Fig Mosaic Transmitted by Mite

first tree virus demonstrated to be transmitted by a mite found in studies on relationship of fig mite to fig mosaic

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The fig mite—*Aceria ficus* (Cotte)—was shown to transmit fig mosaic virus in experiments set up to determine whether or not mosaic symptoms would persist on fig plants in the absence of fig mite infestations.

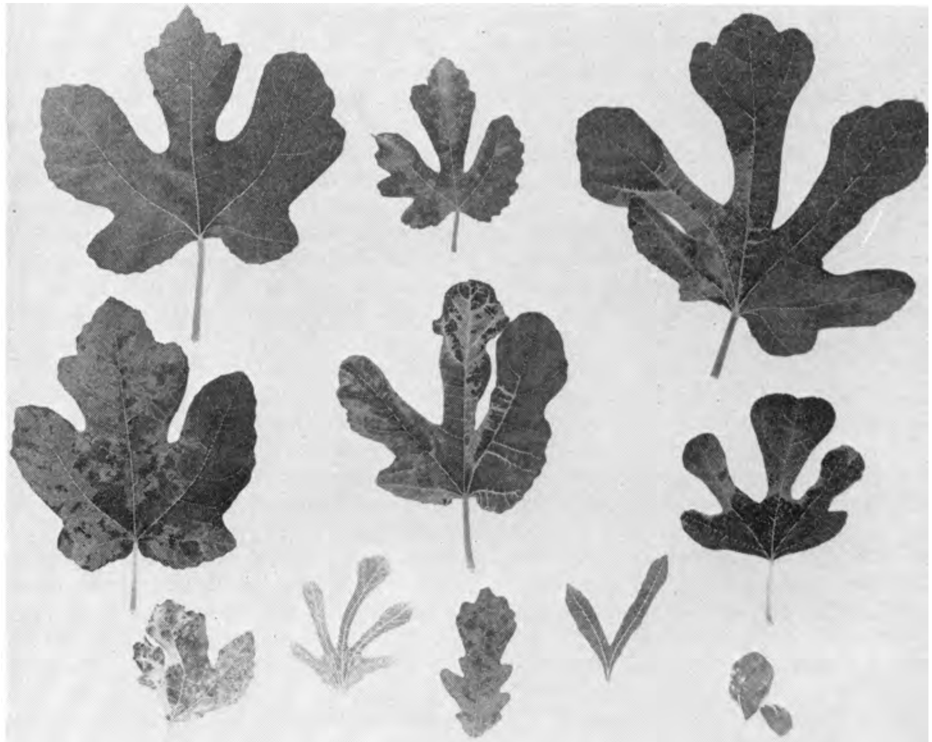
The fig mite is small, ranging from 1/125" to 1/200" in length. It is pale yellow in color, is wider anteriorly than posteriorly, and has two pairs of legs. It is usually found in the buds and on young leaves, but it may occur in huge numbers on old leaves and inside fruit. Feeding may cause a russeting or browning of the plant surface. The mite can cause a blasting of the buds and a chlorosis of the leaves and defoliation of branches or whole trees. In the greenhouse, new growth may be entirely prevented by the presence of this mite. In the field, mosaic and leaf distortion symptoms are commonly associated with numbers of this mite. At least part of these symptoms resemble the effects on other plants demonstrated to be caused by the feeding of eriophyid mites. A good example of mosaic-like symptoms caused by a toxicogenic mite is yellow spot of peaches.

Measurement of loss of fruit production caused by fig mosaic has not been possible because of the lack of healthy plants—other than seedlings—for comparison. The disease was found to be present on all fig trees examined in the field in California.

In the relationship experiments, a series of 37 cuttings from field trees showing mosaic symptoms were treated with dusting sulfur to kill fig mites. The cuttings were then rooted and grown in a mite-free environment. Mosaic symptoms eventually appeared on new growth on these cuttings. In other tests fig seedlings became infected and developed mosaic symptoms after having scions grafted into them from diseased, mite-free sources.

These tests demonstrated satisfactorily that the mosaic-like symptoms on figs did not result entirely from the toxic effect of mite feeding. The transmission of grafting gave good evidence that fig mosaic is caused by transmissible virus.

Mites from mosaic-infected fig trees were transferred individually with a fine brush to small seedling fig plants that were kept in mite-free cages. The test plants were dusted with sulfur after three to five days. The first tests were made with a large number of mites on a few test plants.



Characteristic patterns and distortion of fig leaves from mosaic-diseased test plants.

Some mosaic-like symptoms developed in less than 10 days. Because of the short time required for these effects to appear, it seemed likely that these early symptoms resulted from the toxic effect of mite feeding. Some of the plants appeared to recover partially but later developed more severe symptoms. These reactions suggested that the first symptoms to appear may have been produced by a toxic substance. Later tests were made with smaller numbers of mites, and a good percentage of transmission was obtained with all of them.

Transmission of Fig Mosaic Virus by the Fig Mite *Aceria Ficus* (Cotte)

No. of mites per plant	No. of plants	% of plants showing symptoms: Within 10 days	% of plants showing symptoms: Within 90 days
200	6	100	100
100	20	55	90
50	19	57.9	94.7
20	19	21.1	84.2
5	15	40	93.2
1	10	20	70
0	67	0	0

To differentiate clearly between symptoms resulting directly from the feeding of the mites and the true virus mosaic effects, a virus-free colony of mites has been developed. To get such a colony, mites were grown from eggs transferred to disease-free seedlings. Fourteen plants exposed to the feeding of disease-free mites for five days have shown leaf distortion and slight chlorosis and russeting but no mosaic symptoms.

In a later test, seven plants on which virus-free mites were grown, and eight plants on which an average of 133 mites were established, have shown no mosaic symptoms. The eight plants were fumigated two weeks after the mites were applied and were reinfested at one, two, and three months. The plants were then kept free from mites for two additional months. Later, surveys were made to de-

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FIG MOSAIC

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termine what other potential virus vectors were to be found on the fig. The phytoseiid mites *Typhlodromus longipilus* Nesbitt and *Typhlodromus* sp. (Det. Baker) were the most abundant. Tetranychid mites were found only occasionally in southern California. Flower thrips, *Frankliniella* sp., and the aphids *Aphis gossypii* Glover and *Myzus persicae* (Sulz) were present in moderate numbers. The fig psyllid *Homotoma ficus* L., which research workers in Italy reported as the probable vector or cause of fig mosaic in Italy, has not been found in California.

A series of transmission tests to five plants each was made with these species. No evidence was obtained that any of these insects are vectors of fig mosaic.

Symptoms of fig mosaic are very erratic in occurrence. Some of the inoculated plants have shown only one small chlorotic spot for months before developing conspicuous markings. Symptoms developed more consistently at 90°F than at 80°F. Symptoms on the test plants were highly variable. Some markings consisted of faint, diffuse areas without clear-cut margins, while others were well delineated and contrasted sharply with the leaf in color. The markings varied greatly in size and shape. Many of the leaves showed severe distortion.

Demonstration of transmission of fig mosaic by the fig mite makes it important to determine whether or not the fig mite and fig mosaic can be controlled economically in the field. It will be necessary to study mite control on isolated fig plantings started with mosaic-free plants in order to determine the possibility and benefits of field control of fig mosaic. This will necessitate the finding of virus-free fig varieties from which propagations can be made. No such material is available locally.

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RED MITE

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Mite counts were made during the foliage season by selecting 100 leaves at random, running them through a mite-brushing machine, and counting them under a dissecting microscope. When the mite count reached an average of four or more mites per leaf, the plots were resprayed and the counts discontinued.

The materials used, rates of application, spray dates, and mite counts are shown in the lower table on page 6. Little effect was seen on the mite populations in the plot sprayed with dormant oil followed by lime sulfur, wettable sulfur; the counts paralleled those from the plot sprayed with dormant oil followed by Dithane. Phostex and Trithion in combination with oil did not give satisfactory control, as the former required retreatment in late May and the latter in early June. Dormant oil held the mites in check until June, which is consistent with results obtained in previous seasons.

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CARTON FORMING

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ance standard for this job, when the carton supply worker size stamps, is 488 cartons per man-hour. For the first two methods studied, carton-forming performance standards are 217 cartons per man-hour, and 316 for the third and fourth methods. The performance standard for carton forming by the improved method is 317, which includes inserting treated liners. With this method, no carton-feed worker is required. Size stamping is performed by the carton supply man. The performance standard for carton feeding in the first and third methods is 261 cartons per man-hour, and 373 in the second and fourth methods.

Adaptation of the improved method in an orange packing house is shown in the accompanying photograph. Right and left hand jigs are used to allow a carton former to form on two lines without walking around a work station. Tables are used for holding bundles of cartons. An elevated skate roll conveyor is used for carton bottles where a short distance between conveyor lines prevails. With more space and separate tables for each line, both carton tops and bottoms are placed on the table. Boxes holding treated liners are on center uprights.

Hourly labor costs for crew organizations based on performance standards in relation to filling rate are shown in the graph. For example, with labor costs at $1.00 per hour, forming costs per hour—at a filling rate of 400 cartons per hour—would be $5.11 for the first method and $2.71 with the improved method.

Estimated costs of the jigs as shown in the drawing are $25–$30 each, which is of minor importance when compared with the reduction in labor cost achieved.

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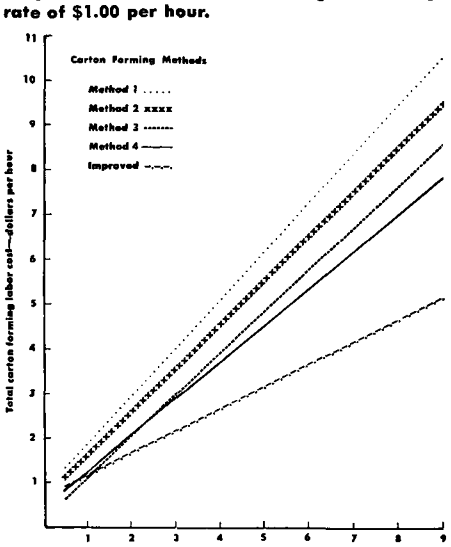
A more detailed report on the construction and installation of the improved jig described in the above article is available, without cost, at the local office of the County Farm Advisor.

The Tom Sims Packing House Equipment Company, the California Citrus Industry Research Association, the Fillmore Orange Association, and the Oxnard Citrus Association assisted in the studies reported here.

Hourly labor costs for forming cartons by different methods at various filling rates. Wage rate of $1.00 per hour.



Commercial installation of improved carton-forming jigs in orange packing house.