Light Brown Apple Moth (LBAM) 101

The light brown apple moth (LBAM) is a small tortricid moth (specifically a leaf-roller), a member of the tortricid moth family, which is ubiquitous in California and throughout North America. Although LBAM originates in the Southern Hemisphere, it has likely been present in California for decades given that it is now residing over thousands of square miles of the state. Until compelling information is provided to demonstrate that the moth was not present in the state prior to 2006, it must be assumed, based on sound science principles of insect demographics (including the public testimony of University of California Davis entomologist and invasion biology specialist, Dr. James Carey[1]), that the moth is a long-established resident of California.

The absence of noticeable or documented crop damage by the moth indicates that LBAM is not a major pest. Instead, it is a simple leaf-roller that is already being well-managed by natural predation and natural parasitoids as well as currently established integrated pest management (IPM) agricultural practices.

Basically, leaf-rollers are innocuous insects, living relatively low in the landscape, preferring cool and semi-shaded habitat conditions, such as creeks. LBAM is an opportunistic moth that is not particular about the types of leafy plants upon which it lands. Once it selects a suitable leaf on which to land, the female lays its eggs, which then hatch into larvae. Typically, only a few of the 30-50 eggs that are laid will hatch. In its larval stage, LBAM usually feeds lightly on the edges of the leaf. If a larva happens to be near a piece of fruit, it will feed non-selectively on that fruit; however, because the moth is an opportunistic feeder, it does not require fruit. In fact, the larvae more easily feed on leaves than on fruit. By contrast, larvae of the codling moth, which is not a leaf roller but is one of the most widespread agricultural moth pests, cause crop damage by penetrating fruit. The codling moth is the classic "worm in the apple," an "internal feeder" while the light brown apple moth is a "superficial feeder" that is much more likely to feed on leaves than fruit.

After about half of the larval stage, or approximately one to two weeks, an LBAM larva will "roll" the leaf to create a small enclosure in which it matures into a caterpillar pupa and then ultimately to an adult moth over the course of subsequent weeks. In general, the larvae cause superficial damage to plants and tend not to accumulate on any one plant due to host non-selectivity as well as predation by other insects.

The moth larvae do not feed for a long-enough period of time or in a manner sufficiently extensive to effect defoliation. By contrast, the California oak moth, which is not a leaf roller moth, is a defoliator. Hundreds of oak moths and their subsequent larvae will target and can defoliate an oak tree over the course of several weeks. This has proven over centuries to be a long-term ecologically interactive and sustainable relationship. LBAM however, does not behave in this way. Instead, LBAM disperses, thereby not causing sustained damage to any particular plant host. Given its dispersive nature, LBAM is more susceptible to general predation by birds, bats, spiders, earwigs, beneficial flies, beneficial beetles, and parasitic wasps, of which most will target the larvae during development. Therefore, the life cycle and environmental interactions of the moth suggest that an eradication strategy is not necessary, as it is a minor pest that is kept in check by natural predators. However, the state of California has recently applied pheromone-based pesticides for the goal of

[1] Carey, James. 2008. Invasion Biology of the Light Brown Apple Moth. Testimony to California Assembly Committee on Agriculture. March 12.

LBAM eradication.

Pheromones used as pesticides are considered useful as part of an integrated, multi-faceted approach to pest management. Such approaches realistically aim for suppression and control of particular insect populations; these programs intend to thwart the build-up of insects and to reduce overall use of pesticides by employing pheromone sprays or pheromone twist-ties. Pheromones are used to control the spread of codling moth populations in specific agricultural settings, but pheromones have not eradicated the codling moth, nor are they expected to.

In early 2008, I traveled to New Zealand for a month (the equivalent of our July) with UC botanist and Arboretum Director Dr. Daniel Harder to investigate the response of horticulturists and agricultural growers to LBAM's 100-plus-year presence in that country. We discovered that, in the natural environment there, the moth and its larvae were very difficult to find because populations are being naturally controlled by other insects. In New Zealand agricultural environments, LBAM started to become a notable pest approximately 20 years ago. Growers acknowledge that this was a direct result of certain miscalculated agricultural practices, particularly the use of broad-spectrum organophosphate pesticides intended to "wipe the slate clean" of all insects in order to meet the United States' quarantine against exotic insects from New Zealand. The U.S. has placed a wide variety of insects into the category "Actionable Pest of Quarantine" (APQ) and exercises a zero-tolerance policy for evidence of any APQ in shipments of agricultural products. For example, the presence of one LBAM larva in a 15-ton shipment of apples would cause the United States to reject the entire shipment.

Approximately 10 years ago, most agricultural growers in New Zealand changed pest management practices to eliminate organophosphate use so that beneficial insects, whose populations had significantly diminished due to the use of broad-spectrum insecticides, could recover. When growers began to use more selective insecticides as well as higher-quality monitoring systems and other IPM strategies, they were able to control the presence of LBAM using these much "softer" techniques. Their success was due in large part to the return to the fields of natural predators, which had survived in the wild. (It is unfortunate and ironic that California nurseries and growers are currently being required by the government to spray organophosphates to control LBAM. This practice is counter to the learned success of the New Zealand model.)

Due to these changes, in 2006, New Zealand shipped 3,000 15-ton shipments of apples to the U.S., only 7 of which were found to have minimal LBAM larva presence. Those 7 were re-routed to nations that do not quarantine for LBAM, such as the European Union. At present, LBAM is considered a minor pest in New Zealand although growers still try for zero presence of LBAM to meet the U.S. quarantine. Thus, the major significance of this insect lies in its trading status rating.

Jeff Rosendale – May 2008

Jeff Rosendale has been actively involved and continuously employed in the horticulture and plant industries in the Bay Area and Central Coast for the past 35 years. His specialty is with plant species and varieties from the world's Mediterranean climates. He is the co-author of the recently released New Zealand Report on IPM Management of LBAM.