

Ceroplastes floridensis COMSTOCK⁽¹⁾ an important pest of citrus trees in Aegean islands.

L.C. ARGYRIOU and A.L. KOURMADAS*

CEROPLASTES FLORIDENSIS COMSTOCK,
IMPORTANT RAVAGEUR DES CITRUS
DES ILES DE LA MER EGEE

L.C. ARGYRIOU et A.L. KOURMADAS

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RÉSUMÉ - L'évolution de *Ceroplastes floridensis* COMST. a été étudiée sur *Citrus* dans les îles de la mer Egée : Astypalée et Rhodes. Deux générations se développent annuellement à Astypalée. L'éclosion maximale des premiers stades larvaires de chaque génération a lieu en mai-juin, puis en septembre-octobre respectivement. Deux parasites, *Coccophagus lycimnia* WALKER (Hym., Aphelinidae), *Tetrastichus ceroplastae* (GIRAULT) (Hym., Eulophidae) et deux prédateurs, *Exochomus quadripustulatus* L. (Col., Coccinellidae) et *Scutellista cyanea* MOTSCH. (Hym., Pteromalidae) ont été obtenus de *C. floridensis*.

INTRODUCTION

The Florida wax scale *Ceroplastes floridensis* COMSTOCK (Homoptera : Coccidae), is restricted in the citrus groves of the Aegean islands, Astypalaea and Rhodes. This scale is a new invader in Greece (2, 3) and it has been an important pest. In addition to weakening the trees by sucking the sap, the damage caused by *C. floridensis* is also due to the development of sooty mold on the honeydew secretion, which covers branches, leaves and fruits. This mold is hard to clean, it sticks firmly on the surface of the plant and thus it marks the fruit rendering it unmarketable.

This species is a polyphagous one (4) but in Greece it has been found only on citrus species. Heavy populations mainly appeared on lemon, grape-fruit and mandarine-orange trees.

The taxonomy, morphology and phenology of *C. floridensis* have been studied elsewhere (1, 5, 7, 8) but there are no data concerning this species in Greece.

In view of the economic importance of *C. floridensis*, a study was carried out to gather information about its biology and natural enemies, in order to work out a rational programme for the control of this scale.

METHODS

The experimental work was conducted mainly in Astypalaea island and some samples were taken also from Rhodes island. The scale populations were sampled twice every month. The samples were collected from the top of green twigs, each of them about 20 cm in length. The samples were brought to the laboratory, where they were examined under a stereomicroscope to determine the numbers of *C. floridensis* alive, their stages of development, the existence

* - Benaki Phytopathological Institute, Kiphissia-Athens, Greece.
(1) - Hom. : Coccidae

of parasites or predators and their rate. All the wax scales alive present on the twigs and leaves were examined until a total of 500 specimens was counted. The distinctions between the various stages were based on the different forms of wax covering them according to the method described by AMITAI (1). However, from egg to adult, the sample was divided into : crawlers ; first, second and third larval instars, preoviposition stage (adult female) and oviposition stage (ovipositing female or mature adult). The crawlers were not included in the counting. In *Astypalaea*, sampling began in May 1977 and ended in December 1979, while samples from Rhodos were taken from May until December 1979.

RESULTS

Phenology.

From our observations on *C. floridensis* over a period of about three years we found out that it produces two generations per year on citrus in *Astypalaea*. This scale is unisexual and ooparous.

The data obtained from the laboratory examinations were used to calculate the percentage of the various stages in the total alive population during the whole year. Fig. 1 shows the process of growth of the scale during a year period. It shows that the scale overwinters mainly in the third instar larva stage and, to less extent, in the second

instar larva and immature adult female. In many females the maturity of the ovaries begins by the mid-February or earlier. From March onwards the scales start developing rapidly and enter to ovipositing stage towards the end of March and by the first days of April. At this time of the year the bodies of the adults are observed to grow rapidly. During mid-May the oviposition reaches the maximum and then gradually decreases until the end of June, when it has been completed. The hatching begins at about the tenth of May. Crawlers appear in mass by the end of May to early June. The first larval instar appears in the mid-May and the majority of this stage in the beginning of June. The second larval instar makes its appearance in the beginning of June reaching its maximum by the end of this month.

The third larval instar appears by the mid-June with a maximum in the mid of July. The first adult females appear in early July and the oviposition starts after the tenth of August. Crawlers start to appear by the end of August to early September. Virtually all the eggs have hatched by the end of October and, in the three years of our observations, the hatching was finished at the latest by the first ten days of November.

The process of the development of the second generation is as follows. The first instar larvae appear in the first ten days of September and reach their maximum towards the end of this month. Early in October the most of the population is in the first larval instar. The second instar larvae make their appearance after the mid of September and

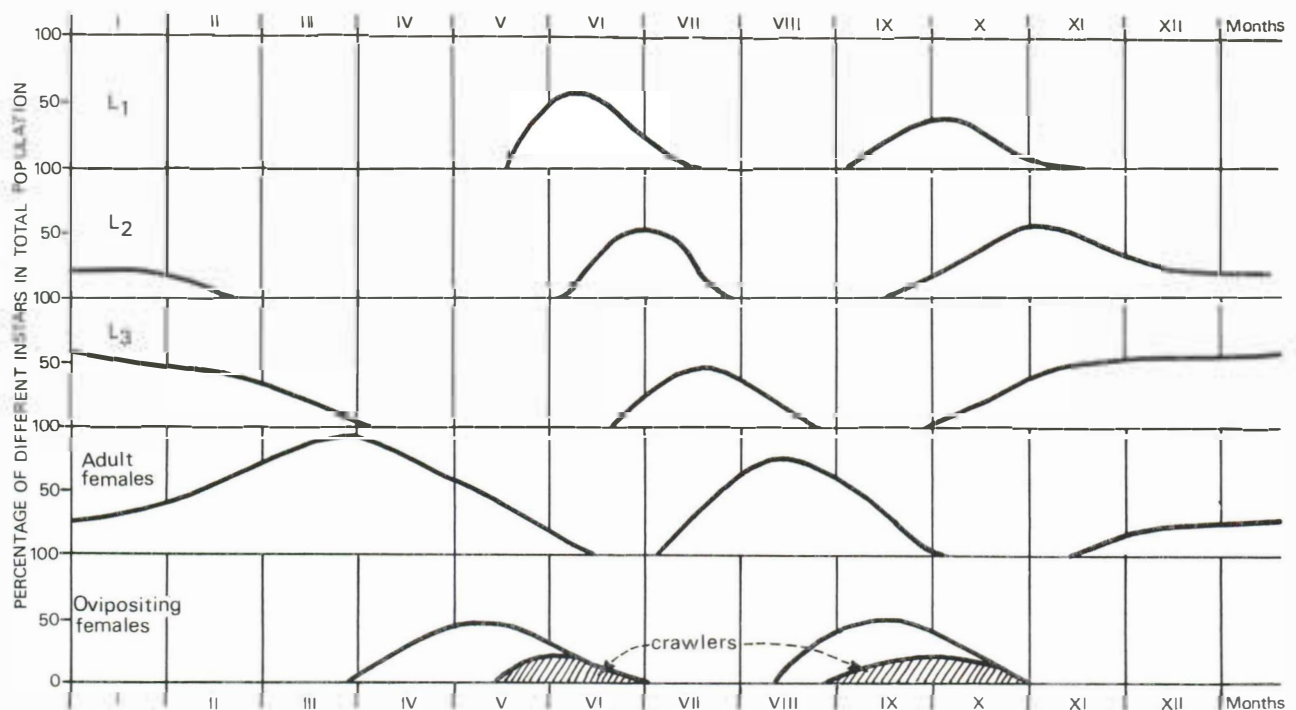


FIGURE 1 * DEVELOPMENT OF DIFFERENT STAGES OF *CEROPLASTES FLORIDENSIS* DURING A WHOLE YEAR IN *ASTYPALAEA*.

reach a maximum about the end of October. A percentage of this stage, which consists of about 15-20 % of the total population, overwinters.

The third instar larvae appear early in October and virtually, late in November, the majority of the population consists of third stage larvae. In this stage, the most of the insects hibernate. However, a part representing the 25 % of the total population, hibernates in the stage of adult (immature female). Thus during the winter months, the population of *C. floridensis* consists of individuals belonging to second, third and adult stages of development, the third instar larvae consisting the largest proportion of the population.

The female deposits a relatively great number of eggs. From 25 countings made on samples collected from the field, it comes out that the average number was 152 ± 29 eggs per female, reaching a maximum of 550 eggs.

Parasites - Predators.

The beneficial insects complex associated with *C. floridensis* in the above mentioned Aegean islands is the following :

Two parasites were found to infest *C. floridensis* in the citrus groves of Astypalaea and Rhodos islands : the endoparasites *Coccophagus lycimnia* WALKER (Hym. : Aphelinidae) and *Tetrastichus ceroplastae* (GIRAULT) (Hym. : Eulophidae). *C. lycimnia* was found in fair number. This is a widely distributed parasite of soft scales in Greece. *T. ceroplastae* was the most abundant species in both islands and it also attacks the fig wax scale, *Ceroplastes rusci* L.

Also, two predators, *Scutellista cyanea* MOTSCH. (Hym. : Pteromalidae) and *Exochomus quadripustulatus* (Col. : Coccinellidae) were found to attack *C. floridensis*. *S. cyanea* is a widely distributed egg-predator of various soft scale insects in Greece. It is a very common natural enemy of black scale, *Saissetia oleae* (OLIVIER) and of fig wax scale, *Ceroplastes rusci* L. *E. quadripustulatus* is the most abundant predator of the soft scales on citrus and olive trees. This predator was found to be present in both islands preying on *C. floridensis*.

DISCUSSION

The data obtained from the samples were used to formulate a rational method of controlling this pest of the citrus trees. As it has been said, the scale *C. floridensis* develops two complete generations a year on citrus trees.

The first generation, as evidenced by the appearance of crawlers and first-stage larvae, appears in late May-early June ; this indicates that late June is the best time to control it with insecticides. Moreover, June is the best time to control Diaspididae scales, such as the red scale (*Aonidiella aurantii* MASKELL.), one of the most important enemies of the citrus today. In the case of a very severe infestation a second spraying, three to four weeks after the first one, would be necessary for full protection of the trees. This spraying would cover the entire range of citrus scales hatches.

The second generation crawlers appear during September and October, reaching a peak in late September. During the last third of September the scale population is composed mainly of crawlers and first-stage larvae, i.e. stages vulnerable to insecticides. If the June spraying was omitted and an outbreak of scale infestation appears in late summer, a spraying at this time is necessary.

But as Diaspididae scales and to some extent soft scales and mealybugs of citrus are under biological control in the citrus-groves of Greece, the use of summer oils would be advised for sprays in order to avoid the damage on useful insects of this habitat.

The natural enemies of *C. floridensis* in the citrus-groves of Astypalaea and Rhodos islands were poor, ranged usually between 2-10 % of the alive scales during autumn. A parasitization of nearly 50 % has been recorded during early June 1977.

The predator *S. cyanea* appears during the oviposition and hatching periods of the scale and once we recorded a peak of 40 % on ovipositing females.

The natural enemies of *C. floridensis* seem to play an important role, but further study will be needed to establish precisely in what this role consists.

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