Technical Working Group

Light Brown Apple Moth
March 2008

Technical Working Group's comments regarding report entitled, "Integrated Pest Management Practices for the Light Brown Apple Moth in New Zealand: Implications for California."

Introduction

We are expressing concerns about the conclusions made in the report entitled, "Integrated Pest Management Practices for the Light Brown Apple Moth in New Zealand: Implications for California." Specifically, we find aspects of the report's analysis of LBAM management in New Zealand to be unfounded and its assumption that the pest's behavior and impact in California can be determined based upon the New Zealand and Australia experience to be scientifically unjustified.

The report essentially concludes that New Zealand has found a way to manage crop damage caused by LBAM using integrated pest management (IPM) techniques, therefore, California should too. Accordingly, the report's authors, Dr. Daniel Harder and Mr. Jeff Rosendale, recommend that LBAM eradication in California should be abandoned. However, the report's account of the LBAM situation in New Zealand fails to recognize the natural resistance of New Zealand's native plants and the long history of scientific studies and biocontrol program development that have just recently resulted in the reduction of this pest's impact on the country's agricultural sector. Until the biocontrol organisms became established at a level to effectively control the LBAM infestations in New Zealand, producers relied heavily for many years on the use of insecticides as the primary means of controlling the pest. The report also overlooks the many fundamental differences between New Zealand and California with respect to biogeography, endemic and introduced flora, and ecology. Additionally, the report offers a narrow perspective about options for managing LBAM infestations, especially as it relates to the assertion that biocontrol is the best option for managing LBAM populations.

In conclusion, the findings and recommendations presented in the report are based upon unjustified suppositions the authors make about what might occur in California based on New Zealand's experience. This approach is inadequate given the significant environmental and crop production differences between New Zealand and California and the fact that, until recently, LBAM was New Zealand's most impactful plant pest. More importantly, the authors' recommendation does not take into account broader issues associated with LBAM, such as the potential for the pest to spread domestically beyond California and the economic impact of actual or potential interstate and international trade quarantines of California host products.

General Points of Contention

The TWG believes that the authors' report is based on several unsupported general assumptions. These assumptions include:

LBAM Could be Managed in California as it is in New Zealand

LBAM was the country's primary horticultural fruit crop pest in the period leading up the mid 1990's. New Zealand has recently met with success in managing LBAM, but this success only occurred due to years of substantial research, extensive biocontrol agent introductions, and developments in IPM-based crop management practices throughout the country's fruit production system.[1] These advancements were made at a considerable cost over many years. Moreover, the cost associated with IPM management of LBAM in New Zealand is now a routine cost of business for producers. It is uncertain that New Zealand's approach to managing LBAM could be applied in the context of California's horticultural systems and associated regulatory environment. While the potential consequences of LBAM becoming established in California are not fully known, it is certain that the long term costs of developing an IPM strategy to manage the pest would be substantial. [2]

California and New Zealand are Comparable

We also find the report's conclusion that there is no evidence of a biological or environmental threat from LBAM in New Zealand to be scientifically unsubstantiated, as is the report's assumption that New Zealand and California share similar climates and plant species. New Zealand and California do not share native plants. It is well-documented that many of New Zealand's native plants have a natural resistance to LBAM, which, in concert with biological control and other IPM strategies, minimizes the impact of this pest and other tortricid species on the countries forests and wild plants.[3] California's native plants and trees may not possess such a resistance; thus, they could make comparatively good hosts for LBAM in contrast to those in New Zealand.

Biocontrol Mitigates LBAM

There is very little definitive data to attribute the decline of LBAM's impact on New Zealand's main fruit production regions solely to the introduced biological control agents. However, it is apparent that there has been a corresponding decline in the population of

[1] Suckling, D.M., Burnip, G.M., Walker, J.T.S., McLaren, G.F., Shaw, P.W., Howard, C.R., White, V., and Fraser, J. 1998. Abundance of leafrollers and their parasitoids on selected host plants in New Zealand. *N.Z. J Crop & Hort Sci*. 26:193-203.

[2] The TWG has recommended that the ecology of LBAM in California undergo formal study.

[3] Sing, P., Fenemore, P.G., Dugdale, J.S. and Russell, G.B., 1978. The insecticidal activity of foliage from New Zealand conifers. Biochem. System. Ecol. 6: 103-106.
GB Russell and GA Lane 1993. Insect Antifeedants – A New Zealand perspective. Proc. 46th NZ Plant Prot. Conf. 179-186. http://www.nzpps.org/journal/

non-target, native tortricid species in these same fruit production regions.[4] If this decline in native, non-target species is attributable to the introduction of biocontrol agents for LBAM, then this situation runs counter to what is now acceptable to New Zealand's Hazardous Substances and New Organisms Act of 1996, which regulates the introduction of new exotic species for the purpose of biocontol. It is unlikely that the United States government would allow the entry and use of similar biological control agents (*T. brevifacies, G. stokesii, and X. rhopaloceros*) that present a potential risk to native, non-target species—such as lepidopteran fauna—if released into LBAM affected areas of California.

No Significant Populations of LBAM were Observed in New Zealand

In the report, it is noted that the authors did not observe significant LBAM activity during their field visit to New Zealand fruit production areas. According to subject mater experts in New Zealand, this is understandable considering the timing of visit did not correspond well to LBAM's seasonal phenology. Pheromone trapping programs demonstrate that this pest is typically still the most abundant tortricid species trapped in fruit production sectors that are undergoing IPM monitoring and control systems. While damage caused by LBAM larvae appears to be much less extensive in New Zealand today, due to ongoing IPM-based production practices, they are still commonly found among many non-native host ornamental and weedy plant species in home gardens and other non-managed environments.

Specific Points of Contention

The report also contains statements that are either technically incorrect or down play the significance of LBAM as a potentially important economic pest. While it is true that, according to some studies, an average adult moth will travel about 100 meters in its lifetime, the report did not reference studies in New Zealand that have found that individual LBAM adults can fly as far as 2 kilometers and LBAM larvae can balloon along air currents for a similar distance. It should also be noted that the photograph included in your report of LBAM feeding damage is hardly a typical example of such damage. Rather, damaged shoot-tips with rolled and webbed leaves are more characteristic of LBAM feeding.

[4] Munro, V.M.W. 1998. A record of releases and recoveries of the Australian parasitoids *Xanthopimpla rhopaloceros* Krieger (Hymenoptera; Ichneumonidae) and *Trigonospila brevifacies* Hardy (Diptera: Tachinidae) introduced into New Zealand for leafroller control. New Zealand Entomologist 21: 81-92.
Munro, V.M.W.; Henderson, I.M. 2002. Nontarget effect of entomophagous biocontrol: Shared parasitism between native lepidopteran parasitoids and the biocontrol agent Trigonospila brevifacies (Diptera: Tachinidae) in forest habitats.
Environmental Entomology 31: 388-396.
Suckling, D. M., G. M. Burnip, A. R. Gibb, J. M. Daly, and K. F. Armstrong. 2001. Host and host plant influences on the leafroller parasitoid Dolichogenidia tasmanica (Braconidae). Entomologia exp. & app.: 100: 253-260.

Other specific points of contention include:

"The southernmost area of New Zealand was not visited because its colder, harsher climate is both less hospitable to LBAM than the warmer climate farther north and dissimilar to the climate of areas where LBAM is presently found in California." Page 4.

The authors missed an opportunity to visit Canterbury, which is located on the South Island. This area of southern New Zealand, contrary to the authors' statement, has high levels of LBAM infestation. Canterbury is arguably similar to California, although a proper climate match is needed.

"Any larva that falls or loses contact with its food source/host plant have little chance of survival, so the larvae stay connected to the plant by the silken thread." Page 4.

In actuality, larvae engage in a process called "ballooning" where they use silk threads as a parachute to drift through air currents to spread to other host plants. The silk does not stay connected with the original plant. Because of LBAM's extensive host range, larvae have a relatively high likelihood of ballooning to another host plant.

"LBAM may mate up to three times during its 1- to 1.5-week lifespan in New Zealand. Female moths typically lay 30-50 eggs per egg mass." Page 5.

The report omits the fact that mated females typically lay on average 300 eggs in their lifetime, which can significantly exceed 1.5 weeks. Mated LBAM females have been known to lay more than 1000 eggs in extreme situations. This statement also underestimates the female's potential lifespan. These facts certainly emphasize the strong and rapid reproductive ability of LBAM.

"Because it is polyphagous, LBAM can disperse and survive without concentrating and adversely affecting all plants in a concentrated area." Page 5.

The ability of LBAM or any other polyphagous insect to survive in an area without causing undue damage does not mean it will not cause damage in some or many situations. Gypsy moth, Japanese beetle, and Mediterranean fruit fly are all polyphagous and are among the most destructive plant pests.

"According to New Zealand Ministry of Agriculture and Food (MAF) and Department of Conservation (DOC) experts, LBAM does not build up in any one host in the wild and has never posed a threat to native forests." Page 6.

This is most likely due to the "biotic resistance" of New Zealand's forest rather than any inherent weakness or inefficiency of the pest itself. The "biotic resistance" of New

Zealand's forests are cited in published scientific articles, which indicate that plant compounds native to New Zealand are toxic to leafrollers.[5]

"Natural predators keep LBAM in check, and it is so rare in the wild that it requires a true expert and meticulous searching to even find any sign of it." Page 6.

The report's authors stated several times that they had difficulty finding LBAM adult and larvae populations. However, LBAM is common in gardens and in wild areas such as forests and waste lands, which collectively represent a significant area of New Zealand. It is surprising that the authors failed to find and observe the insects, even if the timing of their field visit did not correspond with peak periods of LBAM activity.

"Growers in the Hawke's Bay and Nelson regions do not use mating disruption pheromones to control LBAM. They monitor in late spring with pheromone traps specific to LBAM and codling moth. If the trap counts warrant, an IGR is applied (e.g. Intrepid, Confirm: methoxyfenozide, tebufenozide)." Page 8.

The authors seem to promote the use of Insect Growth Regulators (IGR) against LBAM in this and other statements in the report. IGRs are insect hormones or synthetic "mimic" hormones that can be used to disrupt an insect's natural maturation process. While this may be viable option for commercial agricultural areas and, using only limited ground-based applications, in some residential or natural areas, the area-wide use of IGRs is discouraged due to its potential impact on non-target insects and some aquatic invertebrates. Pheromone use is far more innocuous than IGRs.

"Widespread LBAM eradication efforts have never been attempted in New Zealand." Page 9.

This is due to the fact that LBAM is a long-established pest throughout New Zealand, being present for over 100 years, and such area-wide pest detection and eradication techniques were only developed more recently.

". . . pheromones applied by any means cannot be effectively used across large diverse areas with varying canopy heights, mixed species composition, and varying terrain areas." Page 10.

In fact, pheromone is used to control gypsy moth populations across areas with mixed topography and varying tree canopy heights. Aerial applications of gypsy moth pheromone are routinely applied over wild, cultivated, and urban-suburban environments encompassing hundreds of thousands of hectares in the United States.

[5] Sing, P., Fenemore, P.G., Dugdale, J.S. and Russell, G.B., 1978. The insecticidal activity of foliage from New Zealand conifers. Biochem. System. Ecol. 6: 103-106.
GB Russell and GA Lane 1993. Insect Antifeedants – A New Zealand perspective. Proc. 46th NZ Plant Prot. Conf. 179-186. http://www.nzpps.org/journal/

"New Zealand researchers also note that aerial pheromone spraying interferes with monitoring using pheromone traps, and monitoring is critical to successful control." Page 10.

Generally, traps are baited with a synthetic pheromone that mimics the natural pheromone used by female moths to attract males for mating. Increasing the level of pheromone in the LBAM-infested areas prevents males from finding either females or the traps and causes mating disruption. Therefore, pheromone trap shut-down, caused by aerial or ground pheromone applications, is in fact an indication that mating disruption is working effectively. This is true for all other effective mating disruption systems, including those commonly used for area-wide control of codling moth and gypsy moth. Typically, pheromone applications are effective when used in a large scale suppression and eradication programs. Management strategies that rely on the use of insecticides such as IGRs are commonly used at individual field levels.

"Moreover, use of broadcast pheromone spray to eradicate or control the moth is not effective because female moths issue a more concentrated scent plume than the dispersed pheromone scent of an aerial spray application, so male moths are able to find the females (Shaw 2008)." Page 10.

Mating disruption is achieved through the dispersal of pheromone across a target area. Contrary to the report's statement, the airborne concentration of the pheromone can be adjusted to maximize the efficacy of mating disruption within the target area.

"HortResearch stations on both islands agree that eradicating LBAM in California and anywhere would require extensive, widespread use of IGRs with repeated applications to address elusive, selected populations. These experts also question the efficacy of Bacillus thuringiensis (Bt) against LBAM. Bt can also have a detrimental effect on beneficial insects." Page 10.

HortResearch officials dispute the report's characterization of their statements concerning the efficacy of Bt and beneficial insects. On the contrary, HortResearch officials indicated that mating disruption could prove effective in eradicating LBAM populations if conducted as part of an IPM strategy using some limited use of effective insecticides in commercial production areas. These points were also included in the TWG recommendations.

". . . California has 85 native and localized North American species of tortricid moths; none are problematic as a pest. All are kept in check by natural biological controls, so there is confidence to believe that LBAM will also be controlled by native natural predators or parasites." Page 11.

There are over 300 tortricid species in California (California Moth Specimen Database). The University of California IPM Web site categorizes LBAM as an exotic and invasive pest that threatens California's agriculture, urban, or natural areas. Eight other tortricid species in California are listed as pests on this Web site and have insecticides as one of

the recommended treatments: *Amorbia* (western avocado leafroller), apple *Pandemis*, codling moth, fruit tree roller, garden tortrix, oblique-banded leafroller, omnivorous leafroller, and orange tortrix.

"Current CDFA requirements that commercial nurseries in California use the organophosphate insecticide chlorpyrifos if LBAM larvae are found are in direct contradiction to New Zealand findings that organophosphates destroy LBAM's natural predators, resulting in resistance developing in LBAM populations. New Zealand experts recommend use of IGRs in the control of LBAM in agricultural systems as much safer and more effective. Page 11.

Chlorpyrifos is currently recommended only as a regulatory treatment for nursery plants prior to transport out of LBAM infested areas of California. Chlorpyrifos is fast acting and, because it is very close to 100 percent effective on all life stages of the insect, ensures that viable moths are not spread via the movement of nursery stock. Since plants are typically shipped within a day to a week of treatment, there is little concern regarding the depletion of natural enemies or the development of resistance associated with the use of chlorpyrifos.

Tests to evaluate potential alternatives to chlorpyrifos are underway, and additional regulatory treatments, potentially including IGR's such as diflubenzuron or fenoxycarb, may be available for future use.

"The finding that there is no evidence of biological or environmental threat from LBAM in New Zealand, which has climate and crops much like California and where LBAM has been an established exotic for more than a century, bodes well for the ability of California agriculture and ecosystems to accommodate to LBAM's presence and suggests that USDA classification of LBAM as an actionable quarantine pest should be reviewed and revised. USDA's pest quarantine list needs to be re-evaluated based on current, relevant, science-based information." Page 12.

The issue is not just with LBAM becoming established along California's central coast, it also involves its potential establishment in other parts of California, and in other States. What works in terms of LBAM control for some California cropping systems may not work in other places, so to deregulate would be irresponsible and could potentially lead to the entire State of California being under quarantine for domestic shipments and to the possibility of the entire continental United States being under quarantine for international shipments to countries such as Canada and Mexico.