BIOLOGY AND NATURAL CONTROL OF THE GREEN CITRUS APIIID
APHIS SPIRAECOLA PATCH

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BIOLOGY

Identity.—The name of the green citrus aphid is somewhat in dispute. It was first described by Dr. Edith M. Patch in 1914, but in a later paper Dr. Patch stated that it was probably identical with *Aphis pomi*. Dr. A. C. Baker, however, states that a difference occurs in the male forms (*Aphis pomi* being wingless and *Aphis spiraeola* winged) and for this reason the species should not be considered identical.

Appearance in Florida.—Altho there are indications of the presence of this aphid in Florida as early as the autumn of 1922, it was not until 1924 that its identity was definitely determined by Dr. A. C. Baker. It first appeared near Tampa, Florida, and from there spread eastward over the entire state with great rapidity. Since this is the direction of prevailing winds, it is assumed that the insect was thereby distributed. It is now found in Florida, California, Alabama, Cuba and Honduras.

Host Plants.—Considering the two species identical, Dr. Patch gave some 47 host plants. In Florida it was found to feed on some 30 plants, but thrives only on a few, namely, citrus,

"The purpose of this paper is to give a summarized report of two years' work with the citrus aphid carried on at the Citrus Experiment Station at Lake Alfred, Florida, during 1926 and 1927. All phases of the problem were studied and all available literature concerning this aphid was consulted.

The writer is greatly indebted to the Entomologist and Director of the Florida Experiment Station, his advisors at the Ohio State University and several men of the Bureau of Entomology, United States Department of Agriculture, for their aid, suggestions and encouragement during the progress of the work."
spirea, apple and milkweed. Only very tender growth of citrus and apple are attacked, but in the case of spirea the aphid can survive on quite tough, hard foliage or even on tender stems.

**Seasonal Appearance.**—The seasonal appearance of the pest is shown on the chart. Fig. 1.

The winged forms become most abundant during March, usually 7-14, and the migration then takes place. A very great number of plants are attacked and a few generations completed there, but by June the aphid can usually be found on only a few plants again. These are citrus and spirea.

**Life History.**—The life history of the green citrus aphid at Lake Alfred, Florida, differs from that of the same aphid in the north in that no sexual forms were found at this southern station. Consequently no eggs have ever been observed at the Citrus Experiment Station in Central Florida. The insect passes the entire year in the active stage and from August, 1926, to August, 1927, passed through 44 successive first born generations and 20 last born generations. At Gainesville, Florida, both

\[\text{During the past summer it has in places been found in large numbers on the tender growth of Pittosporum. —Ed.}\]
sexual forms and eggs have been found and there the life cycle is very similar to that in more northern climates. The eggs were found on spiraea, apple, pear, and Japanese flowering quince.

The average time to mature or nymphal period ranged from 4 days during September to 16 days during January. The average for the year was 6.93 days.

The number of young produced was greatest also during the month of September and reached a point almost as great in February. During the week of September 13, 1926, an average of 7.3 young per female per day was found. The lowest rate of reproduction occurred in January during very warm, dry weather. The optimum temperature was between 70 and 79° F. and 70% relative humidity. It was found that the aphids reacted most favorably to this temperature in a controlled temperature chamber. The average rate of reproduction per day for the entire year was 2.98 per female. Total young produced per female ranged from 1 to 103, being highest in September and February, with an average of 29.11 per female for the year.

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Eggs were abundant on wild crabapple at Monticello in extreme northern Florida during November, 1927.—Ed.
Length of Life.—The longevity ranged from an average of 11.8 days for June to 33 days for January with an average of 16.7 days. This total life can be expressed in general as a constant which is the product of the two sides of a parallelogram, one side of which represents temperature and the other length of life.

Occurrence of Winged Forms.—In many tests it was found that when aphids fed on very tender succulent foliage they all developed wingless, but when they fed on hardening foliage or on most any unsuitable host they became winged. Since all stages of foliage were always present, winged aphids could always be found, but were most abundant during March and April when most of the tender foliage was hardening.

Occurrence of Sexual Forms.—As has already been stated, no sexual forms occurred at Lake Alfred, Florida, but were present during late fall and early winter at Gainesville, Florida. There is usually a difference of 8 or 10° F. in temperature between the two points, but the writer is not able to state that this condition is responsible for the appearance of sexual forms. Work being done now under controlled temperature and humidity conditions at Gainesville, Florida, should help to solve the problem.

Economic Considerations.—As is the case among northern aphids, the more overwintering forms present, the greater will be the infestation during the next season. If each grower would so cultivate and fertilize his trees as to keep them dormant during the winter, thereby leaving no place for the aphids to live and at the same time destroy the weed host plants, he would do many, many times as much good as by spraying diligently after the aphids have become abundant during the spring. In other words, this problem, just as many others, resolves itself into one where cultural practice and timely and accurate observations will do more toward control than great quantities of insecticides.

NATURAL CONTROL

As usual, the natural control factors can be grouped into two divisions, meteorological and biological. The meteorological factors are occasionally important for winds, dashing rains, extremely high or low temperature and high humidity or very low humidity are all quite destructive to aphids. The biological factors are much more important.

Since the appearance of the green citrus aphid, *Aphis spirae-cola* Patch, in Florida there have been many observations and
many speculations made as to the control derived from its natural enemies. Professor J. R. Watson and Mr. A. H. Beyer of the Florida Agricultural Experiment Station and Dr. F. R. Cole of the United States Department of Agriculture have reported aphid predators at various times. None of these papers attempted to give an estimate of the control effected by the natural enemies named. Since little data of this nature have been recorded and many broad statements as to the natural control of this aphid are made, the writer has tried to collect information that will aid in solving the problem.

Method of Study.—In order to determine the value of the natural enemies one must know when each appears and disappears, its abundance and efficiency, or how many aphids each can destroy in a definite time. Each week at Lake Alfred, Florida, 10,000 aphids were counted and all the natural enemies of this number were recorded. By continuing this through the entire year the appearance and abundance of each predator and parasite were found.

The efficiency of each predator or the number of aphids destroyed daily was found by life history and feeding records. Eggs were collected from the field or from caged adults and the larvae were reared through their complete life cycle with a record kept of all aphids eaten. The average of several individuals was taken as the correct number.

In cases where both adult and larval stages destroyed aphids, feeding records of the adults were also made and the adults were included in the counts. The work of parasites, both insect and fungous, was recorded by actual count of the aphids killed by each parasite.

The following table shows the average number of citrus aphids destroyed each day by the more important natural enemies:

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\begin{align*}
\text{Cycloneda sanguinea} & \quad 26 \\
\text{Hippodamia convergens} & \quad 61 \\
\text{Coccinella oculata} & \quad 21 \\
\text{Scymnus sp.} & \quad 20 \\
\text{Baccha elevata} & \quad 33 \\
\text{Baccha lugens} & \quad 35 \\
\text{Allograpta obliqua} & \quad 34 \\
\text{Syrpheus wiedemanni} & \quad 45 \\
\text{Leucoptis americana} & \quad 17 \\
\text{Chrysopa sp.} & \quad 28 \\
\text{Hemerobius sp.} & \quad 20 \\
\text{Lysiphlebus testaceipes} & \quad \text{dead aphids found} \\
\text{Empusa fresenii} & \quad \text{dead aphids found}
\end{align*}
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The detailed results of the work are shown in the following graphs.
Fig. 3.—Ladybeetles, appearance, abundance and per cent of aphids destroyed daily.

Fig. 4.—Syrphus flies, appearance, abundance and per cent of aphids destroyed daily.
Fig. 5.—Miscellaneous predators, appearance, abundance and per cent of aphids destroyed daily.

Fig. 6.—Parasites and fungus disease, appearance and abundance and per cent of aphids destroyed.
Fig 7.—Aphids destroyed daily by all natural enemies. *Cycloneda sanguinea* (blood red ladybeetle) and *Baccha clavata* are responsible for most of the aphids killed.

It can be very readily seen that when the aphids were not increasing the natural enemies were able to destroy great proportions of them; but when they were increasing at all the natural enemies were not able to control them or even hold them in check.

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**MRS. W. S. BLATCHLEY DIES**

Members of the Florida Entomological Society and other friends of Dr. W. S. Blatchley will be grieved to hear of the death of Mrs. Blatchley which occurred in Dunedin, Florida, their winter home, on December 7. Mrs. Blatchley was 72 years old.