

# Citrus Flat Mite on Increase

light infestations known to occur since discovery of pest in state in 1949 increasing as the use of sulfur sprays decreases

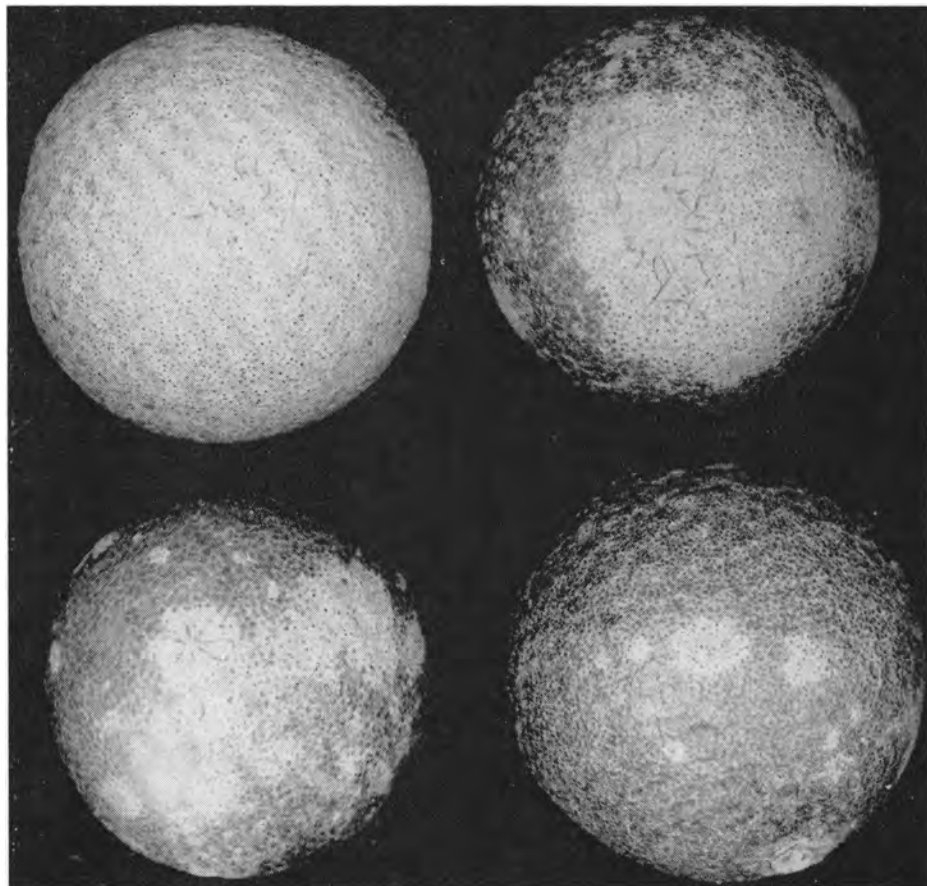
H. S. Elmer and L. R. Jeppson

A general increase in the economic importance of the citrus flat mite has occurred throughout the citrus-growing area of central California since 1952. Infestations of the mite on citrus have been reported from the Coachella Valley, and in 1955, heavy infestations were found severely scarring tangerines in the Imperial Valley.

Damage is almost entirely due to a reduction in the grade of fruit and is similar in all citrus varieties. No injury has been observed on the leaves or wood of infested trees.

A brown or bronzed scablike scar—resembling a sulfur burn—is usually found on the exposed side of the fruit. The injury is irregular in shape and more corky in appearance than a sulfur burn. In cases of mild damage the fruit rind has a slight silvering.

Discolored areas on young fruit which are generally attributed to either leaf hopper feeding or oviposition by citrus thrips appear to be favorable areas for citrus flat mite. On fruit free of mites the spots tend to disappear as the fruit color changes from green to orange. However, in groves with even a light mite population, the secondary injury to the fruit results in small isolated circular depressions with scablike scars. Additionally, fruit scarred by other insect pests, by rubbing branches or by mechanical equipment appear to be favorable locations for the citrus flat mite.



Injury to Valencia oranges caused by feeding of citrus flat mite, *Brevipalpus lewisi* McG.

## Definite Cause Not Known

There is no evidence to definitely establish the cause of the sudden increase in populations of this mite. However, the rise in its importance in central California is closely correlated with the reduction in use of sulfur, lime-sulfur, or oil spray applications. Sulfur or oil is toxic to the citrus flat mite, but the chlorinated hydrocarbon or phosphate insecticides used to replace oil and sulfur for control of other citrus insect pests do not effectively reduce populations of this mite.

Citrus flat mites are very small, flat, and slow moving. They may be found most abundantly near or under the fruit button.

The mites vary from a reddish brown to a rather bright red and usually have

a small dark area in the center of the back. Eggs are pink to red and oval in shape. They are laid singly in cracks and crevices of the fruit, twigs, and leaves.

Observations in 1954-55 indicate that citrus flat mite prefers the green to the ripe fruit. Fruit in any stage of development was more favorable than leaves and twigs of the tree. The mite population is greatly reduced at harvest time since most of these mites are on the fruit. Consequently, fruit held on the trees for late picking supports injurious populations more of the year than early harvested varieties.

The citrus flat mite apparently overwinters—in central California—in the adult stage only since no eggs were observed on the fruit, leaves or twigs from October to mid-April. Eggs, adults, and immature stages of the citrus flat mite

were found throughout the winter months in the Imperial Valley and Coachella Valley citrus-growing areas.

The number of generations of the citrus flat mite throughout the year has not been determined. The peak populations are reached apparently during the warmest months of the year. Periods of extremely high temperatures and low humidity are not effective in reducing populations as is the case with other mite pests of citrus such as citrus red mite and Yuma mite.

The citrus flat mite is most economically controlled by sulfur applied as preventive treatment during late winter or spring. One application of dusting sulfur applied at the rate of at least 75 pounds per acre or wettable sulfur spray applications, using four to six pounds

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## MITE

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per 100 gallons, have generally resulted in satisfactory seasonal control of this mite. Sulfur should not be applied during or immediately preceding periods of hot weather, and treatment should be separated from an oil application by at least 60 days.

Chlorobenzilate applications—at the rate of 10 pounds of a 25% formulation per 100 gallons of spray—may be used to control the citrus flat mite during the times when it is inadvisable to apply sulfur. A thorough distribution type of coverage is necessary for good control.

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## POTATOES

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potatoes down to storage conditions, after which the ventilation was reduced to maintain inside temperatures as uniformly as possible. During the mild fall weather, some temperature readings were taken to observe day and night fluctuations and comparative temperatures for individual locations.

To begin with, temperatures recorded by the thermocouples were observed hourly. This frequency was found to be seldom necessary, so in most cases, intervals were extended to an average of about three hours. In mild weather, even this time was expanded or readings discontinued temporarily. When extremely cold weather arrived, the hourly interval was resumed and maintained to obtain complete sets of data. Extra readings were taken at high and low temperature periods, so as to best define the maximum and minimum measurements.

The critical periods are those of lowest temperatures. Intermediate temperatures pose no special problem for this type of potato storage. Lowest temperatures were awaited, as providing the really significant conditions and data. The coldest occurrence in several years proved to be  $-18^{\circ}\text{F}$ . At this time the most useful data were collected. Humidity, condensation, and frosted interiors were also studied.

The sawdust and rockwool insulated walls proved satisfactory for small-volume storage. Safe potato temperatures were maintained.

The 13" concrete block cavity wall also was adequate, being nearly equal to the well-insulated frame walls.

The 8" concrete block wall proved un-

satisfactory because it cooled too much, frost formed on the inside surface, nearby potatoes froze, and some were spoiled.

Temperatures inside the concrete blocks and the insulation materials revealed the progression of changes within the various parts of the walls, at several hours during the day. Outside minimum wall temperature was  $-18^{\circ}\text{F}$ . The temperature lag within the wall material was especially apparent with the concrete blocks. The interior was warmed by the heat of respiration of the potatoes together with a small amount of supplementary artificial heat. Although having different characteristics, the cavity wall was about as effective as the insulated frame walls.

In contrast, the 8" block wall remained too cold on the interior surface all day long, ranging from  $19^{\circ}\text{F}$  to  $28^{\circ}\text{F}$ —dangerous temperatures for the safe storage of potatoes. Frost was seen only on this one wall section.

Additional temperature recordings in the concrete walls showed an obvious relationship between the 8" and the 13" walls. The superiority of the cavity wall was clear. The cold interior surface of the single 8" wall was the feature which caused potato damage.

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## PACKING HOUSE

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ferent methods showed that relative costs with different methods also are affected by plant capacity and proportion of cull fruit.

In general, the nonmechanized methods were found to be the most economical with short season operation—250 hours per season—low cull proportions, and low rates of packer output. On the other hand, the highly mechanized equipment was found to be most economical with long-season operation—750 hours per season—a high proportion of culls, and high rates of packer output. Between these extremes in operating conditions, a rather broad range was found in which the cost differences between the mechanized and nonmechanized methods are relatively small.

The effect of variation in the factors affecting the costs of the packer-supply operations can be illustrated by reference to several specific results of the cost comparisons. For example, with a given length of season and proportion of culls, the costs of the packer-supply operations

decrease as the size of the plant increases. Thus with 250 hours operation per season, a packer output rate of five lugs per hour, and 30% culls, costs with efficient operation are about 5¢ per lug in a small plant,  $4\frac{1}{4}$ ¢ per lug in an average-size plant, and 4¢ per lug in a large plant. A similar, although smaller, effect is evident with long-season operation.

When output rates of five and 30 lugs per packer hour are compared, the effect of the high output rate is to reduce costs by about 1¢ per lug when the length of season is 250 hours and  $\frac{1}{4}$ ¢ to  $\frac{3}{4}$ ¢ per lug—depending on the proportion of culls—when the season length is 750 hours.

When output rates of five and 30 lugs costs rise about 1¢ per lug as culls increase from 10% to 30%; and there is an additional  $1\frac{1}{2}$ ¢ increase as culls rise from 30% to 50%. With 750 hours' operation per season, the variation in costs as the proportion of culls changes is less regular but approximates  $\frac{1}{2}$ ¢ per lug as culls increase from 10% to 30% and an additional 1¢ per lug as culls rise from 30% to 50%.

Comparing the most efficient methods at a culling rate of 30%, costs with short season operation—250 hours per season—are about  $1\frac{3}{4}$ ¢ per lug higher than with long-season operation of 750 hours. At 10% culls, this difference is  $1\frac{1}{2}$ ¢ and at 50% culls it is about 2¢ per lug.

While substantial differences in costs are associated with the wide range in operating conditions, these cost differences do not necessarily indicate savings potentials. In general, only limited adjustment in the factors affecting the costs of the packer-supply operations is possible for individual shippers. Some adjustment in proportion of cull fruit might be attained through changes in cultural, picking, or marketing practices. Increased packer output rates might be achieved in some plants through adoption of an incentive wage plan. In some areas, size of plant and hours of operation per season might be increased through consolidation of small plants. Such changes, however, would ordinarily involve shifts through only a part of the range in operating conditions and frequently would be economical only as existing plants are worn out.

Some of the changes involved in reducing the costs of the packer-supply operations would affect the costs of other operations. The costs of packer labor would be affected by any change in packer wage plan; changes in practice necessary to reduce the proportion of packing house culls probably would affect picking, hauling, and cultural costs.

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