Orange Tree Quick Decline

insects in citrus plantings studied as possible carriers

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The work on insects in relation to the spread of orange tree quick decline has been going on since 1945. During this period it was determined which insects are found commonly in southern California citrus groves and over 750 transmission tests were conducted in an attempt to discover the vector.

Thus far, one species of aphid has been found to carry tristeza disease of citrus in South America. This is a virus disease and is similar to our quick decline. This aphid is *Aphis citricidus* Kirkaldy, often called *Aphis tavaresi* Del Guercio. It has not been known to occur in the United States. It is found in China, India, the East Indies, Hawaii, South Africa and in several South American countries. It is practically confined to citrus and wherever it occurs is known as the black citrus aphid. In California there is a closely related species, *Toxoptera aurantiae* Koch, which is called the black citrus aphid although it is only one of four black aphid species which attack citrus here. It can be easily distinguished from the others by the presence of a black spot, called the stigma, on the leading edge of each fore wing. *Toxoptera aurantiae* is practically confined to citrus and camellia in California although in the tropics it attacks a large number of plants, including tea and coffee.

Since *Toxoptera aurantiae* is closely related to the aphid vector of tristeza, it was the prime suspect and a large number of transmission tests were made with it. To date no transmission has been obtained with this species.

Survey of Insects

A survey of citrus plantings to determine which insects are present has developed some interesting points. Some 245 species of insects with sucking mouthparts—those most likely to transmit a virus—have been taken to date on orange trees in southern California. Most of these are not common enough to be pests of citrus by themselves but very probably one or more of them carries the quick decline virus and is responsible for its spread. Over 90 species of leafhoppers and about 90 species of aphids have been taken on citrus. While only one of the leafhoppers and only eight of the aphids have been found breeding on citrus trees, almost any of them will feed freely, and many will breed readily on citrus leaves or twigs when confined to them.

Almost 30 species of thrips also have been taken, and more than 20 species of plant bugs, together with smaller numbers of psyllids, membracids, fulgorids, etc. Most of these species do not breed on citrus but feed on it to a certain extent during their continuous movement from one place to another. The insects which breed on weeds in the citrus groves are likely suspects as vectors of quick decline, but even those which breed on distant crops or wild plants travel long distances and reach the citrus orchards when their normal hosts become unsuitable. Almost any of these species might be involved in the transmission of the quick decline virus since with an efficient vector it does not take many individual insects to cause spread such as we have in quick decline.

There has been an interesting variation from year to year and from location to location, as well as a seasonal variation, in the numbers of the various insect species present. For instance, a leafhopper called *Ollarianus strictus*, a desert species which seems to have migrated into citrus areas in recent years and now breeds on pigweed all over southern California, was quite rare in 1945 and 1946, became extremely abundant in the citrus groves in 1947, but has been rare again this past summer. Aphids of various species, but not the green citrus aphid, became very abundant in Tulare County in the spring of 1948 although they are usually rather rare in that area. One of those which appeared in Tulare County was the black citrus aphid, *Toxoptera aurantiae*, which is rather surprising, since it is primarily a coastal species, extending its range into interior southern California only in the spring. This species has never been taken in the Imperial or Coachella valleys. The black aphids found on citrus in these valleys are the melon aphid, *Aphis gossypii*, and the black clover aphid, *Aphis medicaginis*. In the desert valleys perhaps the most common insects on citrus in the summer are the cicada, *Diceroprocta apache*, and the membracid, *Stictocephala festina*, called the three-cornered alfalfa hopper. The former is absent and the latter much less common in the coastal areas.

Aphids are generally more numerous near the coast, becoming progressively less abundant as the interior is reached. Many species of leafhopper, however, are more abundant in the interior areas than near the coast.

Screenhouses Used

The first transmission tests were made to small budded trees set in the field in a

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Left. Sleeve cage on test tree in screenhouse used for quick decline transmission studies. Right. Interior of one of the two screenhouses constructed for the studies.

Transferring leafhoppers into a sleeve cage on a test tree.

DECLINE

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relatively isolated location near Baldwin Park. As materials became available, two screenhouses were constructed at the same location. These are 84 by 96 and 72 by 120 feet in size, respectively, and are covered with 32-mesh plastic screen to make them insect-proof. The screen has been effective in keeping free-flying insects out. It has also raised the temperature and the humidity so that the trees in the screenhouses have grown much more rapidly than those outside. Trees planted in June, 1947, are now beginning to touch the nine-foot ceiling. The long incubation period of the quick decline disease in the plant has slowed the work seriously. A young citrus tree inoculated with quick decline requires a period of one to two years before it shows symptoms. Even then the symptoms may develop slowly, being very obscure at first.

Transmission tests are made by taking insects which have fed on trees infected with quick decline, either naturally or in cages, and confining them on small healthy trees. When the right insect is used under the right conditions, the tree will become affected with the disease. Since it is impossible to collect most species in sufficient numbers on infected trees, most of the insects used are either collected on other plants or reared in the insectary. After a transmission test is completed the insects are killed, and their identity determined by experts. No live insects are ever taken out of the quick decline area.

Total transmission tests to date number 748, involving 137,841 individual insects in more than 200 species. Of these, 351 tests, in which 30,760 insects in 145 species were used, were to plants in the field; and 397 tests, involving 107,081 insects in about 160 species, were to plants in the screenhouses. The number of insects used per test ranged from one or two in the case of certain large species to a test in which 14,000 aphids were transferred to a tree over a period of more than three months.

To date, it is not known which insect carries the quick decline virus. There is one sick tree in the plot outside the screenhouse and another that is strongly suspected. Since these appeared a good series of tests has been made with the insects involved. It is now necessary to wait at least another year for these tests to show whether they are in the right direction.

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COTTON

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There may be days or even weeks on end when the humidity is so low that the usual defoliants do not work well. The solution for that problem lies with the chemists and the plant scientists to a large extent, though the engineers may have a job to do on applicators which will thoroughly cover the foliage with an optimum range of particle sizes.

When labor is saved by mechanization many people must be trained to operate and repair the machines. The driver of a four-row tractor cultivator must have far different training than the man who operates a hand hoe. The same is true for flame weeders. The purpose of cotton mechanization will be defeated if mechanical cotton pickers are operated by untrained and careless men. In California last year—1947—the major distributors of cotton pickers held night schools for owners and operators. The instruction was given by skilled men. This fall the program was enlarged to include daytime training meetings in cotton fields where a number of pickers were actually run by the students under the personal supervision of experienced men.

Progress in all types of farm mechanization will continue insofar as the individual problems encountered are solved by the coördinated efforts of growers, ginners, manufacturers, plant scientists, entomologists, soil technologists, chemists, economists, engineers, and teachers.

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CATCHER

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When the catcher is in place under the tree, the back of the slot is against the trunk of the tree with the frame members reaching forward. This section is fitted by hand with a removable metal cover which has a raised center to deflect the prunes as they drop so they will roll onto belt conveyors placed on either side of the catcher frame. The conveyors are operated from the tractor power take-off.

Two operators are necessary to tend the receiving boxes at the front ends of the conveyor belts. One man controls the clutch which starts and stops the conveyor belts.

The trees are shaken usually by two to four men equipped with pneumatic knockers. The air is furnished by a compressor in conjunction with the tractor. Practical experience with this harvesting method has demonstrated that each knocker augments the others to increase the efficiency and thoroughness of the job.

Speed of the harvesting operation—which averages about five minutes a tree—depends upon the skill of the box tenders and the effectiveness of the pneumatic tool operators.

When the work is well organized there is little waiting on the placing of the catcher equipment.

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Pneumatic knockers, or limb-shakers, in the hands of skilled operators speed up mechanized harvesting.