California Oakworm

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The California oakworm (*Phryganidia californica* Packard) is a common pest of oaks in the coastal valleys of California. Its larvae feed on the leaves and reduce the amount of shade a tree can supply. They irritate homeowners in other ways by dropping frass, and by crawling on walkways and into houses. Swarms of moths which emerge once the larvae have pupated compound the nuisance. The larvae often become so numerous that they destroy every leaf on the oaks, but an infestation rarely lasts long enough to cause tree-killing. Outbreaks usually decline after a year or two, as quickly as they appear.

Range and Hosts

The California oakworm occurs entirely within the boundaries of California, mostly along the coast. Its range extends from Humboldt County south along the coast to Long Beach in Los Angeles County. Moths also have been collected in Del Norte County in northwestern California and have been reported in San Diego County in the south. In the central part of the State they are found inland to Sacramento and Placer Counties.

California live oak and California white oak are its principal hosts, but the larvae will feed on nearly all oaks. They have also been reported as feeding on American chestnut, eucalyptus, azaleas, and tanoak.

Evidence of Infestation

The first signs of California oakworm activity are brown, pitted leaves that appear on California live oak in early spring. As feeding increases with the growth of the larvae, all the green leaves disappear from trees that are heavily infested and the ground beneath is covered with tiny green pellets. By this time the larvae are crawling everywhere searching for more food or pupation sites.

Oaks stripped by feeding decline in vigor and their twigs and branches die back. The decline is reflected in loss of radial growth during years of heavy feeding. The oaks usually survive because of their ability to grow new foliage from adventitious buds after being completely defoliated.

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Life Stages

The eggs of the oakworm are creamy white and are laid in rows, making irregular masses of 2 to 60. They usually are deposited on the underside of the leaf (fig. 1, *A*) but are sometimes placed on twigs or grass or even on brush. Each egg is smooth and rounded and about one twenty-fifth of an inch in diameter. As the embryo develops inside, the color of the egg changes to yellow, then to brown, and finally to a mottled pinkish gray. During this period a slight depression develops at the top of the egg.

When the larvae first emerge from the hatched eggs, they are about 1/10 inch long, are gray in color, and have prominent hairs and a large head. Soon after feeding starts, their color changes to brown with indistinct longitudinal red stripes. Between the third and sixth instars they stabilize to one of two color phases. A light phase, which is more common, has prominent dark longitudinal stripes on a green or yellow background; a less common dark phase has the reverse color scheme. When full grown the larvae are about 1 1/4 inches long, and hairless (fig. 1, *B*).

The smooth and shiny pupa is about 1/2 inch long and 1/6 inch broad (fig. 1, *C*). Its color varies from white to yellow with many black lines and splotches.

The moths are light brown with dark wing veins. The body is 1/2 inch long and the wingspread about 1 1/4 inches (fig. 1, *D*). The males have feathery antennae and faint yellow patches near the middle of the forewing.

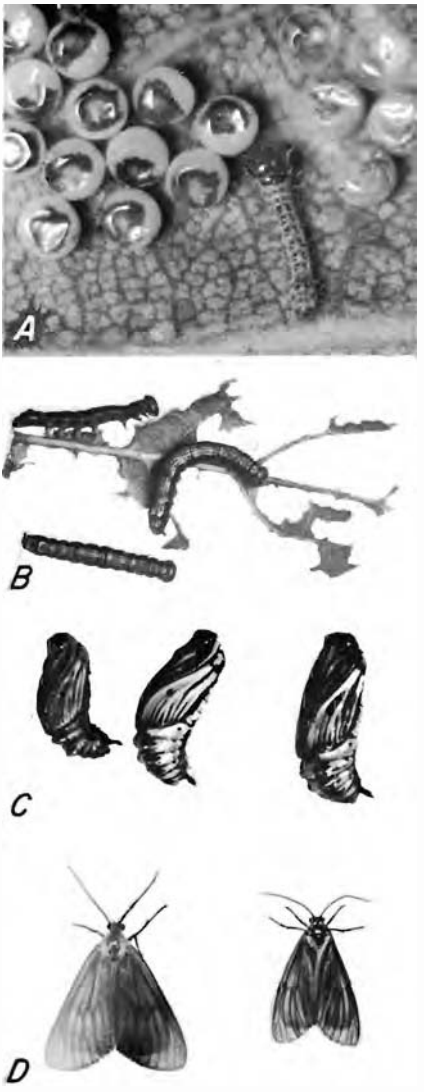

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FIGURE 1.—Life stages of the California oakworm: *A*, Eggs and newly hatched larva; *B*, full-grown larvae; *C*, pupae; *D*, adult moths (male on left).

Habits

The California oakworm normally has two generations a year—a 3-month summer brood and a 9-month winter brood. The winter brood depends on the evergreen live oaks for food. In the San Francisco Bay area, this brood lays its eggs in October. The summer brood, which may infest either live or deciduous oaks, lays its eggs in June and July.

The first generation eggs hatch from October through December, the second generation in July.

The young larvae feed on the soft surface tissue of the leaf veins, causing brown pitted patches, which last as long as the leaves remain (fig. 2). The older larvae chew their way from the edge of the leaf inward to the midrib. During epidemics every green part of the foliage disappears.

By September the worst of the year's leaf destruction is over, and the larvae crawl about seeking pupation sites. They pupate head downward on fence posts, buildings, and walls, but preferably on the lower trunks of oak trees. Larvae of the winter brood pupate in May and June and those of the summer brood in September and October.

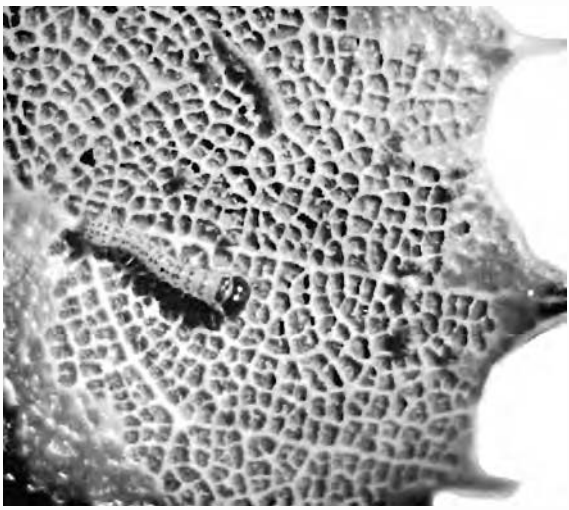

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FIGURE 2.—Young larvae feeding upon surface tissue of a live oak leaf.

The moths emerge in June and July from the winter brood and in October and November from the summer brood. Both sexes are weak fliers. During epidemics, clouds of them may be seen fluttering around oak trees. Mating and oviposition take place within hours after emergence. The adults have not been seen feeding. The sex ratio is 1:1.

The females produce about 225 eggs each and usually lay them on leaves high in the crown of the tree. Sometimes they lay eggs indiscriminately on anything they encounter, but larvae do not live unless the eggs hatch on a host leaf.

Natural Control

Natural enemies of the California oakworm are responsible for marked population changes. Within 2 or 3 years after an epidemic starts, a predator, parasites, and diseases usually decimate the population. The eggs, larvae, and pupae are punctured and sucked dry by the spined soldier bug, *Podisus pallens* (Stal.). The larvae are parasitized by a larvaevorid fly, *Actia* sp. Oakworm pupae are heavily parasitized by an ichneumonid, *Itoplectis behrensii* (Cresson), and a chalcid, *Brachymeria ovata* (Say). A nuclear polyhedrosis virus disease can wipe out dense larval populations. In one area, a microsporidian parasite, *Nosema phryganidiae* Lipa and

Martignoni, was found attacking both the larval and adult stages of the insect.

Mass starvation also greatly reduces the numbers of both the oakworm and its natural enemies. During severe epidemics all the oak leaves may be consumed before the larvae reach full development. Their food supply cut off, the immature larvae eventually die.

Sometimes severe winter weather will kill great numbers of larvae and accomplish control.

When the California oakworm is reduced by high mortality from natural enemies or starvation, the numbers of parasites are also drastically reduced from lack of food. A few surviving oakworms start another generation, which may be almost free from parasites. As succeeding generations build up, so do the natural enemies, and once again the epidemic is cut off.

An important natural control factor in small populations is the oakworm's habit of laying eggs indiscriminately on both deciduous and evergreen oaks. Since the deciduous oaks normally drop their leaves in the fall, all overwintering eggs and larvae on them are doomed, and only those overwintering eggs on the evergreen oak can perpetuate the population.

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