesticides. Moreover, the correction of Willamette mite imbalance poses little problem, as field trials showed that Willamette mite has been overrated as a pest of grapes in the southern San Joaquin Valley. Economic level studies showed that heavy populations of this species can be tolerated without yield and quality reductions in raisin, wine, or table grape vineyards. In fact, the evidence indicates that the presence of Willamette mite is an asset in the natural control of Pacific mite, which is a serious pest of grapevines.

Since pesticides are often responsible for the imbalance of Pacific mites in vineyards, it was reasonable to assume that imbalance would be corrected by simply curtailing the use of all pesticides, particularly in those areas where reliable natural controls of grape leafhoppers exist. However, restoration of balance is not easily accomplished; a point made clear only if population dynamics are compared in vineyards with and without histories of pesticide treatments.

Graphs 1 and 2 illustrate contrasting population trends in adjacent vineyards in the Biola area of northwest Fresno County that differed in their pesticide histories. The Miguel vineyard (graph 1) had a history of extensive treatments for leafhoppers and spider mites, while the Yost vineyard (graph 2) had not. The population trends in the Miguel vineyard (graph 1) show population crashes and the absence of Willamette mites to help support predatory mites, (*Metaseiulus occidentalis* Nesbitt) late in the season. In contrast, population trends in the Yost vineyard (graph 2) showed good late-season support was present. The late-season predator Willamette mite relationship is thought to be an important ingredient in keeping Pacific mite populations at low densities, (graph 2).

Unstable condition

The unstable condition (graph 1)—with widely fluctuating and crashing predator and prey populations—persisted through four seasons (1965 to 1968) in the Miguel vineyard after the cessation of all chemical treatments. For example, the average peak Pacific mite density in the Miguel vineyard during this four-year period was 78.0 per leaf, while in the adjacent, stable Yost vineyard, the average density was 0.1 per leaf. Considerable leaf injury was evident in the Miguel vineyard, in contrast to little damage in the Yost vineyard during all four years. During this period the Pacific mite was the predominant spider mite species in the Miguel vineyard, with Willamette mite remaining conspicuously low after each population crash.

With the exception of 1968 the predator populations also did not recover after the population crashes, presumably because of a lack of prey. Foliage injury induced by high Pacific mite populations, and excessive predation by the predator mite, *Metaseiulus occidentalis* (Nesbitt), are considered responsible for the population crashes.

In the Yost vineyard during the same period, the Willamette mite was the predominant spider mite species, and sufficient numbers persisted late into the season to help support *M. occidentalis*. Severe foliage injury and excessive predation are not characteristic of stable vineyard situations.

Lack of prey

Studies not detailed here revealed that fewer predators overwintered in the Miguel vineyard because the lack of prey in the fall resulted in the development of only small numbers of diapausing predators. Diapause is induced in *M. occidentalis* by the shorter day-lengths and cooler temperatures in the fall. Also, vine-by-vine studies revealed that the late-season predator and prey activity in the Yost vineyard promoted over-wintering of a well-distributed predator population. The Miguel vineyard presented a poorly distributed predator population.

Finally, in the fourth year (1968) of population instability in the Miguel vineyard, predators became active late in the season (graph 3). But unlike the Yost situation, Willamette mites were (as usual) lacking in the Miguel vineyard at that time. That is, Willamette mites in the Miguel vineyard followed the typical pattern and did not resurge after the 1968 population crash, but the predators did (graph 3). It was believed that the resurgence of predators in 1968 was due to a timely increase of tydeid mites. In previous years (1965 to 1967), these tiny, obscure mites were not considered abundant enough on grapes to act as an effective prey for *M. occidentalis*. Until 1968 the predator was rarely, if ever, seen to feed on tydeid mites.

Tydeids

Upon closer examination (after the predator resurgence occurred in the absence of Willamette mites in 1968), it was noted that numbers of very small, molting tydeids could be found hidden along leaf veins and at vein junctions. After some practice, the tydeid eggs could be counted, but it was a tedious job. Since the predator spends a good deal of time searching along leaf veins and in vein junctions, the smaller active stages, molting forms, and eggs of tydeids are probably easy prey. Laboratory studies verified this hypothesis. On the other hand, the fewer but easily seen and larger, immature and adult tydeids became "excited" at the approach of predators and escaped quickly, running backwards as fast as forwards.

Why tydeids were abundant and affected predator response in 1968 but not in the previous three years, was not clear. Perhaps an occasional abundance of tydeids is an important factor in the maintenance of balance over the long run. In any event, the long overdue correction of imbalance by late-season predator activity in 1968 had been predicted for 1969. Graphs 4 and 5 depict the population trends in the Miguel and Yost vineyards in 1969 (tydeid population trends included).

Contrasts

In contrast to the difference in population trends in the Biola plots during the previous four-year period, graphs 4 and 5 show that the Yost and Miguel vineyards now exhibit similar population trends. Thus, balance was finally achieved in the Miguel vineyard, and mite populations remained stable through 1971 despite the need to treat leafhoppers in early August, 1970. Graph 4 shows that the Pacific mite population in the Miguel vineyard no longer fluctuated widely with resulting population crashes and disruption of the important late-season predator and Willamette mite relationship. Graph 4 also shows that Willamette mite was then the predominant spider mite species in the Miguel vineyard as had been the case all along in the adjacent Yost vineyard. Most importantly, no Pacific mite injury occurred in the Miguel vineyard from 1969 through 1971 since balance was achieved.

To a casual observer of the Miguel situation in 1969 and thereafter who had not previously followed the wide fluctuations of the Pacific mite populations, the very low densities now exhibited in this vineyard might be attributed to causes other than regulation by *M. occidentalis*. But the population trends from 1965 to 1968 indicate that Pacific mite populations would have continued to fluctuate widely in 1969 and thereafter if effective predation had not been promoted in 1968. Other vineyards in the immediate area, in which pesticide pressure was not relieved, continued to exhibit highly unstable Pacific mite populations through 1971.

Studies and observations showed that restoration of balance takes more or less than four years, depending on the area of the Valley and the abundance of Willamette and tydeid mites. Along the eastern side of the Valley where Willamette and tydeid mites are favored, the correction of Pacific mite imbalance has taken only one year in the absence of all pesticides. However, in the Monmouth area of western Fresno County where Willamette mites are absent and tydeids are not favored, imbalance has persisted for five years, with no indication of correction. The Monmouth area in contrast to the east side of the Valley is characterized by dry, dusty conditions. Pacific mite is highly favored by these conditions, and in the absence of effective predation, enormous population increases result in severe vineyard injury and sharp population declines early in the season. This situation has none of the conditions necessary for imbalance correction.

In the Monmouth area balance is precarious even in vineyards with no pesticide history. In these vineyards the small tydeid populations are barely able to support late-season predation. In pesticide-disturbed situations, tydeids are even fewer and are ineffective as supporters of predation. Graphs 6 and 7 illustrate population trends in balanced and imbalanced vineyards in the Monmouth area. It is noteworthy that in contrast to the balanced situation (graph 6), tydeids remain conspicuously low in the imbalance situation (graph 7), particularly late in the season when they are needed. It is not clear why this occurs. Widely fluctuating Pacific mite populations appear to have a deleterious effect on other foliage-inhabiting arthropods.

Imbalance correction

To forego all treatments while awaiting correction of imbalance is often not practical. Serious vineyard damage by Pacific mite cannot be tolerated. Treatments may even be necessary for populations that are well below economic injury levels. Control difficulties arise quickly, because resistance and spray coverage problems are exaggerated when densities are high. Yet, if imbalance is to be corrected, treatments of low population densities may preclude the reestablishment and redistribution of natural enemies. Therefore, in order to avoid the hazards of prey explosions while awaiting restoration of balance, the problem of preventing Pacific mite injury must be attacked in a broad, general fashion—not precluding the use of chemicals.

A number of vineyard trials showed that selective acaricides, such as TEPP (tetraethylpyrophosphate), are valuable tools for helping to restore balance. *M. occidentalis* is resistant to TEPP, while Pacific mites in their active stages are fairly susceptible. Timely applications of this material were used to check damaging Pacific mite increases, while the predator was slowly regaining control in the vineyards. Other phosphates, Trithion and Ethion were also used selectively, especially when both leafhoppers and Pacific mites simultaneously needed treatment. Observations indicate that Omite may prove of value as a selective acaracide.

Vineyard studies

Vineyard studies suggest use of a number of techniques which themselves do not interfere with natural enemies. For example, in contrast to clean, cultivated vineyard plots (the normal practice in many vineyards), sudangrass vineyard plots required fewer treatments for Pacific mites. The grass plots require fewer treatments probably because of less dust on the vine foliage, better soil-water infiltration, and generally higher vineyard humidities. More irrigations are necessary when grass culture is practiced during the summer.

Sprinkler irrigation can also be used as a method to help restore balance. Pacific mites are kept below economic levels under sprinkler irrigation, while *M. occidentalis* populations are hardly affected. Although sprinkler systems, portable or permanent, are costly, they may be the most practical way to culture grapes in certain areas of west Fresno County where the chances of correction of imbalance is now uncertain and the cost of repeated treatments has become prohibitive.

Finally, it was observed that cultural practices which improve vine vigor tend to inhibit Pacific mite outbreaks. Sometimes, vine-water stress accounts for such outbreaks. Winter and spring cover crops improve soil-water infiltration and reduce Pacific mite outbreaks. Several cover crops (sudangrass, subclovers, and ryegrasses) were tested. The judicious use of fertilizers, pruning to reduce crop load, and nematode control, all help to improve vine vigor.

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