

# Citricola Scale Enemies

## balance of scale and parasite required

Paul DeBach

The citricola scale, *Coccus pseudo-magnoliarum* Green, increased in numbers in 1948 in western Riverside and San Bernardino counties. It disappeared from economic consideration in those areas during the winter of 1933-34 and remained relatively unimportant until 1947 when it began its current build-up.

Several orange groves showing an increase in citricola scale were observed in the Redlands area during 1948. In general, two species of parasites, *Metaphycus luteolus* and *Metaphycus helvolus*, have been the dominant natural enemies of the scale. Both of these parasites were present and active as the scale increased in size early in the spring. By April the scale was too large to be parasitized by *M. helvolus*, but *M. luteolus* continued to work on the scale, occasionally parasitizing even mature scale. Several *luteolus* would emerge from a single large scale, whereas only one would mature in a small scale.

In spite of this parasitization, which was quite heavy throughout the spring, a sufficient number of scales escaped to mature and accomplish a reinfestation of the trees during the main hatch in June and July. This reinfestation is not surprising because the females of this species of scale lay 1,000 or more eggs. The hatch was uneven enough, however, to enable the parasites to maintain themselves throughout the summer on the largest young scale.

Under extremely even hatch conditions, most of the newly settled scale would be too small to be parasitized until early fall. During July and August *M. helvolus* and *M. luteolus* became very abundant. By late August these parasites had eliminated all but the smallest late-hatch scale. Scales one twenty-fifth of an inch or less in length are too small for them. In addition, only male parasites develop on the smaller scales just above this minimum size. Inasmuch as they were forced to parasitize successively smaller scale during the late summer, about 80% of the parasites which were produced toward the end of this period were males. This eventually led to the virtual elimination of the parasites in September.

Parasite activity was estimated to have accounted for about 90% to 95% of the scale generation by September. This was not enough for commercial control where the scale population was heavy.

Of six groves visited on September 14, 1948, only one could be judged commercially clean as a result of parasite activity. The others had from light to heavy infestations of small, very even-sized citricola scale.

The scale which escaped parasitization during July, August and September, because of its small size, eventually became large enough in October to be parasitized by *M. helvolus* and *M. luteolus*. Unfor-

tunately, the parasites had been nearly eliminated in September. A few parasites undoubtedly were left, and if these succeed in establishing themselves throughout the winter, additional groves may become commercially clean.

This past season's observations indicate that the balance between the citricola scale and its parasites in the Redlands area is rather delicately adjusted around the point of so-called commercial cleanliness. Further studies may reveal that this balance can be improved by periodic releases of parasites or by manipulating other factors which may favorably influence the efficiency of the parasites in the field.

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# Baker Mealybug

## use of green lacewing in control studied

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**Biological control** of Baker mealybug on pears was studied during 1948 in experimental work carried out in conjunction with the normal spray program.

The experiments were designed to find some method by which the utilization of natural enemies could be made compatible with the DDT spray programs practiced for codling moth control.

Laboratory tests confirmed earlier field observations that the larval stage of a mealybug destroyer, the green lacewing—*Chrysopa californica*—is resistant to DDT while the adult stage is susceptible. Field observations indicated that the early DDT sprays tended to inhibit the egg laying of the adult lacewing and as a consequence sometimes there were insufficient numbers of young, predaceous lacewings in the pear trees to hold the mealybugs in check. It seemed reasonable to assume that control of the mealybugs might be achieved by artificially colonizing the lacewing eggs in pear orchards.

At the Division of Biological Control in Albany a technique was developed for the production of lacewing eggs. Approximately 1,000,000 eggs were produced last season and some of these were placed in experimental plots in Santa Clara Valley pear orchards. The method may be considered similar to a spray program in that each tree was treated with eggs. As the eggs hatched the resulting larvae actively hunted for mealybugs throughout the trees thereby giving them full coverage. To carry the comparison further,

such factors as timing, number of applications, and dosage were investigated in this experimental work on mealybug enemies.

The results have been encouraging, for mealybug populations have been appreciably reduced in test plots. For example, the trees in one check plot which did not receive the treatment of lacewing eggs ended the season with a population of mealybugs 30 times heavier than the population existing in comparable trees treated with lacewing eggs. Furthermore, fruit in the lacewing plots remained remarkably free of calyx infestations.

Although the use of the green lacewing shows some promise as a mealybug control method, a considerable amount of investigational work remains to be done, particularly in relation to economics. During the 1949 season the method will be tested on a larger scale in the Santa Clara Valley orchards, and efforts will be made to put it on a sound practical basis.

Additional parasites and predators of mealybugs have been carefully tested in quarantine and have been found safe for release in experimental plots in California pear orchards. These beneficial insects may prove to supplement the work of the predaceous green lacewing.

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