The Orange Tortrix

pest of citrus becoming of economic importance on deciduous fruit

Arthur D. Borden

The orange tortrix—*Argyrotaenia citrana*—a worm which feeds on foliage and enters fruit, caused considerable damage to prunes and apples last season.

Damage to prunes and apples makes this insect of considerable economic importance to deciduous fruit growers. Thus far it has been observed in orchards in Santa Cruz, Santa Clara, Sonoma and Napa counties. Further surveys will determine its distribution in other counties.

The life history and habits of this insect are very similar to those of the apple skinworm, *Tortrix franciscana*, which damaged apples and pears in Santa Cruz and Sonoma counties in 1926. The orange tortrix enters the pulp of the fruit whereas the apple skinworm generally feeds only on the surface. The orange tortrix larvae generally invade the fruit through a small round puncture and feed extensively on the flesh of the fruit. In certain varieties of apples having an open calyx they enter the calyx channel to feed on the seeds.

The work of this insect may be confused with that of the bud moth, *Spilonota ocellana*, which is quite common on prunes in the coastal counties and is often in mixed populations with the orange tortrix, or it may be confused with the larvae of *Eurythmia thurberiae* which is frequently taken in mummied fruit in prune orchards.

Identification

The adult moth of the orange tortrix is about one half inch or less in length. The rusty brown bell-shaped wings are carried almost flat over the body and each wing has a darker diagonal band across the wing and a smaller triangular darker area near the outer posterior margin. In the field the general color of the wings is somewhat variable from a tan to a dark rusty brown. The head is small and quite narrow.

Eggs are deposited in masses on leaf surfaces, on the fruit or on smooth bark. They are pale yellow in color and overlap like fish scales. The egg coloring shows a fine reticulation when observed under the hand lens. Each moth may deposit over 200 eggs.

The mature larva measures over one-half inch in length and has a straw-colored head with a body that varies in color from a light tan to a straw color. The thoracic shield and anal plate are not conspicuous and the body has but very few covering hairs.

The pupae are light to dark brown, less than one half inch in length and are usually found in folded leaves or in the last feeding area.

An overlapping of generations occurs in which nearly all stages may be found at any time of the year. A number of moths were observed to be active in the orchards early in May of this season.

In the control investigations of this insect on citrus it was determined that cryolite sprays or cryolite dusts were effective. Control experiments on deciduous fruits are not far enough along to make recommendations but it has been determined that 50% wettable DDT at a dosage of two pounds per 100 gallons does not give satisfactory control. Parathion—15% wettable—at a dosage of one pound per 100 gallons appears very promising.

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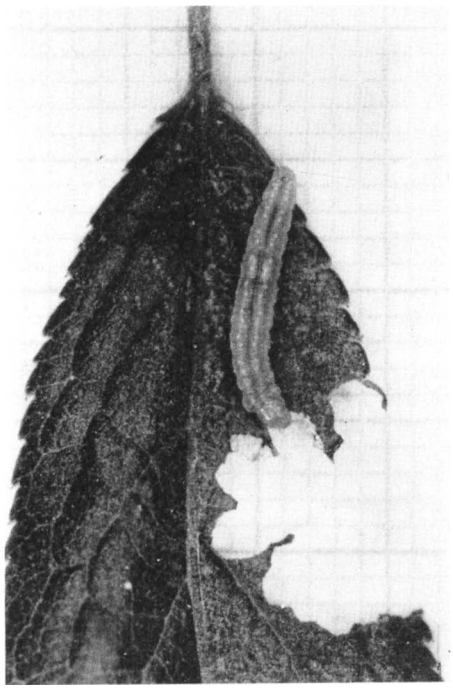
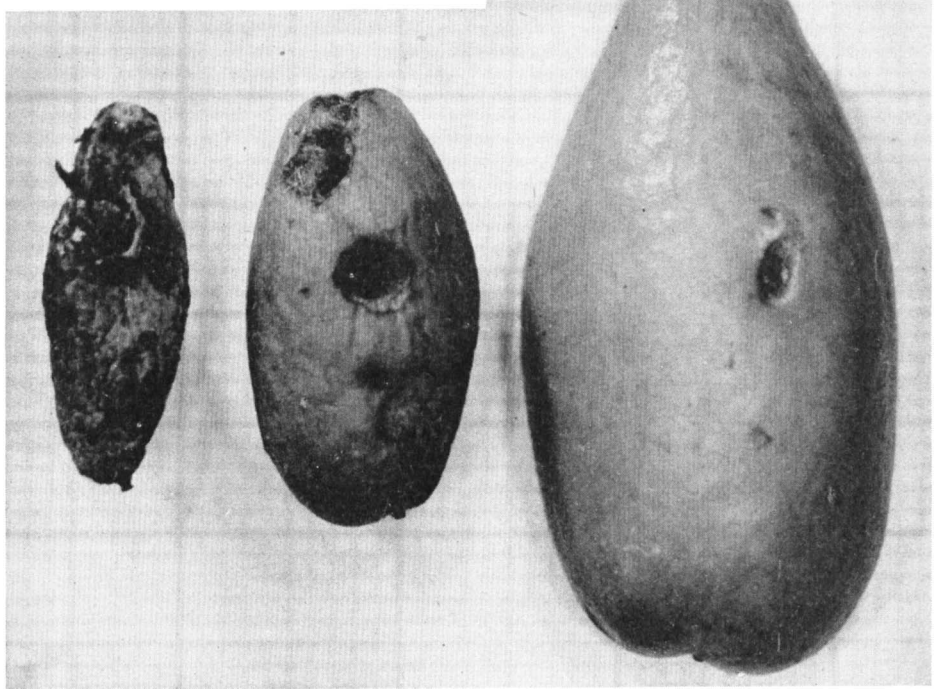
The studies covered by this report were conducted by Rex Bartges, graduate student in the Division of Entomology, under the direction of Arthur D. Borden.





Right. Prunes damaged by larvae of the orange tortrix. Below. Larva of the orange tortrix feeding on a prune leaf.

ROOTSTOCKS

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somewhat, and frequently there is a slight undergrowth of the sweet or rough lemon stock. Generally, this undergrowth is not as pronounced as with sour orange stock.

Sweet orange trees budded upon mandarin stocks also are characterized by fairly smooth unions. However, the mandarin trunk is usually distinguished by vertical ridges or fluting. The mandarin bark itself is smooth and somewhat slate-colored. These two characters readily distinguish it from sweet orange or rough lemon stock.

The Sampson tangelo, while not commonly used as a rootstock for oranges, results in a union which is similar to that resulting when sweet orange is used and it cannot be distinguished from one by visual inspection.

Sweet orange on sour orange stock is usually characterized by an undergrowth of the sour orange stock. Although the undergrowth is frequently very distinct, the union may occasionally be fairly smooth. This variation possibly may be associated with different strains of sour orange. There are no visible distinguishing features of the bark.

There is an overgrowth of the stock associated with trees budded on trifoliate orange, hybrids of the trifoliate orange, grapefruit or shaddock.

The shaddock is not widely used as a stock and the reactions of trees budded on shaddock and grapefruit are similar. They will be considered here as the grapefruit type.

Trifoliate orange stock generally shows more overgrowth than any other stock.

The overgrowth is so extensive it forms a shoulder or shelf several inches wider than the scion. The outer margins of the shoulder may occasionally be higher than the inner margin adjoining the scion.

The bark of the stock is not smooth but is roughened and presents a webbed appearance. This aids in distinguishing it from the grapefruit type which has smooth bark.

The chief difference between stocks of grapefruit and trifoliate orange is that the trunk of trifoliate orange is markedly ridged or fluted. The grapefruit stock is smooth and round.

Grapefruit stock is characterized by two types of unions. One of these displays the wide bench overgrowth similar to trifoliate orange. The bark is smooth and the stock is not ridged or fluted.

The second grapefruit stock type varies in that the overgrowth of the stock is not as conspicuous.

Both types are characterized by a flaring or bulging near the soil line which gives an enlarged bole effect. This enlarged base serves to differentiate this type from sweet orange or rough lemon stock.

Frequently the grapefruit bark is lighter than the orange scion.

The grower cannot be too cautious in his efforts to ascertain the stock or stocks on which his orchard is planted.

Occasionally only an examination of the bud unions may be needed to provide identification. The character of the foliage on root suckers may also be indicative in some cases.

Frequently information on the nature of the bud unions and of the stock suckers may be correlated to provide more positive information.

In many cases it will be necessary to carry out the chemical tests and to supplement them with such observations as have been made in the orchard.

There will be instances when all the facts available are insufficient for positive identification.

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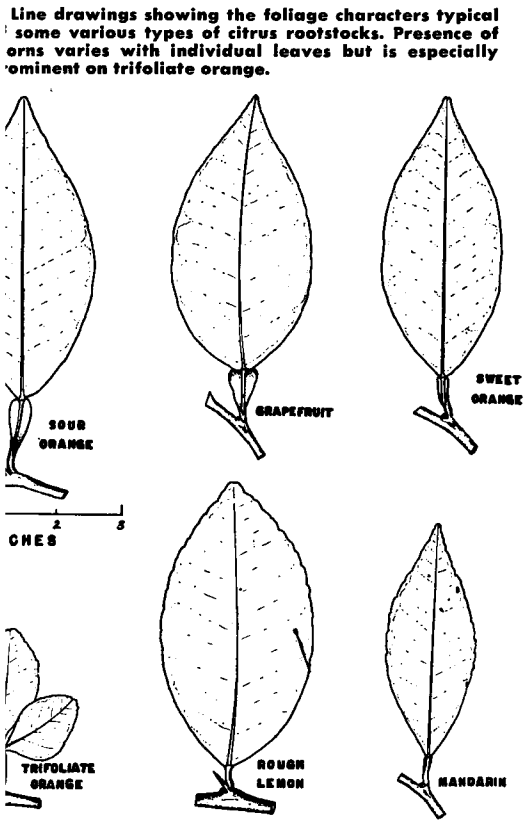
Line drawings showing the foliage characters typical some various types of citrus rootstocks. Presence of orns varies with individual leaves but is especially ominent on trifoliate orange.



GRAPEFRUIT

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A composite sampling consisting of eight fruits of uniform size was taken from each of the six trees per treatment for measurement of fruit quality.

These differences were noted in the fruits with increase in concentration of 2,4-D in the spray treatment: an increase in the ratio of length to width, an increase in the number of rudimentary seeds, a decrease in the number of normal-appearing seeds, a decrease in rind thickness, an increase in soluble solids and pH of the juice, an increase in percentage of rag—tissue not passing through the vibrating screen of an electric juice extractor—and an increase in the specific gravity of the whole fruit.

Samples of abnormally large fruits and of cylindrically shaped fruits from the trees sprayed with 225 p.p.m. 2,4-D also were examined for fruit quality. These fruits generally showed even more extreme effects of high concentrations of 2,4-D in the spray than the normal size fruit.

Additional Experiments

A total of 32 field plots containing 61 comparisons of fruit drop from 2,4-D sprayed and nonsprayed trees were established in 1947 in the counties of Orange, Riverside, San Bernardino, Los Angeles, Ventura and Tulare. Spray applications were made between February 17 and August 7.

The average decrease in drop was 30 fruit per tree or a decrease of 44% of the drop occurring on nonsprayed trees.

The 2,4-D applications were effective in reducing fruit drop in all of the wide range of localities tested.

The 1947 experiments were in agreement with those of 1946 in indicating that in water sprays about eight p.p.m. of 2,4-D is the most desirable concentration to use in the usual spray rig.

The data indicate that 2,4-D may be applied in conjunction with other spray chemicals.

Sprays containing 2,4-D did not seem to impair the keeping quality of grapefruit and may actually increase storageability by reducing the percentage of black buttons on the fruit.

Conclusion

Applications in 1946 and 1947 of water sprays containing eight p.p.m. of 2,4-D effectively reduced the preharvest drop of mature grapefruit when applied at dates ranging from April 15 to just prior to harvest.

Additionally, the 1946 experiments indicated that sprays which were applied before the June drop was completed increased production by apparently reducing the drop of mature fruit which occurs at that time. It is not definitely known whether such a reduction of June drop will be generally beneficial or harmful.

Possible cumulative effects of 2,4-D applications which may be made at any season have not yet been established. A longer period of testing is necessary to determine these effects.

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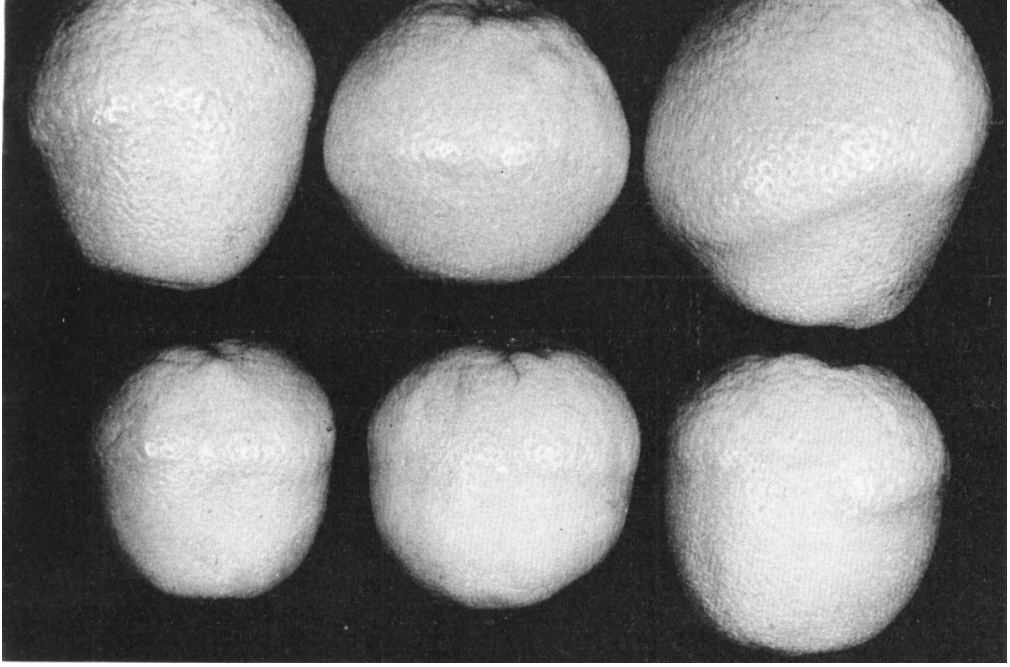

Acorn-shaped citrus fruit, evidence of stubborn disease.

STUBBORN DISEASE

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source used to topwork healthy trees of the same age formed a healthy top.

Characteristics

Stubborn disease is characterized by abnormal branching and formation of multiple buds which produce a brushlike growth of twigs.

The foliage, especially on the south side, usually consists of untimely autumn growth, which becomes somewhat chlorotic during the winter months. There is often a tendency for blossoming during the late fall and winter.

Some of the fruits develop abnormally into forms that resemble an acorn in shape with the rind of the stem half—or some portions of it—growing normally in thickness and the rest of the rind developing less in thickness and with the thinnest portions of the rind near the navel end.

When the fruit is severely affected the pulp opposite the thin portions of the rind has a sour or bitter taste.

The crop decreases until in advanced cases of the disease very few or no fruits are formed.

More Study Needed

It is not known certainly whether it is transmitted by any means other than by propagation of nursery trees but observations would indicate that it is increasing and is suspected of having other ways of spreading. The sudden appearance of the trouble on trees that have been healthy for many years suggests that an insect vector is spreading the disease.

Pending further information regarding the stubborn disease, every effort should be made to select trees entirely free from this disease as a source of propagation for nursery trees. When trees develop pronounced cases of this disease and become nonproductive, they should be replaced. It appears to be useless to topwork these trees with healthy buds, since as has been proved, the subsequent growth will be infected and, in time, the tree will manifest the same trouble.

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SUGARS

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There was a definite change in flavor at 70% inversion and a noticeable one at 90% which was more marked to the more discerning tasters. The flavor of the peaches decreased with increase in storage time, and this decrease was greater in the peaches frozen in 70% and 90% invert sirup. It was particularly noticeable as a combination of oxidized and foreign flavor.

Nectarines

In Kim nectarines there was an appreciable discoloration at 90% inversion which persisted throughout the storage period.

Kim nectarines retained their color better than did the apricots or the peaches. In texture there was little difference between the sucrose and invert sirup samples. Unlike apricots, the nectarine skin was thinner and tender, and remained so during storage. In flavor there was a slight difference at first in invert sirup, noticeable at 70% inversion, but this difference did not persist, owing largely to variability of samples.

In general, nectarines were of higher flavor initially and retained their color and flavor better during freezing storage than did the apricots or peaches.

In Gower nectarines there was no appreciable difference in color, flavor or texture between sucrose and 90% invert sirup samples.

Preparation of Syrups

One method of preparing sirups was to dissolve the necessary amount of granulated sugar in water at 20° C with vigorout stirring. In another case, the water was brought to boiling and the sugar was dissolved with minimum of stirring and then allowed to cool to 20° C in uncovered beakers. There was little difference in oxygen content of the sirups under these conditions at lower densities but the percentage difference progressively increased with increase in density.

Protective Effect

That sugars do exercise a protective effect on nonenzymic oxidation of ascorbic acid has been established but there is a question as to the relative effectiveness of the sugars.

Of the pure sugars tested, the most efficient in retarding oxidation of ascorbic acid in solutions containing about 50 mg. per cent of ascorbic acid allowed to stand quietly exposed to air at room temperature were maltose, levulose and lactose; the least effective was dextrose.

In the case of sirups, the most efficient were puritose and invert sirup.

Under conditions of vigorous oxygenation, the order of decreasing protection was maltose, dextrose, sucrose and lactose. The order of decreasing protection in sirups was puritose, sucrose, invert sirup and low conversion corn sirup.

More work in this field is now under way.

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The above article is a condensation of a report given at the 8th Annual Conference, Institute of Food Technologists, Philadelphia, June 9, 1948.

Work on establishing *Physcus testaceus,* parasite of the Mediterranean fig scale imported from Italy, has been resumed by the Division of Entomology at Riverside, following wartime interruption.