

THE LIGHT BROWN APPLE MOTH

Before it matures into an adult moth (right), the Light Brown Apple Moth's caterpillar stage feeds on leaves and new plant growth. It can also directly damage several kinds of fruits and vegetables.



An invasive pest
of California's
environment,
natural habitat
and agriculture



“...we applaud CDFA’s decision to use an approach to the Light Brown Apple Moth that relies on the principles of IPM [integrated pest management] and that uses a pheromone-based approach instead of toxic insecticides.”

**GINA M. SOLOMON, M.D., M.P.H., SENIOR SCIENTIST
NATIONAL RESOURCES DEFENSE COUNCIL (NRDC)**

How do pheromones work?

Insect pheromones are signals that some insects release to attract mating partners or trigger other behaviors. Humans and other mammals do not respond or react to these insect pheromones and cannot detect them. These pheromones are present in our environment every day.

When we release the pheromone, the treatment works by surrounding the male moths in the area with the pheromone, distracting them so they cannot locate mating partners. The moths simply live out their natural life cycles without being able to locate and mate with a female moth. As breeding subsides, the colony collapses.

Are pheromones safe?

Studies of the LBAM pheromone in particular and of the interaction of pheromones and mammals in general have shown no evidence for concern about exposure to pheromones, even at much higher levels than those present in the aerial treatment approach. The Environmental Protection Agency (EPA), the primary reviewer of pheromone products, does not perform long-term human testing for any pesticide; however, animal studies indicate a large margin of safety for even the most sensitive groups. Based on low toxicity in animal testing, and thus expected low exposure to humans, no risk to human health is expected from the use of these pheromones. During more than a decade of using moth pheromones to control LBAM infestations in Australia and New Zealand, no adverse effects have been reported. Pheromones’ safety record has also prompted the EPA to conclude that consumption of food containing pheromone residues presents no risk. The USDA has also approved this pheromone and others for use on organic crops.

“This really is a benign pest control agent. It is much safer than commonly used home cleaning and home pest control products. In fact, as humans, our bodies are unable to recognize and/or even react to pheromones produced by insects.”

**DR. CARL WINTER, TOXICOLOGIST AND DIRECTOR
UNIVERSITY OF CALIFORNIA, DAVIS FOODSAFE PROGRAM**

What is the Light Brown Apple Moth?

The Light Brown Apple Moth (LBAM) is a small moth, approximately ¼ inch in length, and is generally tan with some darker markings. It is originally from Australia and has also infested New Zealand, New Caledonia, Hawaii and the British Isles. It feeds on such a wide variety of plants that it is considered a significant threat to the environment as well as to agricultural crops. Other nations and territories understandably want to keep it out, and they typically impose trade restrictions such as plant and crop prohibitions, inspections or other requirements to do so. Now that LBAM has been detected in California, officials in Canada and Mexico have imposed such restrictions on the affected areas, complicating and curtailing agricultural exports for local growers.



What damage does the LBAM do?

Before it matures into an adult moth, the LBAM caterpillar feeds on and damages the leaves and new growth of plants. On some crops including grapes, apples, citrus and avocado, LBAM larvae also feed directly on the fruit, rendering it unmarketable. More than 250 kinds of plants are targeted by this pest including Monterey pine, cypress, oak, roses and many common crops and ornamental plants. Most any plant in the average garden or yard is on the list.

How can we eradicate the LBAM?

The centerpiece of the eradication project is aerial releases of the moth pheromone Checkmate LBAM-F to confuse male light brown apple moths and keep them from locating a mate. As breeding subsides, the colony will collapse. The pheromone is the most environmentally friendly alternative available to eradicate this infestation. The overall program also relies on other elements such as insect trapping, surveys, and inspection and treatment of plants and crops to make sure the infestation does not spread.

“LBAM is a generalist defoliator with a long host list including such important native conifers as coast redwood, Douglas fir, grand fir, pine, spruce and cypress species. . . In the absence of its native predators and parasites, LBAM could easily explode through California forests causing yet another wave of dead trees and shrubs and the associated costs.”

**RUTH COLEMAN, DIRECTOR
CALIFORNIA DEPARTMENT OF PARKS AND RECREATION**



Aerial application of the pheromone acts to distract the male LBAM (left) so that he cannot find a mate. As reproduction subsides, the colony collapses.

Is aerial treatment the best option?

Alternatives including mass trapping, sterile insect technique (SIT), pheromone twist-ties and conventional pesticides were all evaluated by a Technical Working Group of scientists.

Conventional pesticides: A number of conventional pesticides, including some that are approved for use on organic crops, would be effective against the LBAM. Unfortunately, these products would also affect endangered insects, Monarch butterflies and other beneficial insects such as pollinators. The pheromone is specific to the LBAM species and, since it is not toxic, it leaves these endangered and beneficial insect populations unaffected.

Trapping or twist-ties: Traps are effective to detect a pest and are a very valuable part of this program, but deploying an array of traps or twist-ties dense enough to be effective as an eradication tool would require thousands of staff and millions of traps/ties, neither of which are available in sufficient quantities. Operationally, this approach is not feasible over a large area or region.

Sterile Insect Technique: Australia and New Zealand have begun developing the facilities, equipment, expertise and technologies needed to conduct sterile insect releases for LBAM. The theory of SIT is sound and the prospects for LBAM are promising, but the project will take years to develop. USDA is working with its international partners to accelerate this process as much as possible so that this option is available in the future.

What areas are infested?

Infestations have been found in California's Central Coast and Bay Area communities including portions of the counties of Alameda, Contra Costa, Marin, Monterey, Napa, San Francisco, San Mateo, Santa Clara and Solano.

A few of the 250+ plants threatened by the



Monterey Pine



Almond



Camellia



Grape



Pine

Why is this an emergency?

The biology of the pest and the recent arrival of the infestation are the driving factors in the urgency of these treatments. A national pest survey in 2005 confirmed that the moths were not present in California at that point. The survey relied on the same pheromone-based traps now in use, and traps were set in several of the same areas now known to be infested. The populations of LBAM are still relatively small and are considered by an international panel of expert scientists to be susceptible to eradication—but only if we take significant action promptly.

The LBAM infestation could grow exponentially with approximately five mating cycles per year and each female moth laying hundreds of eggs per cycle. Failure to act quickly invites substantial environmental and economic impacts.

The program's emergency status allows the eradication to begin under a temporary exemption from environmental analysis, with the understanding that a full environmental assessment of the project, including these emergency treatments, will be completed. That assessment will likely take more than a year to complete, and the process has already begun. If we were to wait that long to begin the eradication effort, experts agree that the infestation would be well beyond reach, spreading over a larger area and multiplying exponentially through several breeding cycles.

Do these pheromone applications affect beneficial insects, endangered species or Monarch butterflies?

Although moths and butterflies are similar insects, the pheromones used by their separate species are different. Monarch butterflies are not attracted to the light brown apple moth pheromone and will not be confused or otherwise affected by it. The pheromone treatment is water-based and contains no oils or other materials that would pose a threat to the Monarch population.

As an alternative to conventional pesticides, the pheromone has the distinct advantage of being highly specific to the LBAM, so mammals and other organisms are not affected. In the pheromone-based traps used to detect LBAM, we have trapped only limited numbers of five closely related moth species, further indicating the highly specific nature of this pheromone. Two of these other species are also invasive pests, although they are not considered significant threats because they do not share the LBAM's wide host range and rapid reproductive cycle. Because these other moths are permanently established in the region beyond the limits of the LBAM treatment area, any reduction in these populations would be expected to rebound after LBAM eradication treatments subside.

Light Brown Apple Moth:



Hibiscus



Corn



Rose

Do these pheromone applications affect the ocean, fish, and aquatic invertebrates?

The EPA has established that pheromone applications are not toxic to fish or aquatic invertebrates because pheromones are insoluble in water. While the scientific data strongly establishes that this product is not harmful to aquatic life, we have also engaged local ecotoxicologists with the University of California to conduct further study to ensure that concerns raised by environmental groups are thoroughly addressed. Early results show no harm to aquatic life.

Toxicity aside, applying pheromones over water is unnecessary to eradicate the LBAM infestation because the moths do not live, breed or feed there. The eradication project can be successful without applying the pheromone over the ocean and other bodies of water, so we have established strict protocols including buffer zones to ensure that we are applying the pheromone only over land.

How are the aerial treatments done?

Three King Air twin-turbine airplanes fly over the treatment areas along parallel paths set by GPS systems. The treatments are performed at night to minimize the inconvenience to the community and because there is less air traffic. The planes release the Checkmate LBAM-F pheromone product through spray nozzles beneath the wings. The planes typically return to the airport and reload several times during the night.

Weather plays a significant role in any aerial treatment. Typically, inclement weather or winds of over 10 miles per hour will cause a delay or postponement. If the weather or winds subside, treatment may resume the same night. If not, treatment usually resumes on the next clear night.

During treatment periods, CDFA offers automatic e-mail updates about the treatment schedule and any delays or rescheduling—please sign up online at www.cdfa.ca.gov/lbam. Updates are also available by calling the hotline at 1-800-491-1899.

During treatments, CDFA also communicates with local officials and members of the media to provide updates if Mother Nature or any other factor imposes a change in plans.



Cypress





In addition to eating the leaves and new growth of plants, the LBAM caterpillar also can directly damage several kinds of fruits and vegetables.



How does the Light Brown Apple Moth affect our local economy?

The current LBAM infestation has already caused the nations of Canada and Mexico to impose onerous restrictions on exports of crops and plants from the infested areas of California. China also has begun the kind of information gathering that frequently leads to such trade restrictions. As businesses are forced to delay, reduce or abandon exports to these nations, employment, investment and tax levels are all adversely impacted. Internally, restrictions are also imposed by CDFA and USDA on businesses such as plant nurseries in the infested areas so that their counterparts outside of the area can be protected from the infestation. These businesses must comply with strict regulations that limit or delay the companies' ability to export their plants outside the area. If the infestation is not eradicated, these regulations and trade restrictions would continue indefinitely and other countries would likely adopt similar measures.

What can I do to help?

Invasive species such as the LBAM can arrive in California in any number of ways, but the most common method is for international travelers to bring in prohibited fruits, vegetables, plants, soil, seeds or related items. Please leave these items in their native countries. If you think you have seen or captured an invasive pest, CDFA also operates a toll-free pest hotline at 800-491-1899. Residents of LBAM treatment areas are also welcome to use this hotline for updates and information about the eradication project.

The LBAM is part of a family of moths called "leafrollers" because the caterpillar rolls the edges of a leaf around itself for protection.



Oak



Redwood

The following agencies and organizations consider the aerial pheromone treatment approach for the eradication of LBAM to be acceptable:

U.S. Environmental Protection Agency (EPA)
California Department of Pesticide Regulation (DPR)
California Office of Environmental Health Hazard Assessment (OEHHA)
California Department of Parks and Recreation
California Department of Public Health (DPH)
California Certified Organic Farmers (CCOF)
Central Coast Regional Water Quality Control Board
U.S. Fish and Wildlife Service
Natural Resources Defense Council (NRDC)
Monarch Watch
Otter Project (Monterey County)

CDFA PEST HOTLINE:

1-800-491-1899

LBAM PROGRAM E-MAIL:

lbam@cdfa.ca.gov

SIGN UP FOR E-MAIL UPDATES:

www.cdfa.ca.gov/lbam



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OCTOBER 2007