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Adults of cypress bark moth.

The cypress bark moth is frequently found infesting cones and trunks of Monterey Cypress in central coastal California. Larval feeding on cones produces unsightly accumulations of frass, while trunk feeding results in the production of swellings and resin flow. Primary concern about the moth may lie in its relationship with a serious fungus disease on the cypress, according to these studies.

CYPRESS BARK ON MONTEREY

THE CYPRESS BARK MOTH, *Laspeyresia cupressana* (Kearf.), is a common insect associated with cypress trees, found only in California, where it occurs from Mendocino County to San Diego County. Its principal host is Monterey Cypress, *Cupressus macrocarpa* Hartw. ex. Gord., which is grown extensively along the coast as a hedge, windbreak, or landscape tree. In addition to several other species of the genus *Cupressus*, other known hosts include members of the genera *Chamaecyparis*, *Thuja*, and *Cryptomeria*. The insect occasionally is found in inland areas where suitable hosts are available.

Larvae of *Laspeyresia* commonly tunnel into the cones of cypress trees. These may become so severely infested that the extruded insect frass, which is held loosely together by larval webbing, appears to drip from the cone clusters. Once inside the cones, the larvae confine their feeding activity almost exclusively to the scale tissue. They feed on the seeds only in early spring when the newly formed cones are small and succulent. Another cone-infesting moth, *Henricus macro-*

carpana Heinr., frequently found associated with *Laspeyresia* in the same cone, feeds only on the seeds of unpollinated cones. This characteristic seed feeding has probably been mistaken by previous investigators for that of *Laspeyresia*, since the larvae of both often infest the same cones. *Laspeyresia*, however, feed on unpollinated and pollinated cones. It is not uncommon to find more than one *Laspeyresia* larva feeding in a single cone. Of almost 3000 cones dissected, 20% contained from two to five larvae.

Laspeyresia larvae also tunnel into primary branch nodes and the trunks of host trees; and occasionally may be found in the smaller branch crotches. At these sites they feed locally on the phloem tissue, apparently avoiding the cambium. This feeding does not girdle trees as some previous investigators have indicated; however, successive attacks at one site give a girdled appearance to the affected area over a number of years. On healthy, undamaged trees the larvae have never been observed to attack the branches in areas other than the nodes. However, on branches injured mechanically or by disease, moth larvae can be found feeding in the affected tissue.

A field study on Monterey Cypress in 1965 was designed to investigate the preferred oviposition sites, initial larval invasion sites, and the successful sites of infestation of trees having both healthy and damaged branches. Adult moths were caged on 20 trees; each cage contained two adjacent primary branches. One of the two branches was both inoculated with the cypress canker fungus *Coryneum*

cardinale Wagener and lacerated with a knife. (The inoculation and slash were considered separate test sites.) The second branch was left untreated. The fungus inoculation and knife slash were made approximately two months prior to the caging. At the time of moth caging, the infections had not developed into cankers, but substantial browning of the phloem was observed on most trees. The cages were made of nylon organdy and were constructed to enclose the basal 2 ft of each branch, together with the section of trunk that included the branches. The cages were opened three times to make counts on the egg-laying sites and the larval invasion sites. The first count demonstrated that female moths preferred to oviposit on the diseased and slashed areas of treated branches. The second count showed that first instar larvae attacked equally the slashed sites, the inoculated sites and the trunk region of each tree (the branch nodes were considered part of the trunk in this count). The final count demonstrated that larvae attacking the trunk and branch nodes were successful 50% of the time while those attacking the induced wounds on the branches were successful only about 3% of the time. There were no successful attacks made on any of the control branches.

Larval feeding on the branch nodes and trunk regions results in the production of large amounts of resin that oozes from the affected areas. This unsightly material seems to attract moths which lay eggs at these sites year after year. The continued larval feeding may eventually

Hedgerow of Monterey Cypress in San Mateo County, infected with cypress canker.



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MOTH CYPRESS



Organdy cage used to contain adults of moth on Monterey Cypress.



Swelling damage caused by moth larvae on Thuja sp.

result in large swellings that deform the branches at these nodal areas. The trunks are affected to a lesser extent. Some hosts, for example *Thuja*, may receive attacks at almost every branch crotch on the tree. This results in severe swellings along the branches.

Seasonal activity

Laspeyresia has two generations each year. The population overwinters as larvae and to a lesser extent as pupae. In January, the larvae which have been feeding continually during the early winter begin to pupate. Adult females, emerging from these overwintering individuals, mate and lay their first eggs during the middle of March. The resulting larvae (spring larvae) increase in size and number from March to August. At the end of August the mature spring larvae begin to pupate. This is the beginning of the second pupal period which extends from August to October. In mid-September the first larvae of the second generation appear. These larvae and many of the late spring larvae will overwinter in the larval stage. There is a noticeable overlap between the spring and fall generations.

The eggs, which appear as small ovoid discs, are laid singly on suitable cone, branch and trunk surfaces. Females are suspected of mating only once during their lifetime since a number of female moths, mated in the laboratory, showed the presence of only one sperm sac when dissected after death. Egg laying is continuous from March to November, after which it ceases abruptly. Peak numbers of eggs are found during the months of

April, June, and August. Each of these peak periods is followed by a period in which many of the eggs are parasitized by a *Trichogramma* wasp.

Fungus association

Cupressus macrocarpa and several other *Cupressus* species are susceptible to a disease caused by the fungus, *Coryneum cardinale*. Monterey Cypress is the most severely affected *Cupressus* species so far investigated. This disease has the ability to kill young cypress trees within a few years after infection. The death of a cypress by *Coryneum* can best be observed on trees located away from the immediate coast.

An obvious symptom of the disease is the formation of cankers on the trunk and branches, from which copious amounts of resin exude. These diseased areas are highly attractive to *Laspeyresia* adults as evidenced by the presence of their eggs at these sites. The resulting larvae are able to successfully feed and mature in the necrotic tissue of the canker. Often larvae will be found in cankers which are on branch sites away from the nodal areas. It is only under these circumstances that the larvae can feed and develop away from the trunk or branch nodes.

The moth larvae are not suspected of contributing appreciably to the decline of the trees due to their localized feeding habit. Thus, some of the reports in the literature, which point to the moth as a tree killer, are believed to be erroneous. Where *Laspeyresia* and *Coryneum* occur together on a tree, the primary killer is

the fungus. Trees attacked only by the moth larvae apparently suffer little from the infestation.

The female moths may possibly play a role in the dissemination of the fungus spores. The spores are known to remain viable for almost two years under certain conditions. The acervuli, or small pustules in which the spores are produced, are common on all cankered branches; these open widely during the cool wet months of winter and spring. It is conceivable that female moths, in their search for egg-laying sites during spring, may walk over these acervuli and pick up some of the spores on their appendages. Upon moving to another tree they may deposit some of these spores on uninfected sites. Female moths probably visit several trees before dying since most cankered areas have only 5 to 10 unhatched eggs at any one time, and laboratory studies have demonstrated the moth's ability to deposit up to 260 eggs over a 10-day period. Since the spores can remain viable for a long period of time, it is possible that the disseminated spores may germinate at some later time when an injury to the bark is incurred. This bark injury may result from insect feeding, mechanical damage, or rapid tree growth causing deep bark fissures. Rain splash is probably another means of disseminating the spores.

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