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History and Status of the Glassy-winged Sharpshooter in California

***by* Matt Daugherty**

Fifteen years ago Southern California grape growers were in the midst of a severe outbreak of Pierce's disease (PD), a fatal disease of grapevines caused by the bacterium *Xylella fastidiosa* (fig. 1). The disease itself wasn't new, having been known to occur in the region since the late 1880s (table 1). What was notable about this outbreak was its especially rapid pace and that it was attributable to a novel insect vector, the glassy-winged sharpshooter *Homalodisca vitripennis* (GWSS; fig. 2).

Although California is home to several native sharpshooter species that are also vectors of *X. fastidiosa*, GWSS is an exotic species here, native to the Southeastern United States. As with several other recent exotic invasive insects in the state, its initial establishment and spread was tied to urban and suburban areas. *H. vitripennis* was first reported in Ventura and Orange counties, perhaps following introduction via infested nursery plants prior to 1990. But by the late 1990s it had spread throughout

Editor's Note

In this issue, our feature articles and *Disease Focus* provide an update on the glassy-winged sharpshooter (GWSS) and the bacterial pathogen it vectors, *Xylella fastidiosa*. GWSS spread throughout Southern California in the 1990s, and was found on hundreds of plant species in agricultural crops, urban landscapes and natural habitats. High pest populations in citrus orchards migrated to nearby nurseries. In addition to a severe outbreak of Pierce's Disease in grapevines and an increase in "minor diseases," mutations of *Xylella fastidiosa*, combined with the broad host range of its vector, led to the spread of disease in new plant host species. In nurseries, quarantine restrictions on the movement of the many host plant species posed challenges. A 2012 survey documented that destroyed plants in infested nurseries represented an average loss of over $10 thousand per nursery. In this newsletter, we describe numerous implemented measures that have been successful in mitigating damage caused by the GWSS, including the new approved treatment program for nurseries.

♦ **Julie Newman and Steve Tjosvold**

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Southern California and into the southern Central Valley, including into vineyards in Riverside and Kern counties, promoting severe outbreaks of PD (i.e., > 90% prevalence at some sites) and other novel *Xylella* diseases (e.g., oleander leaf scorch).

Table 1. Timeline of notable *Xylella* disease events.

Time	Event and location	Notes
1880s	Southern California PD	"Anaheim vine disease"
1930s & 40s	Central Valley PD outbreaks	Alfalfa acting as a reservoir
Late 1980s	*Xylella* diseases in South America	Citrus and coffee trees
c. 1990	GWSS arrives in California	
Late 1990s	PD outbreak in Temecula	First outbreak linked to GWSS
Late 1990s	New diseases in ornamentals	Oleander, sweetgum
c. 2000	PD outbreak in Kern County	General Beale region
c. 2000	GWSS area-wide programs begin	
2012–	PD in General Beale	Failure of chemical control?
2013–	Olive leaf scorch in Italy	*Xylella* is the causal agent?

Xylella fastidiosa is a xylem-limited bacterium that is capable of infecting a broad range of host plants, though it causes severe disease in a minority of them. Notably, GWSS is not especially efficient at transmitting *X. fastidiosa* compared to some other sharpshooters. What is unique about GWSS compared to California native sharpshooters is its ability to achieve much higher population densities and a propensity to feed on a far broader range of host plants. This broad host range likely contributed to its role in the development of novel *Xylella* diseases and potential role in the resurgence of historically minor diseases (e.g., alfalfa dwarf, almond leaf scorch). It addition, it creates challenges for the nursery industry due to quarantine restrictions on the movement of the many plant species or varieties on which GWSS purportedly feeds or reproduces.

Fig. 1. Pierce's disease, like most other *Xylella* diseases, is characterized by progressive leaf scorch symptoms and defoliation. *Photo*: Matt Daugherty.

Since the onset of the disease outbreaks in Temecula Valley 15 years ago, numerous measures have been put in place to mitigate the damage caused by *H. vitripennis*. A major element has been the area-wide control programs in Southern California and Central Valley grape-growing regions. These include GWSS monitoring, releases of biological control agents (i.e., the parasitoid *Gonatocerus ashmeadi*) and regular chemical control. Specifically, foliar insecticides and especially systemic imidacloprid applications target GWSS populations in citrus, to limit spread into nearby vineyards. Collectively, these measures have greatly reduced disease pressure in the region. A recent survey of Temecula vineyards found GWSS densities that were a fraction of the purported "hundreds" of sharpshooters per vine 15 years ago, and overall PD prevalence in the area of

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approximately 0.5%. The second major piece of sharpshooter management involves quarantine requirements for nursery stock shipping from GWSS-infested areas. A compliance agreement requires that nurseries monitor for sharpshooters, designate a controlled staging area for readying plant shipments, and inspect the source and potential receiving locations. More recently, an approved treatment program was established that relaxes the monitoring requirements in exchange for targeted insecticide applications (i.e., carbaryl or fenpropathrin) prior to shipping. Available data suggest that these measures greatly reduce the risk posed by nursery shipments.

Homalodisca vitripennis, though widely distributed in the southern part of the state, has not yet become prevalent in Northern California or much of the Central Valley. GWSS is endemic in most Southern California counties and portions of Kern, Tulare and Fresno counties. In addition, there have been localized infestations found in parts of Santa Clara, San Luis Obispo, Sacramento, Solano, Contra Costa, Butte and Imperial counties — most of which are believed to have been eradicated. The most recent was an apparently successful eradication of a residential infestation in San Luis Obispo. Yet, within the last couple of years there has also been cause for concern regarding GWSS control. Specifically, the General Beale region of Kern County has seen a resurgence in *H. vitripennis* and an accompanying localized outbreak of PD. One explanation may be poor management on the part of certain growers in the area (i.e., no removal of diseased vines or weedy hosts). Alternatively, the resurgence may be indicative of partial failure of area-wide chemical control due to poor uptake of systemic insecticides in some contexts, specifically some of the windbreak trees, or the development of insecticide resistance. The latter possibility has motivated UC Riverside researchers to initiate studies to determine whether there is evidence that the several years of insecticide applications in commercial citrus and nurseries have led to any resistance in *H. vitripennis*. Regardless of the explanation for this resurgence in GWSS, it illustrates the need to continue to remain vigilant about the threats posed by this invasive insect.

Fig. 2. Adult glassy-winged sharpshooter, *Homalodisca vitripennis. Photo*: Rodrigo Krugner.

Matt Daugherty is Assistant Cooperative Extension Specialist, Department of Entomology, UC Riverside.

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Glassy-winged Sharpshooter Nursery Subcommittee Update

by **John Kabashima**

On September 17, 2014 the Glassy-winged Sharpshooter (GWSS) Nursery Subcommittee met at the UC ANR South Coast Research and Extension Center in Irvine, California. This subcommittee reports to the California Department of Food and Agriculture Pierce's Disease Control Program (PDCP), which is funded from federal funds and industry assessments totaling over $18.3 million.

In the opening remarks the committee was informed that several Pierce's Disease (PD) and GWSS research projects have made significant progress, including five GMO field trials and conventionally propagated grapevines that are providing resistance to PD. Reports were presented for the following programs.

Regulatory Nursery Program

There are 550 nurseries within the infested areas of the state under GWSS compliance agreements (fig. 1). There were 30,575 shipments through July 31, 2014. Shipments are down slightly in the regulatory program as compared to 2013. Eleven Notices of Rejection (NORs) have been issued year to date. Most areas are seeing an increase in pest pressure this season. Year to date, origin county inspectors have stopped more than 176 egg masses, 4 nymphs and 9 adults from moving in nursery stock shipments.

Approved Treatment Protocol (ATP). There are eight nurseries that are participating in the ATP with 28 associated shipping yards. This year, the total number of shipments through July 31, 2014 was 8,095, consisting of 1.46 million plants shipped to destination counties. No viable life stages have been found in any ATP shipments. Total number of shipments and plants shipped are up slightly from last year. Six egg masses from four ATP yards have been sleeved by destination counties, with no GWSS emergences. Ten out of 28 yards had holds due to

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trap finds with >10 GWSS adults. There has been an increase in the number of GWSS trapped this year compared to last year. ATP nursery holds tend to peak in July. This can be attributed to a variety of factors, including the GWSS lifecycle and activity in the citrus and avocado nearby. From July to August, there was a reduction in pest pressure. The PDCP conducts quality control at each ATP nursery by placing water sensitive paper on plants staged for treatment to monitor the coverage. Year to date, 205 papers have been placed and only 7 indicated the need for partial retreatment of the shipment. The Monterey County Agricultural Commissioner's Office continues to do residue sampling from ATP nurseries and the results have indicated good coverage this year. Napa County's residue samples have also been very good.

The agricultural commissioners' workload is much better now with the protocol adjustments that have already been made. It was suggested that the Subcommittee look at eliminating the hold period as a result of trap finds with >10 GWSS adults. The hold would still apply until the hold treatment occurred. It was decided that the PDCP would draft up the proposed change and consult with the California Agricultural Commissioners and Sealers Association (CACASA) GWSS Advisory Group. The outcome of that discussion will be shared with the Subcommittee.

Applied Research

Two research projects have been funded by the PD/GWSS Board exploring insecticide resistance in GWSS populations in California. One study, headed by Dr. Thomas Perring, UC Riverside, is a two-year project that will focus on Central Valley GWSS populations and is 50% funded by the Consolidated Central Valley Table Grape Pest and Disease Control District. Dr. Perring's study began on July 1, 2014. The

Fig. 1. Nursery stock in areas of the state infested with GWSS must be inspected to ensure that this invasive pest isn't moved in plant shipments. *Photo*: Matt Daugherty.

second study — headed by UC Riverside's Dr. Rick Redak, Dr. Frank Byrne and Dr. Bradley White — will also explore the Central Valley resistance concerns and additionally has a broadened scope to include populations from agricultural, nursery and urban settings. This project is funded for a three-year period, and began July 1, 2104.

Rapid Response

Fresno County has continued suppression treatments in 2014 in and around the Fresno/Clovis and Kingsburg areas. Year to date, over 3,600 properties have been treated in urban and rural areas. In Santa Clara County, there is one remaining infested area in

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the county, the Capitol area of San Jose. In response to a late season find in 2013, about 76 properties were treated in March 2014. The first Capitol find of 2014 was in an apartment complex and the county, coordinating with the apartment management's pest control operator, scheduled treatments in and around the find site. In Tulare County, there have been GWSS finds in the Visalia area, which is outside of the existing infested area. The county is still delimiting the area and treatments have just started in response to the finds. The exact size of the area is still to be determined. There have been a handful of nursery trap finds in the non-infested areas of the state that have not indicated any breeding GWSS populations and appear to be isolated finds.

Area-Wide Program

The area-wide suppression treatments mainly target citrus, a preferred over-wintering host of GWSS. In the Temecula Valley area of Riverside County there is no longer funding for treatments; however, a trapping program is in place to monitor the GWSS populations. Year to date, 617 GWSS have been trapped in Temecula. Three GWSS have been trapped year to date in the Coachella Valley of Riverside County. In Fresno County, there have been some area-wide finds further west than seen before, with a total of 36 GWSS trapped year to date. Madera County has not had any GWSS detections this year. In Tulare County, there have been 2,598 GWSS trapped year to date, although 80% of those finds come from one organic ranch. Organic groves continue to be a challenge as there are not highly efficacious organic chemicals available. Fall foliar treatments are being scheduled for Tulare County. In Kern County, there are several zones trapped for GWSS. Year to date, there have been significant treatments made, mainly in the General Beale area, to control GWSS. Windbreaks continue to present a challenge in Kern County due to the fact that they serve as a reservoir for GWSS and insecticide coverage is difficult due to their size.

***John Kabashima is Environmental Horticulture Advisor, UC Cooperative Extension Orange County*. *The information used in this article was provided by the CDFA*.**

SCIENCE TO THE GROWER: A Nobel idea for plant lighting

***by* Richard Evans**

Whew! I barely got this article done in time for the newsletter because I have been busy writing my acceptance speech for the Nobel Prize. As it turns out, I've been passed over once again and won't need that speech now, but I'm a glass-half-full type of guy. I'm optimistic about the chance that I'll win next year. I'm also optimistic about the chance that the tuxedo I bought for the awards ceremony will still fit next year.

One of this year's Nobel Prizes caught my eye because it's pertinent to greenhouse flower growers. The physics prize went to three Japanese scientists for their invention of the blue light-emitting diode (LED). Prior to that invention, we had to be content with red and green LEDs. Their energy-efficient light production probably saves money for big-box stores when they are all lit up for the Christmas season, but their incomplete light spectrum offered limited benefits to growers seeking efficient supplemental lighting for greenhouse crops. For example, Eskins (1992) showed that *Arabidopsis*, the guinea pig for plant scientists, takes nearly three times longer to flower when grown in red light than it does in blue light or a combination of blue and red.

Blue LED technology has many commercial applications, but its impact becomes evident when it is combined with red and green LEDs to make white light. All of you have felt that impact when you have watched cat videos on your smartphones while sitting in the audience enduring my extension talks. But you may eventually feel the greatest impact when you use white LED lamps for lighting your crops.

The obvious uses for white LEDs in ornamental horticulture are for increasing plant growth by supplementing natural light in winter months, and for controlling flowering by manipulating photoperiod with night interruptions. Growers have relied primarily on metal halide lamps for supplemental light and incandescent lamps for photoperiod control, but both light sources also emit large amounts of energy at wavelengths that plants can't use. That wasted energy is costly. LEDs have a low heat output, adjustable light intensity and color, and high efficiency of energy conversion to light. They also can be pulsed at high frequencies. Tennesen and others (1995) found that when all of the energy from continuous light was packed into 1.5 microsecond pulses from LED lamps every 150 microseconds, plants produced the same amount of photosynthesis as in continuous light. The rapid pulses of light saturate the plant's photosynthetic apparatus, and the pauses between pulses allow the plant to make use of the light energy they captured. That might not have a practical application right now, but it sure would annoy your neighbors.

Jao and Fang (2004) compared efficiency of fluorescent lamps and arrays of red and blue LED lamps in a tissue culture system. The highest growth rate was achieved with LED lamps that flashed on and off every 0.7 milliseconds. Growth was only slightly slower, and energy use was 80% lower, when the LED lamps flashed on and off every 2.8 milliseconds. That's a substantial energy savings, and I'm sure it still would annoy your neighbors.

Recently, Chang and others (2014) devised a scheme for greenhouse lighting that takes advantage of all of the variables afforded by LED lamps. Their system adjusts the spectrum and intensity of supplemental light as the spectrum and intensity of natural light changes during the day, and also makes adjustments according to the developmental stage of the plants (e.g., changing lighting to affect both vegetative growth and flowering).

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Right now, LED bulbs are expensive, and their high cost doesn't make them a viable option for most commercial horticulture applications. However, energy costs may rise again, and the price of LED bulbs is sure to come down. In the meantime, I'll gladly buy LED bulbs for everyone after I win the Nobel Prize next year.

Richard Evans is UC Cooperative Extension Environmental Horticulturist, Department of Plant Sciences, UC Davis.

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GET CULTURED: Reclaimed water use in nursery production

***by* Don Merhaut**

Reclaimed water has become another water source for agricultural use. While the nursery industry has been using recycled nursery water for decades, the use of reclaimed water, which is treated municipal waste water, is relatively recent and is becoming more frequent. As infrastructure is established to deliver reclaimed water throughout the state, more companies and municipalities will be able to utilize this water source. In some areas, reclaimed water is the only water available.

The use of secondary water sources, such as reclaimed water, can present several chemical and physical problems to the agricultural industry; and, like other secondary water sources, modifications in irrigation and fertilizer management programs will alleviate most if not all of these problems. This article will provide an overview of the important chemical and physical properties used to evaluate secondary water sources for irrigation purposes and highlight some concerns, with emphasis on reclaimed water. In subsequent issues, information will be provided on how to properly treat and utilize reclaimed water.

Hydrogen ion activity (pH)

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Most ornamental and floriculture crops will grow in a pH range between 5.0 and 6.5, although there are exceptions. Many ericaceous plants such as *Vaccinium* and *Rhododendron* plants prefer a more acid media, while most other crops will perform better at pH 6.0. Secondary water sources, such as reclaimed water, may have a pH of 7.0 or greater; therefore, acid injection may be needed to reduce the pH to an ideal range.

Alkalinity

Alkalinity is the measure of the water's ability to neutralize acid through the concentration of bicarbonates, carbonates and hydroxides. Reclaimed water and groundwater derived from limestone regions tend to be alkaline. If alkalinity is high, more acid will be required to lower water pH.

Electrical conductivity (EC)

Electrical conductivity is the measure of dissolved salts in water. This is a common way of estimating the amount of fertilizer dissolved in irrigation water. However, nonessential salts such as sodium will also increase EC. If a non-fertilizer-fortified water source has a relatively high EC (> 1.0 dS/cm), it may become difficult to use, since once fertilizer is added, the EC can easily approach 3.0 dS/cm, which may not be suitable for many crops. Accumulation of salts in containers (fig. 1) can be a major problem if lower quality water is not treated properly before being used. Management practices such as blending with fresh water of lower EC or filtration may be necessary.

Sodium and other non-essential elements

Of all the non-essential elements, sodium (Na) in reclaimed water is usually the biggest concern. However, other nonessential elements may be present. Nonessential elements are a problem because (1) they will increase the EC of the water, (2) they may accumulate to toxic concentrations in the plant, and (3) they may compete with essential nutrients for uptake into the plant.

Essential plant nutrients

Reclaimed water will usually contain essential plant nutrients such as chlorine (Cl), calcium (Ca), nitrogen (N), etc. Though beneficial, the concentration and the ratio of essential nutrients to one another should be known so that fertilizer inputs can be adjusted appropriately. Too high of one nutrient will result in toxicity of that nutrient or deficiency of other nutrients. Chloride concentrations are often high since chlorine is used to sanitize waste water. Other

Fig. 1. Accumulation of salts on media surface due to irrigation with secondary water sources containing high concentrations of dissolved salts.

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essential nutrients which may be in excess include sulfur (S) and boron (B). Correcting water quality is easy if a nutrient concentration is not sufficient. However, if a nutrient concentration is too high, it may mean that dilution or some sort of water purification process may be necessary.

Sodium Adsorption Ratio (SAR)

The Sodium Adsorption Ratio (SAR) of water is the relative ratio of sodium (Na) to calcium (Ca) and magnesium (Mg) in water. As the amount of sodium increases in water, the amount of sodium adsorbed onto clay surfaces increases, which causes clay particles to disperse or "run together." This, in turn, reduces water infiltration into soil. This chemical-physical problem ***only*** occurs on field soils**.** Even if a nursery utilizes clay-containing soils in the media, the clay amount is not sufficient to raise concern for an SAR problem. ***SAR problems do not occur in organic soils or containerized media.***

Physical impurities

Any algae or other type of particulate matter may be present in reclaimed water. If this is the case, the water must be filtered prior to use. Otherwise, emitters will become clogged, especially if microirrigation is being used. Particulate matter may also leave unsightly marks on foliage if irrigation water is applied by overhead irrigation.

Uniformity of availability and quantity

As with other water sources, the consistent availability of water needed for operations should be known. If sufficient water cannot be provided on a regular basis, then alternative water sources or necessary water storage should be arranged.

In future issues, we will address each of these conditions, presenting the problems in more detail and the correctional protocols.

Don Merhaut is a UC Cooperative Extension Specialist for Nursery and Floriculture Crops, Department of Botany and Plant Sciences, UC Riverside.

DISEASE FOCUS: Scorch diseases caused by *Xylella fastidiosa*

by **Jim Downer**

For many years plant pathologists and horticulturists have struggled with scorch diseases. Specific strains of the bacterium *Xylella fastidiosa* caused disease in various hosts. For instance the almond leaf scorch strain causes disease in almond while the Pierce's disease strain causes disease in grape. Unfortunately the host range of a given strain is not unique to its host and can be quite large depending on the strain. Until several years ago strain-host specificity was kept narrow by a limited number of sharpshooter insect vectors with narrow host ranges. When the glassy-winged sharpshooter (GWSS) was introduced to California, it changed everything because this insect has a wide host range, can acquire numerous strains of *X. fastidiosa* and spread them to hosts that have never before experienced these strains. To make matters more complex, some strains may reside in one host without causing dis-

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ease but when moved to a susceptible host may be pathogenic. As a result, the ornamental tree industry has been widely affected in both nurseries (Huang 2007) and landscapes (Hernandez-Martinez et al. 2009) with new disease showing in olive, sweet gum, oleander (fig. 1), purple leaf plum, gingko, mulberry, silk trees and jacaranda. Scorch may also be occurring in other ornamental trees that have not yet been diagnosed as hosts.

Xylella fastidiosa is a fastidious mollicute, that is, a gram negative bacterium that must inhabit the xylem of a living host in order to reproduce. The bacterium causes disease when it multiplies and clogs xylem vessels in sapwood. This reduces the water supply to foliage which then wilts or yellows leaves and defoliates branches and ultimately kills its host. The symptoms somewhat mimic Verticilium wilt but without the staining of the xylem that is observed in that disease. Symptom development is quite variable depending on the strain found in the host. Krugner et al. (2014) suggest that in olive, infections may be self-limiting, and that chronic infection may not be common. It was certainly difficult for Krugner and others to infect and redetect the bacterium in healthy olive plants. I have also observed landscape olives with symptoms of infection that recovered. Krugner et al. further suggest that olive is often in-

Fig. 1. Yellow, brown, dying leaf margins are symptoms of bacterial leaf scorch caused by *Xylella fastidiosa. Photo*: Jack Kelly Clark.

fected by canker-forming fungi that could account for scorch symptoms and so suggest that *X. fastidiosa* may not be the cause of symptoms seen in landscape olives. This logic may also be applied to other *Xylella* hosts such as *Liquidambar* (sweet gum) which are similarly affected by numerous fungal pathogens such as *Botryosphaeria*. However, Hernandez-Martinez et al. (2009) verify that the strain of *Xylella* causing disease in sweet gum can reproduce disease in healthy trees, thus suggesting it is the likely source of scorch symptoms in *X. fastidiosa* positive trees. These two examples underpin the need for continued careful research on each strain and host interaction in order to understand these diseases.

Jim Downer is Environmental Horticulture Farm Advisor, UC Cooperative Extension, Ventura County.

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INSECT HOT TOPICS: Daylily leafminers

***by* James A. Bethke**

The Society of American Florists' Pest and Production Management Conference began as the Leafminer Conference back in 1980. The Leafminer Conference was all about one agromyzid leafmining fly, *Liriomyza trifolii* (Diptera: Agromyzidae), which was causing havoc on a wide variety of vegetables and ornamental plants nationwide. The seriousness of the issue caused a decade of frantic research on the biology and control of this species, and it also caused many growers to go out of business or change what they were growing.

There is a new looming threat, the daylily leafminer, *Ophiomyia kwansonis* Sasakawa (Diptera: Agromyzidae), that is plaguing *Hemerocallis* species in landscapes and ornamental production across the country. Fortunately, if there is one saving grace, it is that it is host specific. It originates from Japan and Taiwan, and it was first noticed on daylilies in the United States in 2006 in Maine (see bugguide.net link below). Soon afterward, it was observed widespread as people took note. As of January, 2014, it has been officially detected in Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Mississippi, Missouri, New Hampshire, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia and West Virginia. The likelihood of detection in California is high, so be on the lookout.

Fig. 1. Daylily leafminer mines. *Photo*: Linda Sue Barnes.

The damage caused by the daylily leafminer closely resembles the damage caused by the serpentine leafminer except that it is more linear rather than serpentine (fig. 1). Pupation occurs in the larval tunnel, often near the leaf base (fig. 2). This is very different than the serpentine leafminer, which pupates in the soil below the plants. This is also problematic because eggs, larvae and pupae (that remain within the leaves) could be shipped to new areas where daylilies are marketed. In colder climates there will be two to three generations per year, but in California, they are likely to reproduce year-round.

As with the serpentine leafminer, control of the daylily leafminer is difficult, and colleagues across the country are seeking answers. It is obviously more difficult to manage in the landscape than in production due to the greater number of chemical control options in production. Due to the fact that they pupate in the leaves, removal of older infested leaves will likely reduce populations. As with other *Liriomyza* species, native parasitoids may attack the daylily leafminer, but none have been recorded so far.

Gaye Williams, an entomologist from the Maryland Department of Agriculture, is conducting a national

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survey for this pest and would love to see any photos of suspected day ily leafminer. Email your photos to Gaye.Williams@maryland.gov.

Fig. 2. Daylily leafminer pupa, which has pupated in the mine in the leaf. *Photo*: Gaye Williams.

James Bethke is Farm Advisor for Nurseries and Floriculture, UC Cooperative Extension, San Diego and Riverside Counties.

Web pages of interest with lots of interesting photos:

http://bugguide.net/node/view/655288

http://freshfromflorida.s3.amazonaws.com/ophiomyia-kwansonis.pdf

http://entnemdept.ifas.ufl.edu/hodges/ProtectUs/presentations/Exotic_Pests_Ornamental_Plants.pdf

http://www.daylilies.org/ahs_dictionary/leafminer.html

http://www.amerinursery.com/article-7705.aspx

http://citybugs.tamu.edu/2013/05/22/new-pest-of-lilies-in-texas/

http://entnemdept.ufl.edu/hodges/september_2011.pdf

http://citybugs.tamu.edu/tag/ophiomyia-kwansonis/

http://ecoipm.com/research/daylily-leafminers/

http://blogs.mcall.com/master_gardeners/2013/05/watch-out-for-daylily-leafminer.html

http://mypestprevention.com/2013/05/daylily-leafminer/

http://www.ldaf.state.la.us/wp-content/uploads/2014/08/Daylily-Leafminer-Profile.pdf

https://www.eppo.int/QUARANTINE/Alert_List/insects/ophiomyia_kwansonis.htm

http://www.fera.defra.gov.uk/plants/plantHealth/pestsDiseases/documents/ophiomyia.pdf

REGIONAL REPORT — UC Cooperative Extension

Santa Cruz/Monterey Counties

Effect of insecticides on light brown apple moth larvae of different ages

***by* Steve Tjosvold**

The light brown apple moth (LBAM) is an important quarantine pest of nursery crops and other agricultural commodities in California. Because LBAM has a large host range, the nursery crops trade can be a high-risk pathway for moving the pest to new locations. The overall goal of this research was to evaluate the efficacy of various insecticides on LBAM larvae on a typical nursery crop under field conditions. Since older larvae are more robust and are usually sheltered in leaf rolls, we evaluated insecticides with various capabilities of plant systemic activity that might help control these larvae.

Established Pacific wax myrtle in 1-gallon pots were infested with five LBAM egg masses and covered in an insect-rearing sleeve to contain all life stages on each plant. LBAM development was monitored by making weekly field observations and periodically larvae were sampled and the head-capsule size was measured to establish their age. (First instars are those larvae that have just emerged from eggs; fifth or sixth instars are the oldest larval stages and can develop into pupae.) All infested plants were divided into three sets of plants and each set was treated with insecticides when it contained larvae of a given age: (1) first and second instars, (2) third and fourth instars and (3) fifth and sixth instars.

Table 1. Insecticides and rates used.

Active ingredient	Trade name	Manufacturer	Rate / 100 G	Rate / A
cyantraniliprole	Mainspring	Syngenta	8 fl. oz	16 fl. oz
emmactectin benzoate	Enfold	Syngenta	2.4 oz	4.8 oz
spirotetramat	Kontos	OHP	2.5 fl. oz.	5.0 fl. oz
dinotefuran	Safari	Valent	8 oz	16 oz
acephate	Orthene	AMVAC	8 oz	16 oz
methoxyfenozide	Intrepid	Dow Agro Sciences	8 fl. oz.	16 fl. oz
Chromobacterium subtsugae strain PRAA4-1	Grandevo	Marrone Bio Innovations, Inc	1.5 lb	3.6 lb

Field Observations

Phytophthora tentaculata

First identified in North America at a Monterey County nursery in 2012, *Phytophthora tentaculata* has since been found on nursery stock in Alameda, Butte, Placer, and Santa Cruz counties and on outplanted stock in restoration sites in Alameda County. Affected plants in California include *Mimulus auranticus* (sticky monkey flower), *Frangula californica* (California coffeeberry), *Heteromeles arbutifolia* (toyon) and *Salvia* sp. In 1993, the pathogen was first detected in Germany on *Chrysanthemum* sp., *Delphinium* sp. and *Verbena* sp. Since the first detection, the host list has increased to include *Gerbera jamesonii, Origanum vulgare*, *Santolina chamaecyparissus*, *Lavendula angustifolia*, *Chichorium intybus*, *Auklandia lappa* and *Calendula arvensis.*

Phytophthora tentaculata causes similar symptoms to those caused by other soil-or-water inhabiting *Phytophthora* species. *Mimulus aurantiacus* symptoms include root and stem rot, with the roots and stem collars developing necrotic, sunken lesions and few feeder roots. In Europe and China, the pathogen is reported to cause crown, root and stalk rot of nurse-

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Plants were laid out in a split-plot experimental design in screened field cages. The three sets were grouped as main plots and insecticide treatments were sub-plots with five plant replications. Applications were made in year 1 on 18 July, 6 Aug, and 16 Aug 2013 and the entire experiment was repeated in year 2 on 25 Nov 2013, 11 Feb and 4 Mar 2014. All treated plants were observed weekly. When mostly adults were present, the plants were harvested and all surviving larvae, pupae, and moths were separated and counted.

Insecticide treatments consisted of the highest labeled rate (for registered products) and included a surfactant (Dyn-Amic, 3 pints/100 G) in insecticide treatments and untreated check treatment. Year 2 included a new treatment (Grandevo). All products were registered for ornamental use in California except for Enfold and Mainspring (see table 1 for rates). All spray applications were made by hand with a carbon dioxide sprayer at constant pressure with a single TeeJet 8002 flat-fan nozzle to groups of plants spaced as they would be in a commercial nursery. The spray was directed at upper-and-lower leaf surfaces and provided thorough leaf coverage at a rate of 200 gallons per acre.

Results are given in table 2 as percent control relative to the untreated check. (The total number of surviving life forms counted on each treated plant was used as the determinant of the percentage control; 100% indicated no life forms survived the treatment). In general, Orthene, Enfold, Intrepid and Mainspring were the most effective on all larval stages. Safari and Kontos provided some, but inconsistent, control on all larval stages. Grandevo, a new bacterial toxin and organically registered, provided moderate control of young larvae, although this was tested in only one of the two years.

Two products (Orthene and Mainspring) were highly effective because they have activity against the target pest and are highly systemic, moving readily in the plant to contact all larval stages. Orthene, a broad-spectrum organphosphate insecticide and long-standing product in the ornamental market, was highly effective on all larval stages, including the larger larvae that were sheltered in leaf rolls. Mainspring, a new diamide insecticide that is primarily active on moth larvae, was also highly effective on all larval stages.

Two products (Kontos and Safari), although highly systemic, are not known for activity on moth larvae. Therefore the inconsistent low-to-moderate control was not so surprising.

Field Observations: continued

ry plants. Subsequently, above-ground symptoms include stunting, leaf russeting and yellowing to browning (chlorosis), defoliation and dieback of twigs, brown to black lesions girdling the basal stem, and eventually plant death.

These detections raise concern for our forest and wildland health. The infested California nurseries specialize in producing native plants for restoration purposes. Unfortunately plants move directly from these infested nurseries to wildlands, so risk of pathogen introduction to forests is very high. The USDA Forest Service, Pacific Southwest Research Station; Forest Health Protection, Washington Office; California Department of Food and Agriculture; and Phytosphere Research are cooperating on a survey to check restoration sites to determine the extent of introduced infestations. A few conservation nurseries will also be surveyed.

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Two products (Enfold and Intrepid) have activity against the target pest but are only locally systemic (moving within the leaves). However, these products were highly effective. Enfold is an avermectin (similar to the long-standing Avid) and is currently being considered for registration in ornamental crops. Intrepid is an insect growth regulator targeting moth larvae. Previous research showed that Intrepid has very good efficacy and long residual activity (3 to 4 weeks) when applied before or after eggs are deposited by LBAM moths. This research demonstrates additional activity on all larval stages. Because of its inherent selectivity and safety to beneficial insects (and the fact that it is currently registered), Intrepid could have a good fit into an integrated pest management strategy in nurseries.

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Table 2. The Effect of Insecticides on Light Brown Apple Moth Larvae of Different Ages

First and Second Instars (small)

Year 1 Treatment	Percent Control	Year 2 Treatment	Percent Control
Orthene	100 a	Orthene	100 a
Enfold	100 a	Enfold	100 a
Intrepid	100 a	Intrepid	100 a
Mainspring	98.2 ab	Mainspring	100 a
Kontos	82.8 bc	Grandevo	70.8 b
Safari	49 cd	Safari	0 c
Untreated	0 d	Kontos	0 c
		Untreated	0 c

Third and Fourth Instars (medium)

Year 1 Treatment	Percent Control	Year 2 Treatment	Percent Control
Orthene	100 a	Orthene	100 a
Enfold	100 a	Intrepid	100 a
Mainspring	100 a	Enfold	99.6 ab
Intrepid	99.7 a	Mainspring	98.2 ab
Safari	5.5 b	Kontos	77.6 b
Kontos	2.8 b	Safari	29.5 c
Untreated	0 b	Grandevo	25.9 c
		Untreated	0 d

Fifth and Sixth Instars (large)

Year 1 Treatment	Percent Control	Year 2 Treatment	Percent Control
Orthene	100 a	Enfold	94.5 a
Enfold	99 ab	Intrepid	94.5 a
Intrepid	99 ab	Orthene	87 ab
Mainspring	97.7 ab	Mainspring	84.2 ab
Safari	74.8 bc	Safari	41.8 c
Kontos	8.9 cd	Kontos	40.4 c
Untreated	0 d	Grandevo	4.8 d
		Untreated	0 d

Treatments are ranked from highest to lowest control within each experimental group. Statistical differences between treatments are indicated by the letters in the column next to the percentage control. Treatments having no statistical difference are followed by the same letter.

REGIONAL REPORT — UC Cooperative Extension
Ventura County

Cool weather diseases of nursery crops

***by* Jim Downer**

The days are getting shorter, a chill is in the air but the drought is still holding. Environmental conditions are often predisposers of disease and while typically dry conditions suggest less fungal disease, this is not always the case in nurseries. Cooling weather is a time to be watchful for diseases caused by *Botrytis. Botrytis cinerea*, the asexual stage of *Botryotinia fuckeliana,*is a necrotrophic fungus that uses enzymes to dissolve host tissues and then absorb the remains. This fungus thrives in cold and wet conditions and will rapidly invade wounded or frost-injured plants. Herbaceous plants or flowers of woody plants (Rose) are particularly susceptible to Botrytis rots. These are quickly diagnosed because the mycelium is easily seen growing on affected plants as "gray mold" which gives it the same common name (fig. 1). Actually the gray part is comprised of spores (conidia) that occur in bunch-like clusters. (Botrytis is Neo-Latin and originated from the Greek *botrus* for "bunch of grapes.") Botrytis rot affects over 200 crop hosts and likely more plants that have not been studied. While various classes of fungicides are available for control, the pathogen is genetically pliable and easily resists typical fungicide regimes. Since the pathogen reproduces rapidly by asexual spores (conidia) it is important to rogue affected plants or trim and dispose of affected parts. Increased spacing to prevent plant-to- plant contact will also slow spread of gray mold. For more information on gray mold see: http://www.ipm.ucdavis.edu/PMG/r280100511.html.

Fig. 1. Gray mold on New Guinea impatiens, *Impatiens wallerana*. *Photo*: Jack Kelly Clark.

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Another cool weather disease is pink rot of palms. Also a fungal disease, it is caused by the pathogen *Nalanthamala vermoesenii.* Many remember the old name *Penicillium,* which was later changed to *Gliocladium* and finally revised to *Nalanthamala* in 2005. Pink rot gets its name from the masses of salmon-colored spores that occur on rotted palm tissues. Pink rot disease has a modest host range within the palm family. It primarily affects king palm (*Archontophoenix cunninghamiana*) but also causes disease in *Chamaedorea, Syagrus, Trachycarpus* and *Washingtonia filifera*. The disease is either a bud rot or a trunk rot. The bud rot affects the terminal bud which leads to distorted growth, stunting or death of that stem. The trunk rot is a canker-like lesion that occurs mostly on the king palm (fig.2). While typically associated with trunk rots of queen palm, the pathogen has never been proven to cause this disease. Pink rot is only able to grow in cool weather less than 70° F. It is also associated with wounds, especially in its trunk-rot phase. It is imperative that clasping leaf bases (crownshafts) of king palm not be torn from the trunks of nursery palms. Palms injured by frost often become infected with the pink rot pathogen during the same cool period. Pink rot is well controlled by EBI (ergosterol biosynthesis inhibiting) fungicides such as thiophanate-methyl and other newer materials. Avoiding wounds and providing frost protection usually prevents most disease. Fungicides applied in advance of sporulation may help slow progress of the disease and lessen rot symtoms.

Fig. 2. Pink rot disease on a king palm trunk. *Photo*: Jim Downer.

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REGIONAL REPORT — UC Cooperative Extension

San Diego/Riverside Counties

Light brown apple moth update

***by* James A. Bethke**

The light brown apple moth (LBAM) needs no introduction because UC Cooperative Extension has been providing research and education about this pest since its introduction in California in 2007. In San Diego County, it has been detected a number of times over the last few years and most of the infestations have been eradicated. However, a lingering infestation occurs in the Oceanside area (fig. 1). In March 2014, 10 separate detections of the LBAM were observed in Rancho Santa Fe and, due to the level of detection, it is assumed that a breeding population exists in the area (fig. 2). This means that the infestation will need an eradication effort and special mitigation due to environmentally sensitive areas within the eradication zone.

The ornamental plant production industry has not been seriously impacted by the Oceanside infestation, but the new infestation in Rancho Santa Fe threatens numerous growers. San Diego growers have been prepped for the required regulatory actions by San Diego County Department of Agricultural Weights and Measures and by the California Department of Food and Agriculture, but it is now likely that the industry needs to get serious about their preparations. In the references below are links to the most pertinent information available. In short, all nurseries should begin to follow the best management practices against LBAM. All the required information specifically for San Diego County growers can be located at the San Diego County Department of Agriculture Weights and Measures' web page.

Shipping requirements are different depending on whether the plant producer is located inside the state interior quarantine area (within 1.5 miles of a detection) or outside. If they are inside the state interior quarantine, growers are required to have inspections every 30 days and the grower must have a certificate of quarantine compliance (CQC), which needs to accompany any intrastate shipments. However, a federal shield can be used in lieu of a CQC. If the plant producer is located outside the state interior quarantine, a single inspection is required. A federal shield must accompany all interstate shipments. All growers must be trapping at a rate of one trap per five acres or at least one trap if less than five acres. There are other requirements for harvested commodities, so see the links on the County's web page.

Field Observations

The Neonicotinoids

The most pressing issue the industry is facing at the moment is the reaction that the big box stores and other customers of ornamental plants have to the neonicotinoid issue. One of the most common calls I have been receiving is from growers who want alternatives to the neonicotinoids because their customers are demanding it. This is in deference to the conclusions of many of the scientists studying the issue and the reviews of the scientific literature by many U.S., U.K. and Australian scientific committees. Regardless, we are having to respond to the needs of the ornamental plant producers in our area.

There is much science that still needs to be done. Nevertheless, even though the jury is still out on this issue, there is considerable public complaint from those who believe that the neonicotinoids are the cause of bee decline or colony collapse disorder.

For one scientist, Dr. Lu of Harvard University, the cause cannot be anything but the neonicotinoids, "… Lu had a hunch that pesticides, above all, were to blame for the vanishing bees. He wasn't the first to see a connec-

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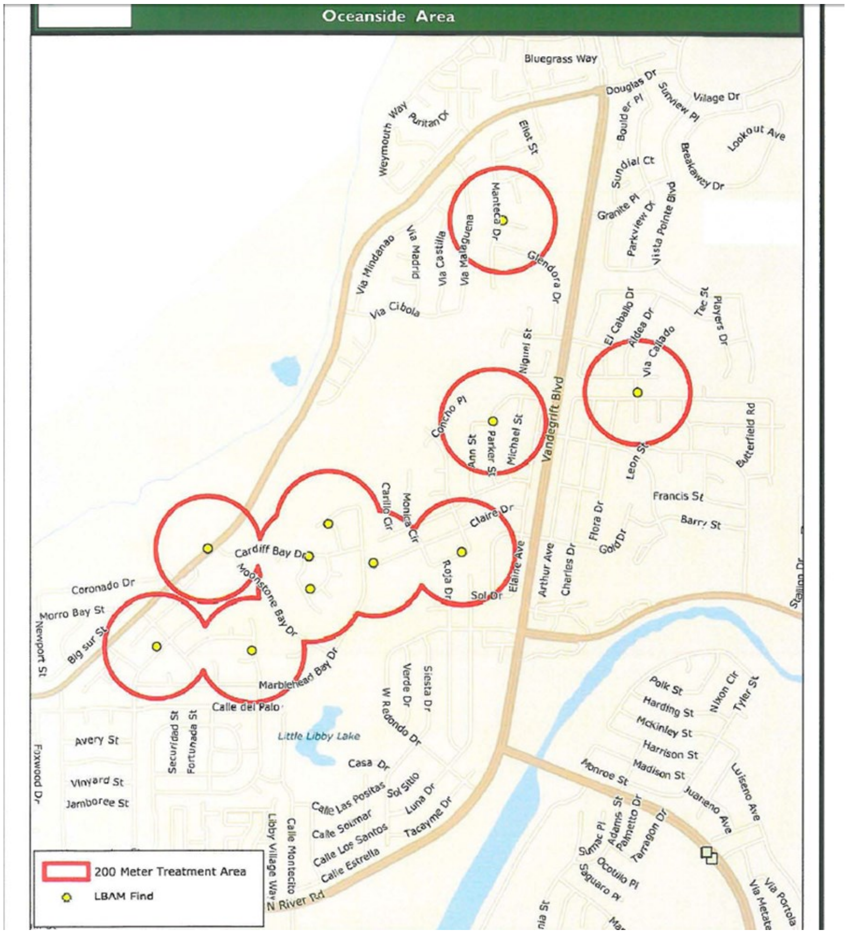

Fig. 1. Lingering LBAM infestation in Oceanside, CA. *Source*: CDFA.

References

[CDFA] California Department of Food and Agriculture. Light brown apple moth (LBAM). http://www.cdfa.ca.gov/plant/lbam/index.html. (Includes all relevant information, maps and nursery regulations.)

San Diego County Department of Agriculture Weights and Measures. Light brown apple moth quarantine. http://www.sandiegocounty.gov/awm/LBAM.html.

[CANGC] California Association of Nurseries and Garden Centers. 2009. Light brown apple moth (LBAM) Nursery Industry Best Management Practices. http://www.cdfa.ca.gov/plant/lbam/rpts/LBAM_BMP-Rev_3.pdf.

Tsjosvold SA, Murray NB, Epstein M, Sage O, Gilligan T. Field Identification Guide for Light Brown Apple Moth in California Nurseries.
(Guide and training video are available under "Emerging Pests" at: http://www.ipm.ucdavis.edu/PMG/selectnewpest.floriculture.html.)

Field Observations: continued

tion, but he was determined to prove one" (http://www.bostonglobe.com/magazine/2013/06/22/the-harvard-scientist-linking-pesticides-honeybee-colony-collapse-disorder/nXvIA5I6IcxFRxEOc8tpFI/story.html). The basis for this statement is a precursor to very poor science.

The bottom line is that bee decline and colony collapse disorder was occurring long before the neonicotinoids were widely used on the market. However, it is a fashionable thing to be anti-pesticide, especially if your customers are easily swayed in that direction.

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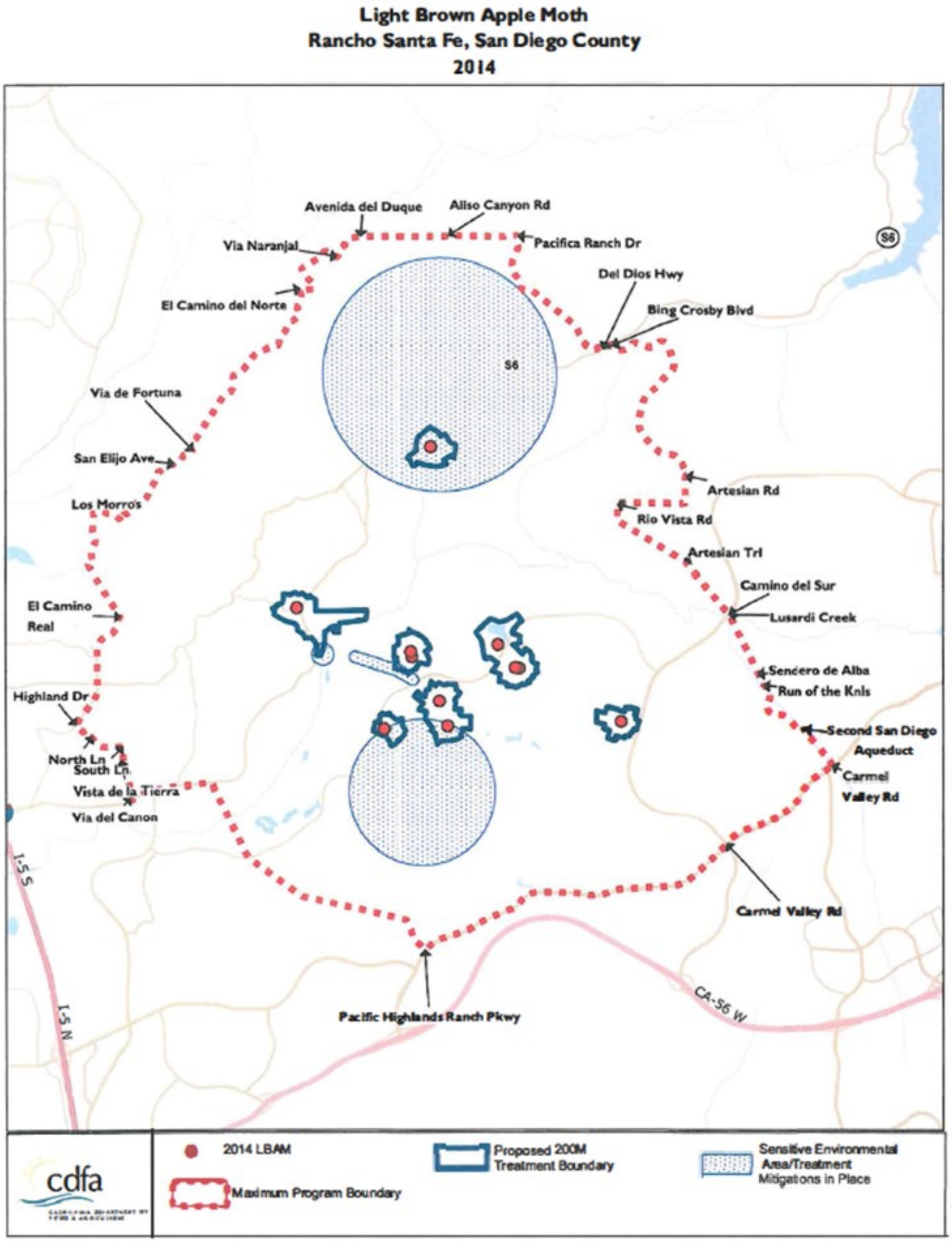

Fig. 2. New LBAM quarantine in the Rancho Santa Fe area. Much of the area is ecologically sensitive and requires special mitigation. *Source*: CDFA.

CAMPUS NEWS

***submitted by* Don Merhaut and Matt Daugherty**

New weed specialist at UC Riverside

Dr. Travis Bean

Dr. Travis Bean joined the Department of Botany and Plant Sciences at UC Riverside as Cooperative Extension Assistant Weed Science Specialist on September 1, 2014. His work focuses on (1) improving treatment efficacy and reducing unintended consequences of invasive and weedy plant control efforts, particularly from herbicides; (2) determining predictors of different phenological stages to identify opportunities for the management of weeds; and (3) creating and adapting novel technologies to improve weed monitoring efficiency and track population growth.

Bean earned his B.S. in plant sciences, an M.S. in range management and a Ph.D. in natural resources from the University of Arizona. Prior to joining UC Cooperative Extension, Bean worked as a research specialist at the University of Arizona, where he coordinated regional management of the invasive buffelgrass (*Cenchrus ciliaris*) among several agencies and jurisdictions, and performed research aimed at improving chemical control. He has also designed, implemented and monitored two large-scale revegetation efforts to restore native plant communities on former agricultural lands in arid southwestern Arizona.
-Don Merhaut

Asian citrus psyllid online course

The Asian citrus psyllid and the bacterial disease that it spreads, huanglongbing, are among the most significant threats to citrus production in California. An important element of mitigating the impact of this insect and disease is minimizing human-assisted spread, which has occurred in other regions via the transportation of infested nursery plants.

UC Cooperative Extension researchers have developed an online course to provide information to retail nursery and garden center personnel that may help limit psyllid infestations in these environments and minimize their role in psyllid and disease spread. The approximately 1-hour course discusses the biology of the insect and disease, how to look for each of them, existing control strategies, and best management practices in a nursery setting. To access the course go to http://class.ucanr.edu/, click on the "Asian Citrus Psyllid & Huanglongbing for Retail Nurseries" link at the bottom of the page, and sign up for an ANR Online Learning account.
-Matt Daugherty

Asian citrus psyllid nymphs and waxy tubules on lemon. *Photo*: Mike Lewis, UC Riverside.

New Publications from Agriculture and Natural Resources

***compiled by* Steve Tjosvold**

Guide and Video for Field Identification of Light Brown Apple Moth in California Nurseries

A new publication and video from UC IPM is geared to assist field inspectors and nursery scouts who need to identify suspect light brown apple moth larvae in the field. The field guide can be downloaded as a pdf document on the UC IPM website. A narrated 13-minute video can be streamed from UC IPM for training purposes. This project, involving author contributions from UC Cooperative Extension, California Department of Food and Agriculture (CDFA) and Colorado State University, was supported in part by a CDFA Specialty Crop Block Grant.

Authors: S. A. Tjosvold, N. B. Murray, M. Epstein, O. Sage, T. Gilligan
PDF and video: (under "Emerging Pests in California" and "Light Brown Apple Moth")
http://www.ipm.ucdavis.edu/PMG/selectnewpest.floriculture.html
Printed guides: contact Steve Tjosvold at satjosvold@ucdavis.edu for availability

Lace Bugs: Pest Notes for Home and Landscape

This updated Pest Note describes identification, damage symptoms, biology and management of lacebugs. Over a dozen species of lace bugs (family Tingidae) occur in California. Many of the plant hosts — including alder, ash, avocado, azalea, coyote bush, birch, ceanothus, fruit trees, photinia, poplar, sycamore, toyon, walnut and willow — are produced in nurseries.

Author: S. H. Dreistadt, E. J. Perry
Publication Number: 7428
http://www.ipm.ucdavis.edu/PDF/PESTNOTES/pnlacebugs.pdf

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Get timely information on news and other events of interest to the California ornamental horticulture industry.

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