

## Relative Abundance of Three Coccinellid Predators of the Green Scale, *Coccus viridis* (Green) on Plumeria Trees<sup>1, 2, 3</sup>

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The plumeria, *Plumeria* spp. and hybrids, is one of the most important flower and ornamental crops in Hawaii (Watson *et al.*, 1965). The flowers are commonly used in making leis and the plant is used extensively in landscaping. One of the common pests attacking plumeria is the green scale, *Coccus viridis* (Green). In this study three introduced species of coccinellids, *Cryptolaemus montrouzieri* (Mulsant), *Azya orbiger* (Mulsant) and *Orcus chalybeus* (Boisduval) were found to be the main natural enemies of this pest. Hymenopterous parasites and fungus also attack the green scale; however, probably due to dry climatic conditions, these natural enemies were not important mortality factors. The present study is concerned with the relative and seasonal abundance of these three coccinellids and the green scale on plumeria trees.

### METHOD OF STUDY

Studies were carried out in the residential area of Waialae, Honolulu, Oahu, where there were many plumeria trees in private yards (Fig. 1). This area is in zone A of Ripperton and Hosaka (1942). According to these authors zone A is usually situated on the dry, leeward sides of the Hawaiian Islands. Most of the zone lies between sea level and 500 ft altitude. The rainfall is usually below 20 in annually, and the mean annual air temperature about 75°F.

Although there were other species and cultivars, only the Singapore plumeria, *Plumeria obtusa* L., (Watson *et al.*, 1965) was utilized because it is very susceptible to green scale attack, and does not shed leaves annually as do other plumerias. The Singapore plumerias used in this study were low spreading trees approximately 3 to 4 m tall and were not sprayed with insecticides.

Changes in the relative abundance of green scale and the coccinellid predators were followed at monthly intervals for a period of nine months, January to September, 1971, on five plumeria trees (Fig. 1). On each tree the coccinellids were counted by walking under the trees and looking up

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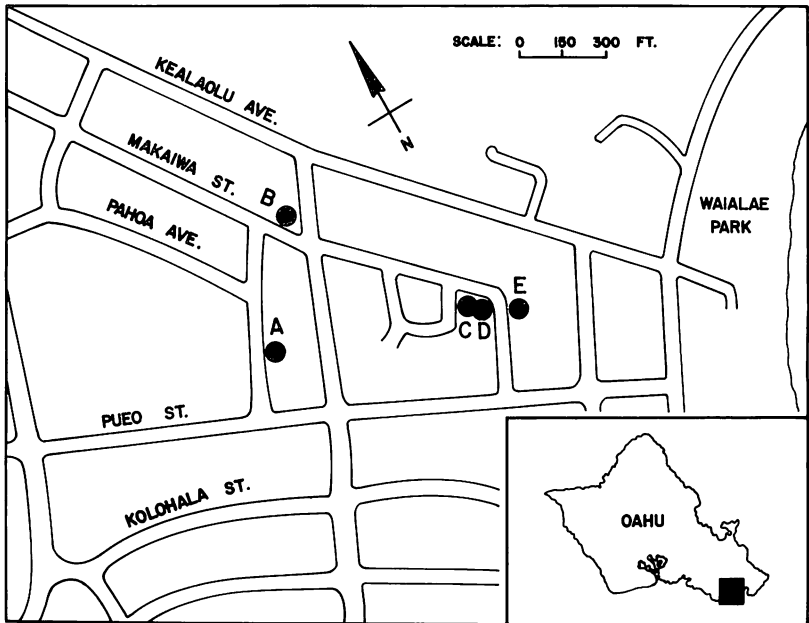


FIG. 1. Diagrammatic sketch of the experimental area showing the location of the five sampling trees.

into the canopy. The population of green scale was estimated by means of an index ranging from 0 to 5, which was based on the estimated percentage of leaves infested as follows:

- 0.....0-9 percent infested leaves
- 1.....10-19 percent infested leaves
- 2.....20-29 percent infested leaves
- 3.....30-39 percent infested leaves
- 4.....40-49 percent infested leaves
- 5.....more than 50 percent infested leaves.

Because green scale and its predators occurred on the lower surfaces of the large, broad, horizontally arranged leaves, the insects were visible from the ground. Leaves above 2.5 m high were not considered. Although there were five experimental trees (A,B,C,D and E), the results on only three trees are presented. The data obtained from trees C and E are omitted because they are similar to those of tree D.

### RESULTS

*The relative abundance of coccinellid species on plumeria trees.* Data obtained on the relative abundance of the three important species, shown in table 1, indicate that in general the percentage of *A. orbigera* was

higher than that of *C. montrouzieri* and *O. chalybeus*. Of 147 additional coccinellids from Singapore plumeria in other areas of Oahu during March to August of 1971, 51.4% were *A. orbigera*, 31.9% *O. chalybeus*, and 13.7% *C. montrouzieri*. These data indicate that *A. orbigera* was the predominant species, and *C. montrouzieri* was the least abundant.

TABLE 1.—The Relative Abundance of Adult *C. montrouzieri*, *A. orbigera*, and *O. chalybeus* on Plumeria Trees during January to September, 1971.

Tree	Total number of coccinellids	Percentage of		
		<i>C. montrouzieri</i>	<i>A. orbigera</i>	<i>O. chalybeus</i>
A	380	2.4	25.0	72.6
B	87	3.4	95.4	1.2
C	373	11.5	37.0	51.5
D	306	7.5	71.9	20.6
E	231	11.7	75.3	13.0

Seasonal abundance of the green scale. There were only minor fluctuations in populations of green scales in all trees. The indices of abundance on all trees ranged from 0 to 3. However, in general there was a tendency for population indices to decline during the summer months (figs. 2-4).

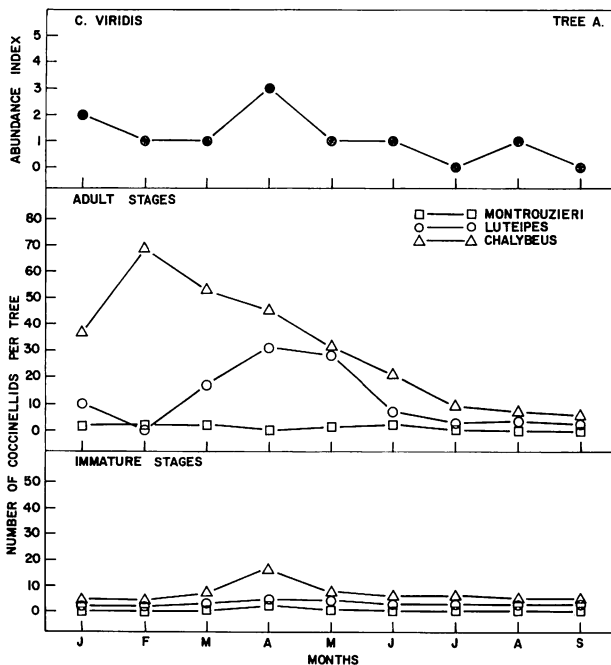


FIG. 2. Relative changes in the population of the green scale and its coccinellid predators on plumeria tree A. Read *orbigera* for *luteipes*.

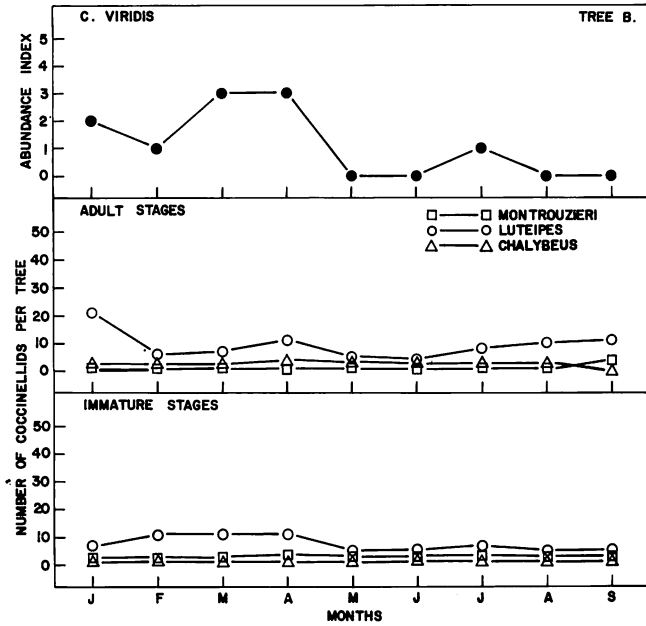


FIG. 3. Relative changes in the population of the green scale and its coccinellid predators on plumeria tree B. *Read orbigera* for *luteipes*.

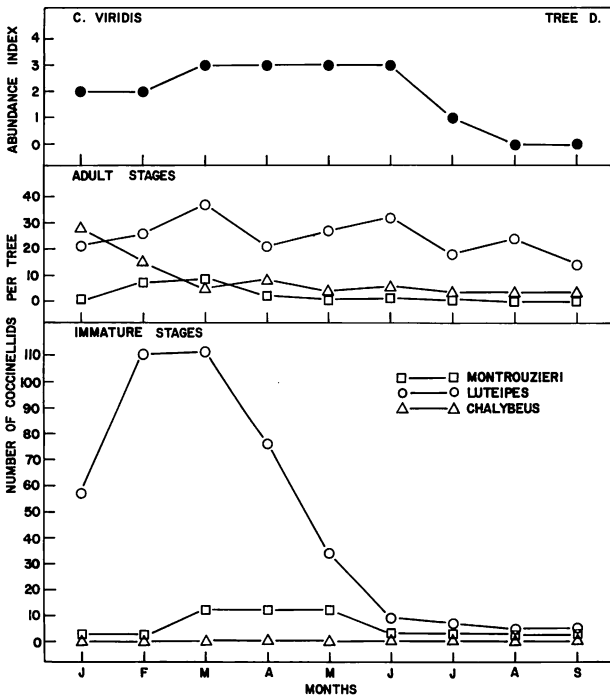


FIG. 4. Relative changes in the population of the green scale and its coccinellid predators on plumeria tree D. *Read orbigera* for *luteipes*.

*Seasonal abundance of adult coccinellids.* The populations of *C. montrouzieri*, *A. orbiger*a, and *O. chalybeus* varied from tree to tree. The population of *C. montrouzieri*, the least abundant species, was the most stable. With the exception of tree B, the population of *O. chalybeus* was usually higher during the beginning of the year than during the later months. The population trends of *A. orbiger*a was stable on tree B and D, but on tree A it was high during February to July.

*Seasonal abundance of larvae of coccinellids.* Like the adults, the larval populations of *C. montrouzieri*, *A. orbiger*a and *O. chalybeus* varied among the trees. Populations of larvae of all three species were stable on trees A and B. On tree D the population of *A. orbiger*a was high during February and March.

*Sex ratio.* Data on sex ratio of *C. montrouzieri*, *A. orbiger*a and *O. chalybeus* were obtained from adults collected on plumeria trees in different areas of Oahu. Of 20 adults of *C. montrouzieri* collected, 7 were males and 13 females. A chi-square test, with correction for continuity (Snedecor and Cochran, 1967), gave a computed chi-square value of 1.25 ( $P > 0.25$ ) which was consistent with a hypothetical sex ratio of 1:1. Of 80 adults of *A. orbiger*a collected from the same area, 40 were males and 40 females; a sex ratio of 1:1. Of 47 *O. chalybeus* adults collected, 21 were males and 26 females. These data again were subjected to a chi-square test with correction for continuity. The computed chi-square value of 0.34 ( $P > 0.50$ ) was consistent with the 1:1 sex ratio hypothesis.

#### DISCUSSION

During this study the population index of green scale never exceeded 3, which means that never more than 39% of the leaves were infested. At this population level there was no apparent damage caused by the pest. Green scale populations apparently were maintained below economic threshold levels by the coccinellid predators, and therefore it was unnecessary to use insecticides for scale control. Populations of the green scale were relatively stable throughout the nine-month study period. This stability may have been due to interactions between the three predator species as well as between predator and prey populations. The presence of other prey, such as mealybugs, other species of coccids, aphids, and psocids on which the coccinellids fed, also may have helped to stabilize green scale populations.

The reason for the relatively low populations of *C. montrouzieri* associated with green scale on plumeria is not known; however, it may be that green scale is nutritionally inadequate for this species. Rao and David (1956) reported that *C. viridis* was eaten by *C. montrouzieri*, but it was not its favoured food. It is also possible that the host plant, plumeria, may not be entirely suitable for *C. montrouzieri*. It was observed during this study that populations of *C. montrouzieri* were high on certain other plants infested by green scale, such as natal plum (*Carissa*

*grandiflora* Alphonse de Candolle). On this host populations of both the scale and *C. montrouzieri* were high, but there were no larvae or adults of either *A. orbigera* or *O. chalybeus*. The relative abundance of the three species of coccinellids may also be influenced by inter-specific competition. However, this was not investigated during the present study.

#### SUMMARY

Populations of green scale, *Coccus viridis* (Green), fluctuated very little and remained below economic threshold levels on Plumeria trees in Honolulu. This was attributed to predation by the coccinellids, *Azya orbigera* (Mulsant), *Orcus chalybeus* (Boisduval), and *Cryptolaemus montrouzieri* (Mulsant). Data on the relative abundance of these coccinellids on plumeria trees indicated that *A. orbigera* was more abundant than *O. chalybeus*, and *C. montrouzieri* was the least abundant. The sex ratio of each species was 1:1.

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