OBSERVATIONS ON PEEL INJURY TO POPE SUMMER ORANGES IN THE VERO BEACH AREA [1]

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In 1948 Pope Summer oranges in one group of groves in the Vero Beach area showed essentially the same type of damage that has always been described and recognized as katydid injury (Watson and Berger, 1937). However, owners of the groves believed that grasshoppers were doing the damage, and it was so severe that investigations concerning it were initiated. The problem was particularly important since Pope Summer oranges are picked in late June or July and demand an exceptionally good price in fresh fruit markets. Down grading had been as much as thirty to forty percent in some instances, which represented a sizeable economic loss to the grower.

Observations have been made during the course of approximately three years, 1949-1951, and while positive conclusions cannot be drawn at present, certain definite facts have been

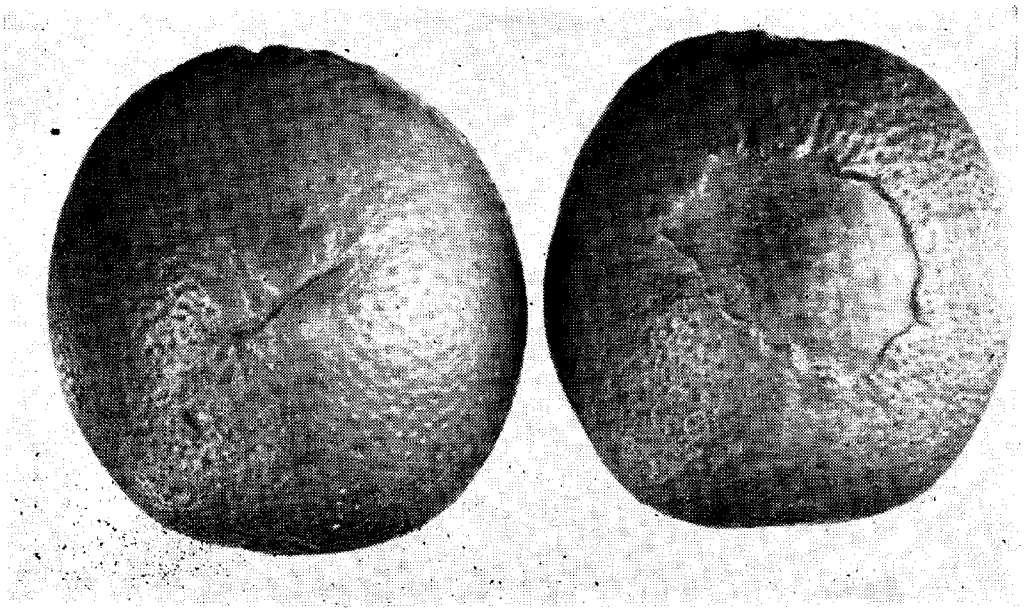

Figure 1. Two oranges which had been damaged just after setting. The one on the left was apparently damaged by one gouge of the insect's mandibles. The one to the right was more severely injured.

[1] Presented at the 1951 annual meeting of the Florida Entomological Society in Winter Haven. Florida Agricultural Experiment Station Journal Series, No. 83.

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ascertained and recommendations for control may be made. This paper will discuss the findings made during this period.

The injury on mature fruit is a blemish that may cover as much as half of the fruit (figure 1). In the particular groves investigated the injury was found almost exclusively on Pope Summer oranges, while Marsh Seedless grapefruit, Temple oranges, and Pineapples had very little if any injury at any time. According to reports from some other growers along the Indian River, this same type of injury has been observed in other Pope Summer orange groves on previous occasions. Occasionally the damage has been extremely severe, but it has never seemed to persist from one year to the next. In the groves where these observations were made the injury was first noted on the crop set in the spring of 1948. Since that time injury occurred in 1949 and again in 1950, but in 1951 very little injury was found.

The fruit is injured before it reaches the size of a pea. Injury may take place any time after the petals have fallen and before the fruit has attained a diameter of about ½ inch. Apparently by that time the peel has taken on such characteristics that it is not considered edible by the insects involved.

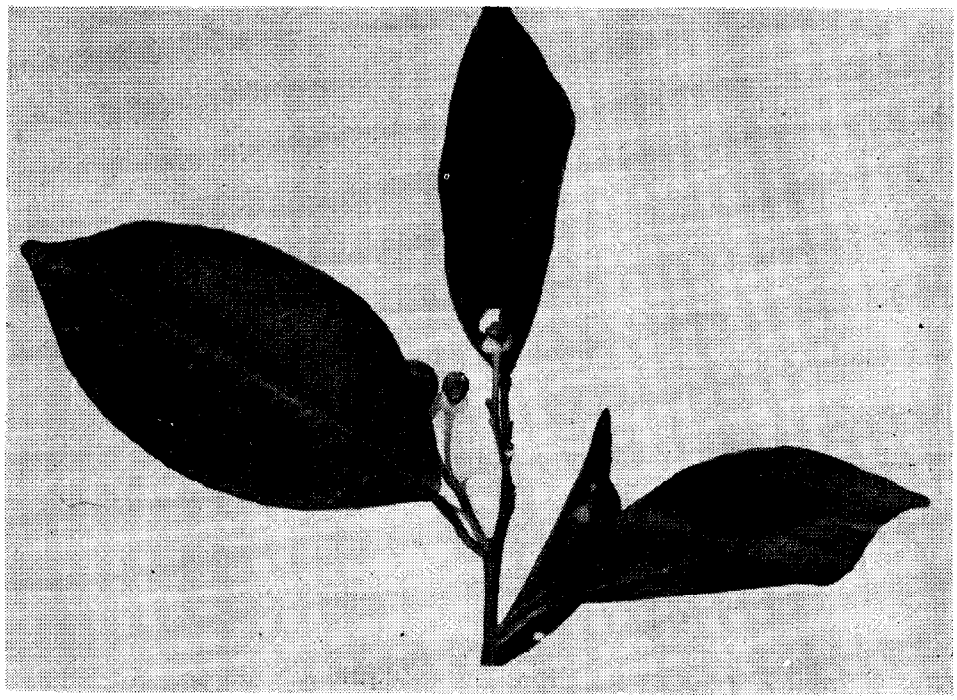

Figure 2. Fruit shortly after injury. All four fruits in the picture had been injured (⅔ natural size).

Figure 2 shows typical fruit injured shortly after the petals had fallen. The extent of the blemish at maturity will depend upon the amount of injury which occurs on small fruit. If injury is sufficiently severe, the fruit will drop. If less severe, it may cause the fruit to grow lopsided, or the fruit may attain a relatively normal appearance with only a small blemish on one side. Larger fruits are uninjured during the course of the summer months, except that occasionally the peel is chewed at the margin of an old scar.

It was noted that late bloom fruit which appeared in the grove following a bloom in late June or in July suffered severe injury in the summers of 1949, 1950, and 1951. There was a relatively heavy late bloom crop set in 1949. In the two following years there was little late bloom fruit, but where it was present, injury was common. However, fruit which had already sized was not being injured at that same time. It is apparent from this observation that the insect involved is present not only in the spring but throughout the summer months. However, injury occurs only to very small fruits.

In 1949 and again in 1950 the injury was accompanied by severe foliage damage throughout the grove. Foliage injury was characterized by holes eaten in the center of leaves as well as along the margins. In 1951, however, foliage injury was not present, although there was some injury to the fruit that spring. Fruit injury appears to be only superficial, with only the external layers of the peel being affected. Whether or not the insect which is injuring the fruit was causing the foliage injury has not been satisfactorily determined.

THEORIES CONCERNING CAUSE

Numerous possibilities concerning the cause of this injury have been examined and, in almost all cases, found wanting. Each of these possibilities will be discussed separately below.

The citrus root weevil, *Pachnaeus litus* (Germar), was considered a possibility. This beetle has been reported often in the Homestead-Miami area and it is known to injure fruit and foliage in Cuba. Although, according to Florida State Plant Board records, it has been reported as far north as the Vero Beach area, it has not been common there. Never, during the course of the three years' observations, were beetles of this species encountered in the grove nor was the injury which has

been pictured by Wolfenbarger (in press) exactly the same as that found at Vero Beach. It is, therefore, not believed that this insect is involved in the present injury.

Since the injury was identical with that caused by the broad-winged katydid, *Microcentrum rhombifolium* (Sauss.), particularly close attention was paid to this insect. Very few katydids were noticed in the springs of 1949 and 1950, and in 1951 very careful observation for this insect was made. It was not seen in the grove in the spring of 1951. When this insect is present, observation has shown that foliage injury may be severe. There can be no question that they will chew on fruit and will cause injury identical to that under discussion here. The fact remains that this insect was apparently rare in these groves and, under the conditions discussed here, was not a problem on Pope Summer oranges. The type of injury which it normally causes on foliage is shown in figure 3. In 1951 this katydid produced a hatch which was approximately simultaneous with the set of fruit and thus its life cycle during that year was most satisfactory for an insect which would injure young fruit. However, it can be stated positively that the injury caused in the spring of 1951 in the particular groves involved was not caused by the broad-winged katydid.

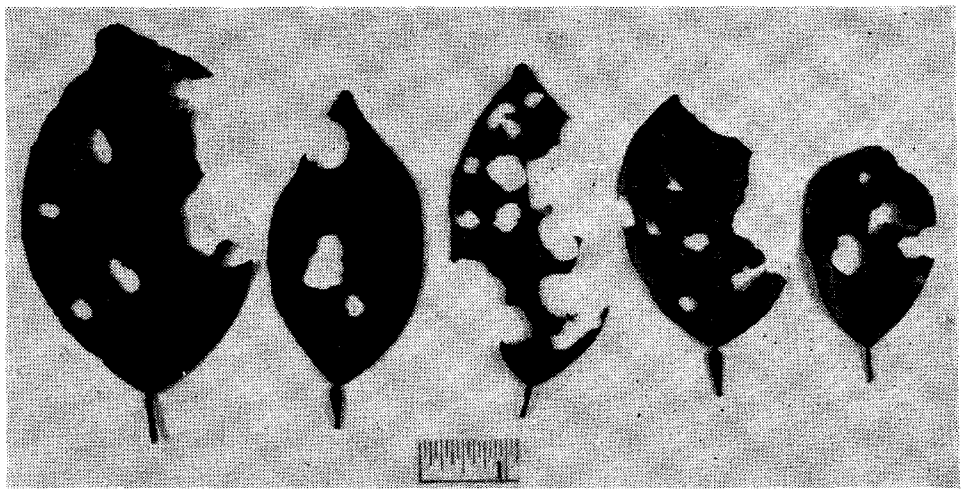

Figure 3. Leaves with holes chewed in centers and at margins by the broad-winged katydid. In the laboratory the restless bush cricket caused similar feeding patterns.

The owners of the grove originally believed that the injury was caused by some species of grasshopper. During the three years, numerous collections of grasshoppers were made to deter-

mine what species were present and which were most abundant. The most common grasshopper found in the grove in the spring of the year was the Eastern lubber, *Romalea microptera* (Beauvais). This species hatches in the spring of the year (Griffiths and Thompson, in press), usually by mid-February, and it was present in the grove in 1949 and again in 1950 in considerable numbers. Nymphs were found commonly during the spring of of the year on trees in areas where fruit was injured. In 1951 this species was almost nonexistent at the time fruit was set but, nevertheless, some injury occurred on the fruit. In 1949 no correlation could be made between the relative intensity of lubber infestation and the amount of fruit injured. In fact, the areas where lubbers were scarcest were the areas where most injury occurred. In the laboratory it was extremely difficult to get this insect to feed upon young fruits. While they would occasionally chew on the side of a small fruit, it was obviously not a desirable food source.

The second most common grasshopper found in the grove was *Melanoplus femur-rubrum propinquus* Scudder, the red-legged grasshopper. Griffiths and Thompson (in press) found that this insect hatches in mid- to late-February in most years and nymphs were present at the time the fruit was set. In the laboratory this insect failed to feed readily upon young fruits. It was uncommon also in the spring of 1951, although some individuals were present.

In addition to the above-named species *Schistocerca obscura* (Fabr.), *Schistocerca americana americana* (Drury), *Paroxya atlantica atlantica* (Scudder), *Paroxya clavuliger* (Serville), and *Dicromorpha viridis* (Scudder) also were found. None of these species was ever in sufficient abundance to be considered of any importance.

Individuals from three genera of Tettigoniiae, *Odontoxiphidium, Orchelium,* and *Conocephlus,* were collected, but these appeared to bear no relationship to the fruit injury.

The common field cricket, *Acheta assimulis* Fab., was always present in considerable numbers in the trash at the base of the tree. However, these crickets were never collected on the tree itself and in the laboratory they showed a marked aversion to fruits, although on one occasion one fruit was nibbled by a caged specimen.

The restless bush cricket, *Hapithus agitator* Uhler, was found on several occasions in the grove and there is definite

reason for believing that this very probably is the major cause of the fruit injury. This cricket is pictured in figure 4. In the summer of 1949 it was collected on trees in the vicinity of late bloom fruit which had been injured. One nymph was collected in sweepings of the cover crop. Specimens brought in to the laboratory readily chewed on fruit and foliage. The injury on foliage was similar to that made by katydids. Only the angular-winged katydid was found to eat fruit as readily as did the restless bush cricket. In the laboratory it appeared that small fruits were a preferred part of the cricket's diet. After the first collection, observations on the prevalence of this cricket were attempted, however the author was uniformly unsuccessful in finding specimens of this insect. During the blooming period in 1951 a careful search was made under the trees. Both nymphs and adults of the restless bush cricket were found among trash under the trees. These were found at a time when injury was occurring and at a time when most of the injury was confined to that part of the tree which was in intimate contact with some of the cover crop. In other words, injury was primarily on the lower limbs and usually only in those areas where tree and cover crop were touching. In such areas, insects without wings would be capable of climbing onto the tree and injuring fruit. Such would be the case if nymphs of this species were implicated. Due to the readiness with which the restless bush cricket will feed on young fruit in the laboratory as well as its occurrence, both under the trees and on the trees on several occasions, and the fact that this insect is apparently present throughout the spring and summer months when injury regularly occurred to young fruits, it would appear quite possible that this is the culprit that produced most of the injury to Pope Summer oranges. It is believed that until definite proof is found to the contrary, this insect should be considered the major insect involved. It is, of course, possible that some injury is caused by other insects, but in all probability the majority of the damage was performed by this one species.

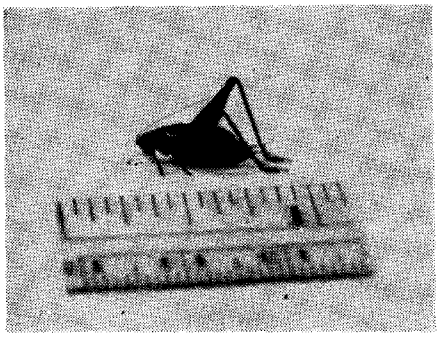

Figure 4. Restless Bush Cricket. The insect is light brown to tan with a light line along the wing margin.

CONTROL MEASURES

During the springs of 1949, 1950, and 1951 several insecticides were applied to determine if the damage could be successfully prevented. In these tests toxaphene, chlordane, lindane, dieldrin, and aldrin were tested. All of these are good insecticides for the control of grasshoppers and related Orthopteran species. Toxaphene was used on a commercial scale in each of two years. It was found that the application of these materials at the time petal fall was about half completed prevented the injury relatively well. Sprays applied before bloom were not generally successful. It is believed that insecticides should be used at dosages comparable to those for grasshopper control (Better Fruit Program, 1952; Griffiths and Thompson, in press) and applied to cover the foliage, young fruit, cover crop and ground under the tree.

SUMMARY AND CONCLUSIONS

In 1948 peel injury to Pope Summer oranges was first reported on the crop of fruit set in 1947. This injury in some instances involved as much as 30 to 40 percent of the crop. Observations during the succeeding three years indicated that the injury was not caused by the common broad-winged katydid, *Microcentrum rhombifolium* (Sauss.), or by grasshoppers which were present in the grove. It appeared that the injury was probably caused by the restless bush cricket, *Hapithus agitator* Uhler. Chemical control was attempted and it is probable that the application of either toxaphene, chlordane, lindane, or aldrin at the time of petal fall at dosages comparable to those used for grasshoppers in citrus groves would yield relatively satisfactory control.

LITERATURE CITED

Better Fruit Program, 1952. Florida Citrus Commission, Lakeland, Florida.

Griffiths, J. T. and W. L. Thompson. Grasshoppers in citrus groves in Florida. University of Florida Agricultural Experiment Station Bulletin No. 496. 1952. (In press.)

Watson, J. R. and E. W. Berger. Citrus insects and their control. University of Florida Extension Bulletin No. 88. 1937.