NOTES ON THE BIOLOGY OF THE FLORIDA RED SCALE
*(Chrysomphalus aonidum (L.))*

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The Florida red scale was first noticed in Florida in 1879 on a sour-orange tree imported from Cuba and planted near Orlando. Although it has been present in citrus groves here for 60 years and has been one of the most destructive scales, second only to the purple scale *(Lepidosaphes beckii (Newm.))* in damage to trees and fruits, very little has been published on the species. Work on its biology and on control was resumed as a definite work project at the Orlando laboratory in 1936 and is being continued in the new laboratory at St. Lucie.

LIFE HISTORY

METHODS OF STUDY: For the study of the life history of the Florida red scale, in 1939 orange and grapefruit trees that had very few scales on them were selected and tagged for identification. Artificial infestations were obtained by gathering leaves from trees that had heavy infestations and attaching them to the leaves or fruits of the selected trees. The infested leaves were clipped to both the upper and lower surfaces of leaves to be infested, and were fastened to fruits by means of rubber bands. The infested leaves were usually left on for two days so that the crawlers could crawl from under the scale coverings of the females and onto the clean leaf or fruit. After the old leaves were removed, the crawlers that had settled were identified by India ink numbers placed on the leaf or fruit. Each individual that settled was examined every two days when possible, and its stage was recorded. New infestations were

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1For much valuable advice and supervision the writer is greatly indebted to Herbert Spencer and Max R. Osburn.

made the first of each month to determine the influence of the seasons on the time spent in each stage.

The studies were made under as nearly natural conditions as possible. The trees selected were part of a grove and were not artificially protected in any way. The crawlers and marked scales from the artificial infestations were therefore exposed to the weather, predacious insects, and fungi as are the scale insects in any grove. The only difference between the artificial infestations and the natural infestations was the placing of the crawlers on the leaves or fruits and the marking. Supplementary work on some crawlers on potted plants was done in the screened insectary.

**Natural Mortality:** From March through September, 820 scales were under observation. Of that number, 256, or only 31 percent, reached the second larval stage and only 143, or 17.5 percent, reached the adult stage. Of these adults, 51 were females and 92 were males. Only 10 of the females were able to survive long enough to produce young.

Weather and insect enemies destroyed many of the scales marked for observation. A tropical storm on August 11, with 60-mile gusts of wind and 2 inches of rain in 24 hours, killed 90 percent of a lot of 178 that had settled and had been marked the week before. One trashbug (a hermerobiid or chrysopid) was seen destroying young scales, and the torn coverings of others were apparently the work of predacious enemies. Internal parasites also destroyed some, as indicated by the holes left in the scale coverings. Less than 1 percent of the scales studied showed any evidence of entomogenous fungi.

**The First-Stage Larvae:** Observations were made during July and August to determine the time between hatching and settling of the crawlers, the time required to reach the white-cap stage, and how long they remained in this stage. The white-cap stage is considered to cover the period from the time the young scale becomes completely covered with the white, waxy substance secreted from the body until the outline of the true scale can be distinguished.

For this experiment two small seedling orange trees were planted in boxes and placed in the screened insectary. Two methods were used for infesting the leaves with crawlers. By the first method the scales of the ovipositing females were lifted and the leaf to which they were attached was held over the leaf to be infested and gently tapped to dislodge the crawlers and
allow them to fall on the clean leaf. By the second method the scale coverings were lifted in the same way and the crawlers were transferred with a fine camel’s-hair brush. All the crawlers on the new leaf that did not move were then removed, and the others were watched constantly until they settled. As they settled they were numbered with India ink, and then were examined every few minutes until the first-ring stage was reached, that is, until the waxy covering began to expand laterally, forming a ring around the central nipple.

After the crawlers were placed, they generally went over both the upper and lower surfaces of the leaves, and selected a small area over which they moved carefully until they found the exact place, usually a small depression. When they were settled they began “rounding” almost immediately. The first noticeable change was the disappearance of the antennae and legs. They were apparently drawn under the body, and then a white, waxy substance was thrown up over the body.

Eighteen crawlers were studied. The average time after the crawler was placed on the leaf before it settled was 1 hour and 43 minutes, and 1 hour and 28 minutes for the settled crawler to reach the white-cap stage. The average time spent in this stage was 20 hours and 45 minutes.

The longest period spent in the first larval stage was during March. The average was 19 days, with a range of 17 to 22 days. In June the average was only 10 days, with a range of 7 to 16 days. The average for the 7-month period was 14 days.

With a view of determining how far crawlers would travel with no hindrance, records were made of the distance traveled on smooth paper for 2-hour periods. The crawlers were placed on the paper, and their movements were traced and measured with a map measurer. Six crawlers were observed, and the average distance traveled was 38 inches, with a range of 19 to 59 inches. The average temperature was 86.5°F. and the relative humidity 67 percent.

Observations were also made of five crawlers on mature grapefruit until they settled, and their movements were traced and measured. The average distance was 4 inches, with a range of 1.5 to 9 inches. The average temperature was 77°F. and the relative humidity 84 percent.

To determine what percentage of the crawlers settled under natural conditions, 77 crawlers were placed on orange leaves and were left for several hours. Only 39 were able to settle.
This points to a 50-percent mortality during favorable weather. In stormy weather this would undoubtedly be greater.

THE SECOND-STAGE LARVAE: The time spent in the second larval stage has been determined separately for males and females, because of difference in lengths of time for development. In this stage the males can be distinguished from the females by the color and shape of the outer covering. The male is darker, slightly longer than wide, and more convex than the female; the female has a reddish brown color which gradually turns darker with age, and is flatter than the male. The longest time spent in this stage was in March, when 14 days were required by the male and 23 days by the female. The shortest time spent by the male in this stage was in August, when only 4 days were required. For the female the shortest time was in June, when only 10 days were required. The average for the entire period was 8 days for the male and 15 days for the female.

LIFE CYCLE: The length of time from crawler to oviposition ranged from 52 days when settling occurred in August to 95 days when it occurred in February, with an average of 74 days for all ovipositing females.

A generation, from crawler to crawler, required less than 60 days during the summer.

The span of life for the ovipositing females from crawler to death ranged from 56 days in August to 110 days in January, with an average of 84 days.

THE ADULT FEMALE: When a female scale reached the adult stage, all other scales were removed from the leaf and it was watched closely for the first young. As the young appeared, they were removed so that they would not be counted twice. The most complete record of the number of young that a female produced is from a female that settled June 10. The first young were noticed 59 days after infestation, and the female produced an estimated 102 crawlers in 41 days, of which 51 were able to settle and start development. The full span of life for this scale was 100 days. The average time spent in the adult stage by the females that oviposited was 58 days, with a range of 28 to 80 days.

SEASONAL HISTORY

Work on the seasonal history of this scale was carried on during 1937 and 1938. Leaves were gathered at regular intervals and the scales were examined under binocular microscopes. A percentage method of recording the stages found was used for
this work. The numbers of scales examined each time were counted and classified as eggs, crawling young, males, and females, and were further subdivided as to age where it was possible. The results show that active crawlers can be found in any month of the year and that reproduction of the species is continuous. Reproduction has two peaks each year, the first during March, April, and May, and the second during July, August, and September. The latter peak is responsible for the young that heavily infest the fruit. Weather conditions are thought to be more favorable for reproduction during these months.

SUMMARY

The life span of the female has been found to be about 100 days during the summer months, young being produced within 52 days. The natural mortality of the scales is very heavy, only about 17.5 percent reaching maturity during summer. The most rapid period of growth was found to be in June and the slowest observed was in March. Crawlers may be found in any month of the year, with two distinct reproductive peaks.

BOUNCING BUDS

All entomologists are acquainted with the Mexican jumping beans, but the writer never seems to remember of having heard of jumping buds. Late in February, 1940, Doctor W. A. Murrill was making a comparative study of the buds of plum trees. In the course of this investigation he pulled the buds off of the branches of two Chickasaw plums and placed them in separate piles. To his surprise they did not stay separated, but began to jump about, some covering as much as an inch or two in one jump. This was disconcerting to the eminent botanist who wanted to keep the buds separate. He investigated the cause of this untoward behavior and found that the buds were inhabited by the larvae of weevils. He turned them over to the writer who in company with Doctor Murrill visited the plum thicket and collected more of these plum buds. A considerable percentage of the buds were found to be infested. They dropped from the trees without opening and the larvae pupated in the ground. Some that were brought to the laboratory and placed on moist earth on March 4th emerged on March 23rd and 27th. They were identified by Mr. L. S. Buchanan of the National Museum as Anthonomopsis mixus Lec. They were highly parasitized by a Calcidoioid identified by A. B. Hahan, also of the National Museum, as a species of Zatropis. No opportunity was given to obtain another generation since by the time these weevils emerged the plum blossoms were gone. There can be but one generation a year in plum buds.

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