



University of California UCNFA News

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Polyphagous Shot Hole Borer: A New Tree Pest in Southern California

by John Kabashima and Monica Dimson

Southern California’s urban forest and nursery industry is threatened by an infestation of an invasive beetle pest. In 2012, DNA analysis of beetles from an avocado tree in Los Angeles County determined that the insect was a new species. This beetle was named polyphagous shot hole borer (PSHB), although it still has to be described scientifically and given a species name (for now it is *Euwallacea* sp.). Since then, PSHB has been observed on a wide variety of trees common to urban landscapes and natural areas of Los Angeles, Orange, Riverside and San Diego counties. What makes PSHB so dangerous is that it is the vector for a *Fusarium* fungus that causes a disease called Fusarium dieback, which is potentially fatal to susceptible host species (Editor’s note: See “Disease Focus” and Steve Tjosvold’s “Observations” in this issue for more information about this disease).

Editor’s Note

This newsletter issue focuses on the identification and management of new insect pests, as well as new strategies for managing some old foes. Most of the species addressed—including the polyphagous shot hole borer, brown marmorated stink bug, Bagrada bug, Japanese beetle and light brown apple moth—are exotic invasive insects. The introduction of new insect species poses major challenges in the form of shipping restrictions, quarantine regulations, and the development and implementation of new pest management programs, costing the nursery industry billions of dollars. Some of the insects discussed in this issue—including several bark beetle species, cycad scale and yellowjackets—are not invasive. However, noninvasive insect pests can also cause significant economic losses in nurseries and generally require control strategies that are labor-intensive and costly. Yellowjackets (discussed in John Kabashima’s new regional column for Orange and Los Angeles counties) do not harm crops, but can present serious human safety issues. We hope the monitoring and control measures described in this issue will better prepare you in addressing insect pests and help to reduce economic losses in the nursery industry.

◆ Julie Newman and Steve Tjosvold

POLYPHAGOUS SHOT HOLE BORER:

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This small beetle has attacked hundreds of different tree species (hence the name “polyphagous”), and so far, scientists have been unable to identify its method of host selection. The beetle’s long host list includes over 110 tree species that are susceptible to *Fusarium* dieback. New reproductive hosts—tree species in which PSHB can cultivate the fungus and successfully produce offspring—continue to be discovered. For now, the list of 27 reproductive hosts includes avocado, box elder, castor bean, English oak, coast live oak, cork oak, Engelmann oak, valley oak, California sycamore, coral tree, red willow, weeping willow, sweet gum, Palo verde trees and several species of maple.

Early infestations are very difficult to detect. The beetle itself is tiny: females are black in color and about 0.07 to 0.1 inch long (fig. 1), while the brown-colored males are smaller, at 0.05 inch long (fig. 2). Entry and exit holes of this beetle are a mere 0.033 inch in diameter. Luckily, some host trees respond with obvious gumming (e.g., golden rain tree), bleeding (e.g., California sycamore), or white-sugar exudate (e.g., avocado) at the entry hole, but staining can be subtle, tricky to recognize, and differs greatly from host to host.

Only a few holes may be evident on a tree’s bark, but PSHB can bore a network of galleries from a single entrance. It is in these galleries that PSHB inoculates the host species with *Fusarium* and proceeds to farm the fungus in the tree’s living tissue (fig. 3). In reproductive hosts, females lay their eggs at the ends of the galleries. When the larvae hatch, they too will feed on the fungus. Brothers and sisters mate with each other (so that when females leave the gallery, they are already pregnant) and the mother may mate with her sons (so that she never needs to find a male when she travels). This means that this particular beetle species does not use pheromones for mating—and that pheromone trapping methods are not an option.



Fig. 1. Female polyphagous shot hole borer (PSHB), *Euwallacea* sp. Photo by G. Arakelian.



Fig. 2. Male polyphagous shot hole borer (PSHB), *Euwallacea* sp. Photo by G. Arakelian.



Fig. 3. Cross section showing fungus-infested PSHB beetle galleries in a heavily infested box elder limb. Photo by J. Kabashima.

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Researchers at the University of California, Riverside (UCR) are investigating PSHB/*Fusarium* biology and potential control methods, such as biological control and insecticide/fungicide treatments for the beetle and the fungal symbiont (funded by the California Avocado Commission). Drs. Akif Eskalen and Richard Stouthamer recently returned from Vietnam, the origin of the Los Angeles, Orange, Riverside and San Bernardino County infestations (Taiwan is the suspected origin of the infestation in San Diego County), where they searched for natural enemies.

While UCR works on developing potential control strategies, UC Cooperative Extension, Orange County is helping to conduct extensive field surveys for PSHB. This work, funded by Orange County Parks, mainly focuses on PSHB activity in County parks (approximately two dozen parks), but also addresses problems on other properties throughout Orange County where we receive requests for monitoring assistance. The goal of the survey is to track the extent of PSHB activity and monitor the progression of the infestation. Using tree inventories provided by West Coast Arborists and Orange County Parks ensures that we reach the “indicator” species (host species thought to be preferred by the beetle). The coordinates of each inspected tree are recorded on GPS devices, which have proven to be an efficient

data management tool. We record the tree species and mark each tree as either PSHB-positive or PSHB-negative. We then assign PSHB-positive trees an infestation level of low, moderate, or heavy, based on the number of entry/exit holes on the trunk and branches and whether or not dieback is observed. Wood samples are taken from a handful of PSHB-positive trees when the beetle is discovered at a new location. These samples are sent to UCR and screened for *Fusarium* by Dr. Eskalen’s laboratory. Once lab-verified, the coordinates of PSHB-positive trees are uploaded to the Orange County Parks/West Coast Arborist tree inventory.

PSHB is a new pest in Southern California, and many questions about its management and the regulatory impact on nursery shipments still need answers. However, collaboration between UCR (Dr. Tim Paine, Dr. Eskalen and Dr. Richard Stouthamer), UC Cooperative Extension, Orange County (John Kabashima), Orange County Parks, and West Coast Arborists has allowed us to share what resources and information we do have. We encourage all growers and land managers to alert us regarding any potential sightings of PSHB and to be vigilant, as always, about the movement of firewood.

For more information about this pest, check out the website information listed in the resources on the next page.

John Kabashima is Environmental Horticulture Advisor and Monica Dimson is Staff Research Associate, UC Cooperative Extension Orange County.

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References

Arakelian G. 2012. Polyphagous shot hole borer (*Euwallacea* sp.) vectoring Fusarium dieback (*Fusarium* sp.). County of Los Angeles, Dept. of Agricultural Commissioner/ Weights and Measures. <http://acwm.lacounty.gov/pdf/Polysshotoleborer.pdf>.

Eskalen A, Stouthamer R. 2012. New beetle, fungus disease complex threatens avocado production. From The Grove 2(2): 3. <http://www.californiaavocadogrowers.com/sites/default/files/2012-Summer-From-the-Grove.pdf>.

Eskalen A. 2014. Fusarium Dieback / Polyphagous Shot Hole Borer. <http://eskalenlab.ucr.edu/avocado.html>.

Eskalen A. 2014. Polyphagous Shot Hole Borer (*Euwallacea* sp.) and Fusarium Dieback (*Fusarium* sp.). Center for Invasive Species Research, University of California, Riverside. http://c isr.ucr.edu/polyphagous_shot_hole_borer.html.

Stouthamer R, Rugman-Jones P, Eskalen A, Gonzalez A., Arakelian G, Hodel D, Drill S. 2014. Polyphagous Shot Hole Borer. http://ucanr.edu/sites/socaloakpests/Polyphagous_Shot_Hole_Borer/.

Western Plant Diagnostic Network. 2012. Polyphagous shot hole borer vectors Fusarium disease in California. WPDN First Detector News 5(2):6-7. http://www.wpdn.org/webfm_send/254.

The Threat of Brown Marmorated Stink Bug to Nurseries and Floriculture

by Chuck Ingels

The brown marmorated stink bug (BMSB, *Halyomorpha halys*) is native to East Asia. The first documentation of this species in the United States occurred in Pennsylvania in 2001. It has been found in over 40 U.S. states either as reproducing populations or single finds. BMSB was first found in the western United States in Portland in 2004, and has spread throughout western Oregon and into Washington.

In California, a reproducing population of BMSB was first found in Pasadena and San Marino in Los Angeles County in 2006, and it has since spread to several other cities in that county. In 2013, a large reproducing population was discovered in Sacramento and an infestation was found in Yuba City. Presently, there are many other counties that have reported single finds.

The California Department of Food and Agriculture (CDFA) has given BMSB a pest rating of “B,” so eradication efforts are not practiced. Consistent with this rating, CDFA relies on the Nursery Stock Standards of Cleanliness, which require that nursery stock be free from pests of limited distribution. Any nursery stock for sale in California found in violation of these standards is required to be brought into compliance. Therefore, the county agricultural commissioner can require by written order that nursery stock

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be held, treated, or disposed of in order to ensure compliance.

According to the Los Angeles County Agricultural Commissioner’s office, so far there have been no BMSB reports or finds in nurseries. However, residents in several cities near Pasadena and San Marino and in some areas in the San Fernando Valley have submitted many BMSB samples, and have reported damage on various fruit trees and ornamentals.

Identification

The adult BMSB is a typically shaped stink bug, about 5/8 inch long and marbled brown. It can be distinguished from other stink bugs of comparable size and color by the following characteristics: the antennae have two distinct white bands, the forward edge of the head is blunt, the upper margin of the shoulder (thorax) is smooth, the legs are marbled brown with faint white bands and a banded abdominal edge is visible to the side of the wings (fig. 1). The beneficial insect, rough



Fig. 1. Adult (top) and late-instar nymph (below), showing characteristic white bands on antennae and legs, blunt forward edge of head, smooth upper shoulders and banded abdominal edges. White bands on legs are clearly visible on nymphs but are often less prominent on adults. Photo courtesy of USDA.

stink bug, is commonly mistaken for BMSB, and distinguishing features are shown in fig. 2.

Life Cycle

The number of generations per year depends on seasonal temperatures. In the northern United States, there is typically one generation per year

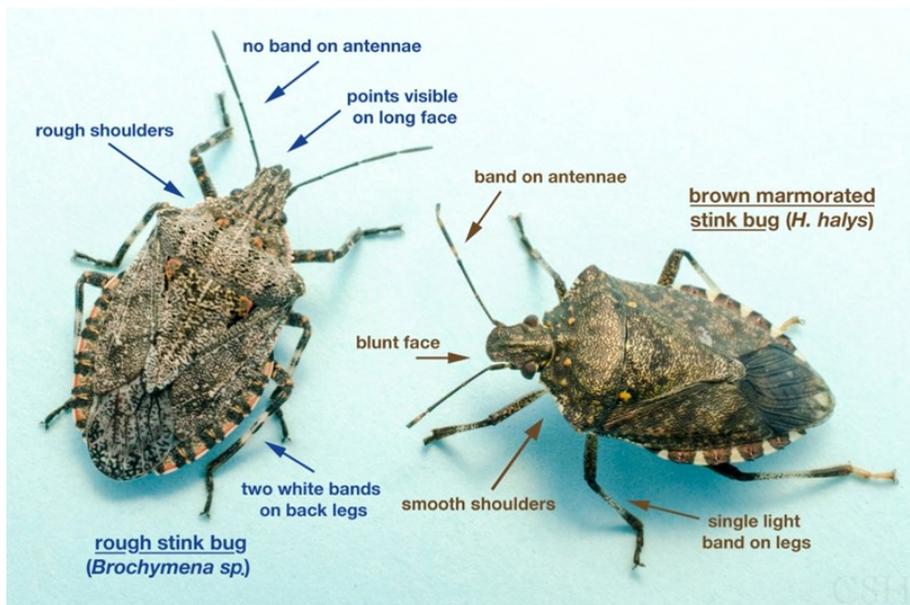


Fig. 2. Comparison of rough stink bug (left) with BMSB (right). Rough stink bug has double points at the tip of the head, narrower shoulder angles and a jagged leading edge of the shoulder. BMSB has a blunt head, wider shoulder angles and smooth shoulders. BMSB also has two white bands on the antennae. Photo by C. Hedstrom, Horticulture Dept., Oregon State University.

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and two to three generations in southern portions of the mid-Atlantic. In southern states there can be up to five generations (USDA 2010). The length of time in each stage varies depending on seasonal temperatures. On average, they will develop in 33 to 45 days (Nielsen 2008). The last generation overwinters as adults for about 5 to 7 months, depending on cool-season temperatures. Adults overwinter in tree crevices and buildings, becoming a serious nuisance pest when populations are high. In late summer and fall, adults aggregate in sometimes large numbers as they begin to overwinter (fig. 3).

Host Crops and Other Plants

BMSB is a serious pest of many fruit, nut and vegetable crops, and it has caused millions of dollars of damage to crops in the mid-Atlantic states. BMSB may reach very high numbers, and since one bug can feed on many fruits, losses can be severe. A table of over 170 host species can be found on StopBMSB.org (<http://www.stopbmsb.org/>). Major hosts include many ornamental tree species with fruits or pods, such as tree of heaven (*Ailanthus altissima*), catalpa (*Catalpa* spp.), redbud (*Cercis* spp.), English holly (*Ilex aquifolium*), Southern magnolia (*Magnolia grandiflora*) and princess tree (*Paulownia tomentosa*). Only three common flower species appear on the list — cockscombs (*Celosia* spp.), snapdragon (*Antirrhinum majus*) and sunflower (*Helianthus annuus*). Other species reported by Michigan State University Extension (http://msue.anr.msu.edu/news/brown_marmorated_stink_bug_a_new_nursery_pest_in_michigan) are spider flower (*Cleome* spp.), dahlia (*Dahlia* spp.) and zinnia (*Zinnia elegans*). BMSB feeding on ornamental flower species generally hasn't caused serious damage, but damage was



Fig. 3. Aggregation of adult BMSB on Chinese pistache branch in Sacramento, Sept. 2013. Photo by Baldo Villegas.

noted on snapdragons in Maryland. The list of host plants will likely grow as the pest spreads to new regions. For example, Chinese pistache was originally not on the list, but was recently added because all BMSB stages were found on these trees in Sacramento in fall 2013.

Damage

BMSB have long, piercing-sucking mouthparts for ingesting plant juices. As they feed they inject enzymes into the plant, which may be toxic to plant tissues. Early-season feeding on fruit by adults and nymphs causes catfacing, dimples, or depressed areas on the surface, and mid-season feeding results in pithy areas internally. BMSB can also feed on leaves, stems and thin trunks as well — they do not cause visible tissue damage initially, but leaves and shoots may become misshapen or deformed.

THE THREAT OF BROWN MARMORATED**STINK BUG** : continued from page 6**Monitoring**

BMSB traps consist of an inverted clear plastic container with an entry cone opening that is attached to a plastic stand. Two lures are generally used together; one contains methyl decatrienoate (MDT) and the other contains BMSB pheromone. The use of traps for monitoring BMSB is considered relatively ineffective when populations are low, and also generally in late spring. Other monitoring methods include beat-tray sampling and timed searches of foliage. These methods are likely more important than trapping, or used in combination with trapping, especially in field edges bordering riparian areas and on susceptible ornamental species.

Insecticides

BMSB is a new pest so insecticides will play a key role in management, at least until reduced-risk methods are developed. Insecticides used on BMSB include pyrethroids,

organophosphates and neonicotinoids; most lose residual efficacy after a few days, likely due to degradation from UV light. Some organic insecticides suppress nymphs but have much less effect on adults.

Current Threat

Once introduced to an area, BMSB can take years to build up population densities high enough to destroy an entire crop. East Coast researchers say it may take up to 8 to 10 years, but in hot areas of California there may be more generations, potentially reducing the time of buildup. Small outbreaks will likely catch some growers off-guard — especially in crops near highway rest stops, mini-storage facilities, and homes and businesses of those who visit infested areas.

View the BMSB Pest Alert and the BSMB identification video at www.ucipm.ucdavis.edu to learn how to identify this pest.

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References

Nielsen A. 2008. Developmental rate estimation and life table analysis for *Halyomorpha halys* (Hemiptera: Pentatomidae). *Environ. Entomol.* 37(2): 348-355. <http://www.ncbi.nlm.nih.gov/pubmed/18419906>.

USDA. 2010. Qualitative analysis of the pest risk potential of the brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål), in the United States. Online literature review. 33 p. http://www.michigan.gov/documents/mda/BMSB_Pest_Risk_Potential_-_USDA_APHIS_Nov_2011_344862_7.pdf.

Management of the Bagrada Bug in Nurseries

by Darcy A. Reed, Julie P. Newman, Thomas M. Perring, James A. Bethke, John N. Kabashima

Although the Bagrada bug has caused devastating crop losses in California for growers of organic vegetable crops, this invasive pest is also a major problem in nurseries where bedding plants, plugs and transplants are produced in the mustard family (Brassicaceae). Moreover, because the Bagrada bug is a B-rated pest, it is subject to eradication, containment, control, or other holding action at the discretion of the individual county agricultural commissioner; when found in the nursery it is subject to state-endorsed holding action and eradication. Strict monitoring of outbound plants is required to prevent pest spread through the movement of plant material. Since the Bagrada bug can be found incidentally on a broad range of plant species, extensive crop monitoring in nurseries is necessary.

This plant-feeding stink bug, also called painted bug (*Bagrada hilaris*), infests wild mustard weeds in late winter to early spring. Pest populations rapidly increase in the weeds when seasonal temperatures rise and invade mustard family crops after the weeds dry out in late summer. The Bagrada bug is an invasive pest species, native to Africa, that was first found in Los Angeles County in 2008. By 2012, the pest had disseminated to San Diego, Imperial, Orange, Riverside, San Bernardino, Ventura, Santa Barbara and San Luis Obispo counties. According to information obtained from several UC Cooperative Extension advisors (Surendra Dara, farm Advisor/IPM advisor in San Luis Obispo and Ventura counties; David Haviland, farm advisor in Kern County; and Shimat Joseph, IPM advisor in Monterey County), the Bagrada bug seems to survive cold winters and continues to spread to various counties in California. It has since been reported in San Francisco, Fresno, Monterey and San Benito counties; was suspected to be present in Santa Cruz County in 2013; and appears to have been present in Kern County since 2010.

Identification and management of this pest was discussed in the *UCNFA News* Spring 2013 edition (Ventura/Santa Barbara and San Diego/Riverside regional reports). Since then, we have published provisional UC IPM Treatment Guidelines for the Bagrada bug in nurseries, which includes details on pest management practices (monitoring, cultural control, mechanical control and chemical control), as well as information on the identification and biology of this pest, plant damage symptoms, host range and references. The UC IPM Treatment Guidelines for the Bagrada bug are available at <http://www.ipm.ucdavis.edu/PDF/PMG/bagradabug.pdf>.



Adult Bagrada bugs are black with orange and white markings and are commonly found mating, positioned end-to-end. Multiple stages of adults and nymphs (not shown) have caused large white stippled areas on this alyssum plant. Photo by G. Arakelian, Los Angeles County Agriculture Commissioner's Office.

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SCIENCE TO THE GROWER: Is sustainable ornamental crop production sustainable?

by *Richard Evans*

The theme of this issue is insects, but I don't want to write about them. I hold no particular grudge against insects, but I've never been able to maintain a lasting relationship with any. One little critical remark from me and they're crushed. To assuage my guilt, I'm going to write instead about the science of being green, sustainable and local in the ornamental nursery industry.

Organic crop production, once the domain of a committed subset of producers, has been more widely adopted recently, in part because the perceived value added may enable growers to compete more effectively in niche markets. Even ornamental crop producers have been urged to adopt practices that permit them to paste ecolabels on their plants. So, in addition to having to compute the economic costs and benefits of organic and sustainable crop production, growers must assess the strength of consumer demand for plants that satisfy the current enthusiasm for organically, sustainably and locally grown crops.

A group of researchers in the Midwest has investigated this issue (Yue and others 2011). They surveyed 834 people in Indiana, Michigan, Minnesota and Texas who had bought ornamental plants within the previous year. The researchers asked participants how many plants they had bought, and what type, then asked how inclined participants were to buy conventional plants; sustainable plants; organically grown plants; locally produced plants; plants grown in energy-efficient facilities; and plants grown in biodegradable, compostable, or recyclable pots.

What did the researchers find? Participants were not enthusiastic about organically grown

plants, and were only mildly inclined toward plants produced sustainably or efficiently. Consumers were enthusiastic about plants that were locally grown, or produced in biodegradable, compostable, or recyclable pots. In their search for correlations, the researchers found that people with young children were most likely to be interested in organically grown plants (probably out of fear of what those kids otherwise might say when they become teenagers). Also, the older the participant, the higher the interest in compostable pots. (That stands to reason, since the older the participant, the closer he or she is to looking and feeling like a compostable pot.) Purchasers of perennials within the past year were more interested in buying sustainable and locally grown plants. Purchasers of shrubs within the past year were also interested in sustainable plants. However, purchasing a tree had no subsequent relationship to interest in "green" production. (Perhaps tree buyers feel that their work is done here.)

One wonders how applicable this study is to other parts of the country. The researchers did find that participants from different states had different levels of interest in these plant types and production methods: people from Indiana were least interested in plants that came from energy-efficient greenhouses or were grown in biodegradable and compostable pots. The authors didn't offer a reason for the unusual behavior of Indiana's people. (I could furnish one, but lack sufficient space.) In any case, I wouldn't be surprised to find that attitudes in favor of sustainable and organic production are stronger in California.

The authors conclude that consumers are more interested in sustainable pots than in sustainable plants. So let's briefly consider sustainable pots. Biocontainers, which are not petroleum-based

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and decompose quickly, have been around for a long time, but more options have become available within the last decade. Some of the most detailed studies of their physical properties have been done by Michael Evans's group at the University of Arkansas (Evans and others 2010; Beeks and Evans 2013). (By the way, Professor Evans and I are not directly related, but it is possible that both of us are related to Charlemagne. I didn't know Charlemagne well, but he did give me a fruitcake for Christmas once.) Evans's group has reported that some types of biocontainers— notably those made from rice hulls—are highly resistant to crushing. However, none of the biocontainers could match plastic for punch-through resistance.

Biocontainers have not been widely adopted by growers because of concerns about their suitability for ornamental crop production. Koeser and others (2013) looked at the suitability of biocontainers for greenhouse crops. They compared seven types of biocontainer with plastic containers to see how well they stood up to mechanized

filling and transplanting, coleus production, handling and shipping. The plant production part of the study included effects of hand, drip and ebb-and-flow irrigation. Coleus plants grew just as well in the biocontainers as in plastic pots, regardless of irrigation method, but rapid decomposition of biocontainers occurred when subjected to ebb-and-flow irrigation. Bioplastic, wood fiber and straw biocontainers were as resistant to mechanical damage during filling and shipping as plastic pots. Pressed manure and peat pots were particularly susceptible to shipping damage.

Do the environmental benefits of biocontainers make them worthwhile? Koeser and others (2014) recently evaluated the carbon footprint of biocontainer use. They considered all of the material and energy inputs to produce a petunia plant in a greenhouse. In their study, a conventional plastic pot accounted for about 16% of carbon emissions, but another 47% was attributable to lighting and irrigation. The authors concluded that there was a negligible difference in carbon footprint between various biocontainers and plastic pots, and that improving the efficiency of supplemental lighting would be much more likely to reduce the carbon footprint. Good idea!

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

References

- Beeks SA, Evans MR. 2013. Physical properties of biocontainers used to grow long-term greenhouse crops in an ebb-and-flood irrigation system. *HortScience* 48: 732-737.
- Evans MR, Taylor M, Kuehny J. 2010. Physical properties of biocontainers for greenhouse crops production. *HortTechnology* 20: 549-555.
- Koeser A, Kling G, Miller C, Warnock D. 2014. Compatibility of biocontainers in commercial greenhouse crop production. *HortTechnology* 23: 149-156.
- Koeser AK, Lovell ST, Petri AC, Brumfield RG, Stewart JR. 2014. Biocontainer use in a *Petunia × hybrida* greenhouse production system: a cradle-to-gate carbon footprint assessment of secondary impacts. *HortScience* 49: 265-271.
- Yue C, Dennis JH, Behe BK, Hall CR, Campbell BL, Lopez RG. 2011. Investigating consumer preference for organic, local, or sustainable plants. *HortScience* 46: 610-615.

GET CULTURED: Silicon in plant nutrition

by *Don Merhaut*

Silicon has received attention in the plant community because its use in production may increase crop resistance to disease and insect attack. The possible benefits of silicon in plant growth and development are primarily related to increased disease resistance and tolerance in some plants, especially grasses such as oats and rice. Silicon may also increase the strength of plant cell walls and increase resistance to environmental stress (i.e., reduce water loss).

Silicon is a non-essential element in plant nutrition. For any element to be considered essential, it must be required for a plant to complete its life cycle, required by all plants, and not completely replaceable by another element. (These three criteria are still up for debate in the scientific community.) Even though silicon is not considered a plant nutrient by these criteria, it still has been documented to have beneficial effects on plant growth.

Soils

Silicon is the most abundant element in the soil, averaging 54%. However, organic soils have the lowest amount of silicon. The solubility of silicon increases with increasing soil solution pH. Silicon will also interact with other elements such as iron, aluminum, phosphorus and calcium. At lower soil pH, silicon and phosphorus can react and precipitate out of solution.

Plant Uptake and Metabolism

Silicon is taken up passively into plants in the form of silicic acid (H_4SiO_4), silica anions, or

silicon-organic complexes. In rice, silicon has also been documented to be actively taken up into root systems. However, some plants may actually restrict silicon uptake. In the root system, silicon may interact with other nutrients: silicon may increase the uptake of phosphorus and molybdenum, but may inhibit the uptake of boron, manganese and iron. Once in plants, silicon is transported, via the driving force of transpiration, into the leaves.

Environmental Stress Resistance

Silicon is incorporated into cell walls, which will increase cell wall strength and structure. In some plants, silicon may also accumulate within the leaf epidermis, forming silicate “knobs.” These knobs may reduce water loss that occurs from leaf surfaces. In addition, the accumulation of silicate compounds near stomata openings may reduce water loss caused by transpiration. Finally, silicon accumulation in the cell walls of xylem vessels may reduce or limit the compression of vessel elements during periods of high transpiration rates, thus allowing better water flow through the xylem.

Disease Resistance

Disease resistance from silicon may occur in two ways: physically or biochemically. The physical attributes of silicon are associated with increased cell wall strength, since silicon compounds are laid down in cell walls. The formation of specialized silicon-containing knobs that form on the leaves of some plants may also be a physical deterrent for insect feeding and some pathogens. The biochemical properties associated with silicon are more

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complex. Silicon may induce certain chemical defense reactions in response to pathogen or insect attack. These responses have been observed in both dicots (broadleaf plants) and monocots (such as grasses).

Sources of Silicon

Silicon can be derived from clay, quartz and other minerals; however, solubility is very low. The most common sources of silicon are calcium silicate and potassium silicate. The high solubility of potassium sulfate renders it suitable for hydroponic systems. However, always check for fertilizer incompatibility to prevent costly precipitation of fertilizer sources.

Use of Silicon in Production

The benefits of silicon in plant production are not well understood. However, if you are considering the use of silicon in crops, do a less-costly, small pilot study. As with other horticultural management programs, always consider stage of crop development and environmental factors. Since silicon is taken up in the transpiration stream, applying silicon during new active vegetative growth will probably maximize silicon accumulation in the developing tissues. Once cell walls have been laid down, there will probably be limited, if any, silicon accumulation in cell walls. Since silicon levels are low in organic soils, and container production is almost 100% organic substrates, there is a possibility of a benefit from silicon fertilization. However, keep in mind that silicon does interact with other nutrients, so a deleterious effect may also occur in certain situations.

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DISEASE FOCUS: Fusarium dieback and polyphagous shot hole borer

by Jim Downer and Akif Eskalen

Some fungi threaten plants when they form a disease complex with their vectors. The polyphagous shot hole borer (PSHB) (*Euwallacea* sp.) is considered an “ambrosia” beetle because it affiliates itself with the fungus *Fusarium euwallaceae*, a potent vascular wilt fungus in plants. Beetles carry fungal cells within specialized structures called mycangia near their mouth parts. When the beetle enters a tree, it creates brood galleries beyond the cambium, where its fungal symbiont begins to grow in the tree. *Fusarium euwallaceae* colonizes the wall of the entire brood gallery and becomes

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food for beetle larvae (Eskalen et al. 2012 and Mendel et al. 2012). In some host (tree) interactions with the beetle, the fungus continues to invade the sapwood, plugging the vessels, which results in symptoms of branch dieback or tree death (Eskalen and Stouthamer 2013).

The host range for PSHB is quite large, but the hosts preferred by the beetle and the lethal host range are restricted to fewer species. A current host list with susceptibility to the beetle and the *Fusarium* disease can be found in Eskalen et al. 2013 (see “References” below). In this study, Eskalen and others examined 335 host trees at two botanical gardens in Los Angeles County. Of the trees examined, 207 had symptoms of PSHB attack. There were 113 tree species in 40 plant families from which *Fusarium* was recovered. Families with the most members from which *Fusarium* was recovered were the Aceraceae, Fabaceae and Fagaceae. There were 27 trees from

all these that were suitable for beetle reproduction, however the authors indicate this might be an underestimate.

This beetle/fungus complex poses risk to both ornamental and native trees in California, and the number of susceptible trees is five times higher than with *Phytophthora ramorum*, the pathogen causing sudden oak death (Eskalen et al. 2013). Other *Fusarium* diseases of trees are relatively unusual in California — the only other two notable ones are mimosa wilt, caused by *Fusarium oxysporum* f. sp. *Pemiciosum*, and date palm wilt, caused by *F. oxysporum canariensis*. The *Fusarium* causing wilt disease associated with PSHB was recently named *F. euwallaceae* by Freeman and others (2013).

Beetle/fungus combination can cause mortality (wilt) on trees, such as *Acer negundo* (fig. 1), *Quercus robur* and *Platanus racemosa*, and on weeds, such as *Ricinus communis*. Pathogenicity



Fig. 1. Beetle galleries and wood discoloration (left) and branch dieback (right) on box elder (*Acer negundo*) caused by PSHB and *Fusarium* disease complex. Photos by A. Eskalen.

DISEASE FOCUS:

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is linked to host susceptibility and perhaps the ability of PSHB to find and enter a susceptible host. Unlike other ambrosia beetle vectored-diseases, PSHB seems to attack healthy trees that have no typical predispositions (age, drought, stress, etc.). *F. euwallaceae* causes necrosis to wood tissues inside the tree and lines the brood galleries made by the beetle. Necrosis extends

outward from beetle galleries and in a susceptible host will extend into the sapwood, resulting in wilt symptoms on the tree. Wilt symptoms may be localized to a branch, but more typically involve collapse of the entire tree. Sometimes there is a partial response to infection; necrosis occurs but the pathogen does not spread sufficiently to cause wilt.

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References

Eskalen A, Stouthamer R. 2012. A new beetle-fungus disease complex threatening avocado. California Avocado Society 2011 Yearbook 94:120-126.

Eskalen A, Stouthamer R, Lynch SC, Rugman-Jones P, Twizeyimana M, Gonzalez A, Thibault T. 2013. Host range of fusarium dieback and its ambrosia beetle (Coleoptera:Scolytinae) vector in Southern California. Plant Dis. 97:938-951.

Eskalen A, Gonzalez A, Wang DH, Twizeyimana M, Mayorquin JS, Lynch SC. 2012. First report of *Fusarium* sp. and its vector tea shot hole borer (*Euwallacea fornicatus*) causing Fusarium dieback on avocado in California. Plant Dis. 96:1070.

Mendel Z, Protosav A, Sharon M, Zveibil A, Ben Yahuda S, O'Donnell K, Rabaglia R, Wysoki M, Freeman S. 2012. An Asian ambrosia beetle *Euwallacea fornicatus* and its novel symbiotic fungus *Fusarium* sp. pose a serious threat to Israeli avocado industry. Phytoparasitica, Online publication. doi:10.1007/s12600-012-0223-7.

Freeman S, Sharon M, Maymom M, Mendel Z, Protosov A, Aoki T, Eskalen A, O'Donnell K. 2013. *Fusarium euwallaceae* sp. nov. — a symbiotic fungus of *Euwallacea* sp., an invasive ambrosia beetle in Israel and California. Mycologia 105:1595-1606.

INSECT HOT TOPICS: Japanese beetles

by James A. Bethke

For years, California has been avoiding the establishment of a very serious pest, the Japanese beetle (fig. 1), *Popillia japonica* Newman (Coleoptera: Scarabaeidae). You may be aware of the effort by the CDFA in capturing Japanese beetles in traps at the Sacramento Airport. Indeed, the CDFA collects hundreds of Japanese beetles on aircrafts from infested states every year. Four Japanese beetles were detected in the Fair Oaks area of Sacramento County in 2012, in the same area where they were detected and treated in 2011. On August 28, 2013, an adult male Japanese beetle was unexpectedly trapped in the South Lake Tahoe Airport in El Dorado County. Therefore, El Dorado County was added to the list of infested counties requiring eradication efforts (the other counties are Los Angeles, Merced, Orange, Placer, Riverside, Sacramento, San Bernardino and San Diego counties).

That's so few beetles, so why all the fuss? It's mainly because if Japanese beetles become established, they can severely damage a great

number of different types of plants (300 plants in 79 plant families) and the soil-borne larvae can severely damage plant roots (which can cause significant damage to turf in lawns, parks, golf courses and pastures). Control of this pest back East is estimated to cost more than \$460 million, so the CDFA takes Japanese beetle detection in California very seriously. Additionally, if the Japanese beetle becomes established in California, the movement of nursery stock will be under a set of new phytosanitary requirements.

Adult Japanese beetles are good fliers, active on warm sunny days, and prefer plants that are in direct sunlight. Adults devour flowers, and over-ripe or wounded fruit and can leave behind skeletonized leaves and large, irregular holes in leaves of trees and other plants. They tend to aggregate and feed at the tops of plants and work their way down. Hosts include a wide variety of plant types such as grapes, stone fruit, raspberry, rose, zinnia, corn, hops, canna, crape myrtles, birch trees and linden trees.

Egg laying begins soon after the adults emerge from the ground and mate. Females leave plants in the afternoon, burrow 2 to 3 inches into the soil in a suitable area, and lay their eggs — a total of 40 to 60 during their life. The developing beetles spend the next 10 months in the soil as white grubs. The grubs develop in the soil, feeding on the roots of various plants, but grasses are particularly favored.

There are some good efforts nationally in an attempt to limit the spread of this serious pest. In 1998 (revised in June 2013), the National Plant Board U.S. Domestic Japanese Beetle Harmonization Plan (DJBHP) was developed by the American Nursery and Landscape Association,



Fig. 1. Japanese beetle adult, *Popillia japonica* Newman, on a rose flower. Photo by Jack Kelly Clark.

UC Statewide IPM Project
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INSECT HOT TOPICS:

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U.S. Department of Agriculture and 50 state departments of agriculture (see National Plant Board link below). The purpose of the plan is to assure that the risks of movement of Japanese beetles associated with marketing of nursery stock and other regulated commodities are acceptably managed and are consistent with the National Plant Board Plan Quarantine, Nursery Inspection and Certification (PQNIC) Guidelines. Under this plan, the movement of nursery and greenhouse plants from infested areas needs a state phytosanitary certificate, or an equivalent certification of quarantine compliance, when shipping nursery stock to states that consider Japanese beetle a quarantine pest, such as California.

Obviously, if California became a Japanese beetle infested state, it would necessitate that nurseries follow another set of phytosanitary rules, but by doing so, California would avert more stringent requirements.

Lastly, the green fruit beetle (fig. 2), also known as known as green June beetle or fig beetle, is often mistaken for the Japanese beetle in California. For a size comparison between the two beetles, use the link to the CDFA Japanese beetle profile web page below.

Some pertinent web sites:

http://www.cdfa.ca.gov/plant/pdep/target_pest_disease_profiles/japanese_beetle_profile.html

<http://nationalplantboard.org/docs/jbccolumn.pdf>

http://www.aphis.usda.gov/publications/plant_health/content/printable_version/JB3-07.indd.pdf

http://www.aphis.usda.gov/publications/plant_health/content/printable_version/jbidcard5-07.pdf

http://www.cdfa.ca.gov/plant/pdep/target_pest_disease_profiles/Japanese_beetle_host_list.html

http://en.wikipedia.org/wiki/Japanese_beetle

http://extension.cropsci.illinois.edu/fieldcrops/insects/japanese_beetle/

<http://ohioline.osu.edu/hyg-fact/2000/2504.html>

<http://www.ext.colostate.edu/pubs/insect/05601.html>

<http://www2.ca.uky.edu/entomology/entfacts/ef451.asp>

<https://www3.ag.purdue.edu/counties/marion/Pages/JapaneseBeetles.aspx>

<http://extension.entm.purdue.edu/publications/E-75.pdf>

<http://www.extension.umn.edu/garden/insects/find/japanese-beetles/>

<http://www.ces.ncsu.edu/depts/ent/notes/O&T/flowers/note44/note44.html>



Fig. 2. Common green fruit beetle (also known as green June beetle or fig beetle), *Cotinus mutabilis* (Gory & Percheron). Photo by Jack Kelly Clark.

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REGIONAL REPORT — UC Cooperative Extension

Santa Cruz/Monterey Counties

Light brown apple moth update on regulations and research

by *Steve Tjosvold*

The Animal and Plant Health Inspection Service (APHIS), the regulatory arm of the USDA, announced in early February 2014 that they will maintain their current classification of light brown apple moth (LBAM) as a quarantine pest. This announcement and the analysis that preceded it was a result of petitioners requesting the deregulation of LBAM. APHIS announced, “By maintaining a regulatory program for LBAM, APHIS is seeking to minimize the further spread of the moth in the United States and maintain foreign trade markets for our producers.” The announcement is available at:

http://www.aphis.usda.gov/newsroom/2014/02/pdf/fr_lbam_quarantine.pdf.

We have been conducting research in Santa Cruz and Monterey counties to aid in LBAM detection and management. In the *UCNFA News* Spring 2013 issue, I described one of those research projects where we are evaluating the importance of LBAM in areas around the perimeter of nursery and berry fields because we suspect that LBAM may be migrating from natural vegetation and weeds into these production areas. (See: http://ucanr.edu/sites/UCNFAnews/Regional_Report_Santa_Cruz_Monterey_Cos/Spring_2013__LBAM_field_data_available_for_Monterey_Bay_Area_growers/.)

The eight monitored production sites are grouped into five generalized regions in Santa Cruz County and north Monterey County. Our data shows a relatively synchronized peak moth emergence in early November in all monitored areas in 2011 and 2012. But in 2013, there is a noticeable decline in the numbers of LBAM adults that we have trapped and larvae found on the nursery-perimeter hosts. We believe that the drought in 2013 is taking a toll on LBAM because their plant hosts are either not as prevalent or not as suitable for colonization. The period from

Field Observations

Polyphagous shot hole borer detected in Santa Cruz County

A new invasive pest, the polyphagous shot hole borer (PSHB), was recently detected by the California Department of Food and Agriculture (CDFA) in a survey trap in Santa Cruz County along Highway 17 close to the Santa Clara County border. The tiny beetle is part of a new insect-disease complex that is threatening avocado, coast live oak, box elder and other trees in Southern California. The newly identified beetle penetrates the bark of many hosts and carries a symbiotic fungus (*Fusarium* species) that the larvae feed on. The fungus can then cause branch dieback in susceptible hosts. The same beetle and fungus have also been found in Israel, where the complex has caused severe damage to avocado trees since 2009.

The situation in Santa Cruz County is being sorted out by CDFA. The one beetle detection in the survey trap is only an indication that it is in the area, and it is not currently considered established. Delimitation traps may be installed and potential hosts may need to be inspected in the oak and California bay woodland where the trap was placed.

PSHB is a Q-rated pest, which is a temporary designation of a pest that is suspected to be of economic importance. Information needs to still

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February 19, 2013 (the last significant rainfall) to just before the recent February 2014 rains has proven to be one of the longest periods with significantly below-normal rainfall. Young growth on perennial hosts and some annual hosts have just not been readily available for LBAM to thrive. To date, the greatest numbers of larvae have been found on French broom (*Genista monspessulana*)(19%), coyote bush (*Baccharis pilularis*)(16%), dovefoot geranium (*Geranium molle*) (10%), buckhorn plantain (*Plantago lanceolata*)(7%) and wild radish (*Raphanus raphanistrum*) (7%). There are 31 different host species that have been identified so far. The data for moth emergence and a complete host list is updated every 2 weeks and can be accessed through the UCCE Santa Cruz homepage: <http://cesantacruz.ucanr.edu/>.

Another project was to evaluate California Department of Food and Agriculture official regulatory insecticides and other newer insecticides in field conditions. Insecticide treatments were applied before and after egg deposition and the efficacy was evaluated based on the survival of the brood to attain adulthood. In addition, residual activities of the insecticides were evaluated to help make management decisions on the timing and frequency of field applications. Treatments did not affect egg laying except for lambda-cyhalothrin (Scimitar), which repelled moths and greatly reduced egg laying and the size of egg masses for 3 to 4 weeks. Diflubenzuron (Dimilin) was not



Light brown apple moth leafroller larvae are commonly found in shelters (leaf rolls) composed of leaves pulled together with silken webs. A mature larva such as this one can be up to 18mm (3/4 inch) long with a light to medium green body, yellow to light brown head, light to medium green segment just behind the head, and light-colored hairs and legs. Photo by S. Tjosvold.

**FIELD OBSERVATIONS:
Continued**

be gathered before any determination might be made if or how regulatory action would be enforced. So far, no quarantine has been established. PSHB could be transported in firewood, solid wood packing or shipping material, and possibly nursery stock with at least 2-inch diameter trunk diameter.

For more information see John Kabashima's article in this issue of *UCNFA News*, and the following links:

http://cisr.ucr.edu/polyphagous_shot_hole_borer.html

<http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=8170>

http://ucanr.edu/sites/socaloakpests/Polyphagous_Shot_Hole_Borer/

Thank you to Marylou Nicoletti, Santa Cruz County Agricultural Commissioner, for providing information about CDFA efforts in detection and delimitation for PSHB.

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effective. All other treatments reduced survivorship, with *Bacillus thuringiensis* (Dipel) and indoxacarb (Provaunt) lasting up to 1 week, spinosad (Conserve) lasting 1 to 2 weeks, and chlorantraniliprole (Acelepryn) and emamectin benzoate (Enfold) lasting 2 to 3 weeks. Horticultural oil (Pure Spray Green) did not improve control when combined with *Bacillus thuringiensis*, spinosad, or methoxyfenozide (Intrepid). Methoxyfenozide, a registered insect growth regulator targeting moth larvae, lasted 3 to 4 weeks, and could be a very useful integrated pest management product in nurseries.

This research was funded by a Specialty Crop Block Grant (CDFA/USDA).



Trapping for LBAM on nursery perimeter. Scout checks commercially-available Jackson trap and pheromone bait that specifically attracts and traps male LBAM moths. Photo by S. Tjosvold.

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REGIONAL REPORT — UC Cooperative Extension Ventura County



Polyphagous shot hole borer look-alikes

by **Jim Downer**

As we continue an historic drought in California, trees all over Southern California are showing symptoms of stress. Drought predisposes trees to pests and diseases, and in some cases, these trees have died. Drought-stressed trees in landscaped and naturally vegetated areas of nurseries can serve as host reservoirs, increasing pest problems in plant production areas and increasing the spread of invasive pests

REGIONAL REPORT: Ventura and Santa Barbara Counties, continued from page 19

on nursery plants. Trees and other woody plants in nurseries also bear the burden of extra drought stress as irrigation waters become increasingly saline due to drought effects on water supplies.

The polyphagous shot hole borer (PSHB [fig. 1 A]), as described elsewhere in this newsletter, is a serious pest of nursery and landscape trees that threatens many species. Counties adjacent to Los Angeles are at high risk for invasion of PSHB. The drought has stressed many of the reproductive host trees that could be attacked by PSHB. Trees are also often attacked by other native or established beetle pests. In some cases, these beetle pest species closely resemble PSHB and may cause similar symptoms, such as bleeding, cambial discoloration and gallery formation.

On coast live oak (*Quercus agrifolia*), there are two beetles that resemble PSHB: the western oak bark beetle (*Pseudopityophthorus pubipenis* [fig. 1B]) and the oak ambrosia beetle (*Monarthrum scutellare*). The western oak bark beetle is common in Southern California while the ambrosia beetle is more common in the northern half of the state, but both have been detected throughout California. As with many beetle/tree interactions, both of these insects are especially attracted to drought-stressed trees. When attacked, coast live oak bleeds heavily and since these insects often attack in larger numbers, there is a uniform pattern of bleeding along the main branch stems or trunk. The cambium of oak bark beetle attacked trees often reveals small galleries and little or no necrotic tissue.

Prunus spp. such as peach, nectarine, plum and apricot are common in back yards and nurseries.

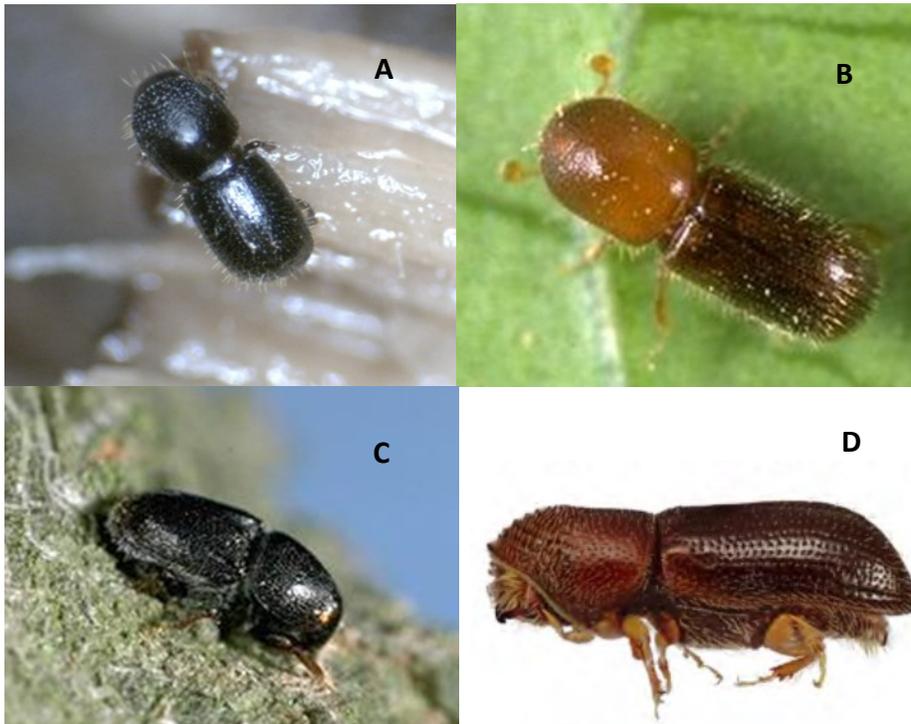


Fig. 1. PSHB (A), western oak bark beetle (B), shothole borer (C), walnut twig borer (D). Photos by A. Eskalen (A); JK Clark (B,C); S. Valley, Oregon Dept. of Agriculture, Courtesy of UCIPM: “Detecting and Identifying the Walnut Twig Beetle” (D).

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This year we are seeing increased attack of *Prunus* by the shothole borer or fruittree bark beetle (*Scolytus rugulosus* [fig. 1C]), a beetle very similar in stature to PSHB. The insect is the same size as PSHB and makes numerous holes which causes excessive bleeding in *Prunus* (see fig. 2 A,B for tree damage caused by PSHB and by shothole borer). Fungi may gain entrance through the beetle's entrance and exit holes and eventually girdle limbs, which may result in branch or tree death.

Another insect that could be mistaken for PSHB is the walnut twig borer (fig. 1 D), which vectors thousand cankers disease of walnuts (both native and English). This beetle (*Pityophthorus juglandis*) carries with it a fungus, *Geosmithia morbida*, that causes extensive cambial necrosis, and

ultimately twig and branch dieback results from its presence.

These four look-alike beetles are all small, with similar diameter bore holes; all cause host bleeding and destroy the vascular cambium when they attack en masse. Also of note is that the host range of the look-alike insects is much narrower than of PSHB. So when examining oak, *Prunus*, or walnut, these insects should be considered first before assuming PSHB is present.

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Fig. 2. Sap bleeding and staining symptoms caused by PSHB on coast live oak (A) and gumming in response to wounding by the shothole borer on *Prunus* (B). Photos by A. Eskalen (A) and JK Clark (B).

REGIONAL REPORT — UC Cooperative Extension

Orange/Los Angeles Counties



Western yellowjacket

by John Kabashima

Although yellowjacket wasps are important biological control agents of a variety of pests, they may pose problems in nurseries in lunch areas, around garbage containers and on plants with ripe fruit. Yellowjackets defend their nests vigorously when disturbed, and they can sting nursery workers and customers visiting the nursery. This can be a serious safety issue because some people have a hypersensitive reaction to even a single sting. To control yellowjackets in the nursery, it is important that food, garbage and empty beverage cans are placed in containers with tight-fitting lids. Aerosol formulations of insecticides labeled for use on wasp and hornet nests can be effective against yellowjackets. However, these products must be used with extreme caution as wasps will attack if they sense a poison being applied to their nests. Moreover, timing of control is important since wiping out entire colonies of yellowjackets can be detrimental.

A team of researchers from UC Riverside and the UC Cooperative Extension, Orange County are preparing for a fourth summer of monitoring and controlling the western yellowjacket, *Vespu-la pensylvanica* (fig. 1). This integrated pest management (IPM) research project is conducted in Irvine Regional Park (IRP) and the surrounding foothills, where high summer wasp populations pose problems each year for picnicking park visitors. Our goal is to demonstrate

that minute quantities of insecticide can be used, not to wipe out entire colonies of yellowjackets, but to prevent painful confrontations with humans. To accomplish this, traps are routinely monitored and treatments are made only when the action threshold is reached; which minimizes the amount of pesticide used to reduce populations below the threshold level, and prevents exposure to nontarget organisms and the environment.

A chemical lure (heptyl butyrate) attracts workers and queens to the traps, where they tumble into jars of Sierra antifreeze coolant (propylene glycol) diluted with water (1:1, vol:vol). Traps are inspected every 7 to 14 days. The yellowjackets are counted and the number of wasps trapped per day is calculated; wasps are preserved in 95% ethyl alcohol for future molecular marker studies. The IPM project treats only when yellowjacket populations reach the action threshold of 10 wasps per day. When the action threshold is reached, a bait of 0.025% (wt/wt) fipronil and chicken breast is prepared and placed into bait stations. The bait stations are cages constructed from pine board and 1-inch hardware cloth, which allow wasps to pass through while keeping out nontarget organisms. Yellowjacket foragers carry the bait back to their nests. (This is an experimental, not a legally registered use of fipronil).

During the summer of 2013, 49 traps were hung in trees around the park perimeter and 7 in the park interior. Trap counts began climbing in late July, necessitating the only treatment of

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the season on August 1. A total of 10 bait stations were hung near the two traps where the action threshold was exceeded. Three bait cups containing 30 grams of 0.025% (wt/wt) fipronil and Swanson Premium Canned Chicken Breast were placed into each of the cages. During the 24-hour baiting period, the yellowjackets took 5.2 ± 0.7 grams (mean \pm SEM, $n = 30$) of bait per cup. This means only 1.3 milligrams of fipronil were carried back to the yellowjacket nests. The impact of baiting was immediate: trap counts decreased throughout the park, not just in the treated areas, dropping from 337.2 wasps per day (sum of all 56 traps) on August 1 to 78 wasps per day on August 3 (see fig.2).

We hope these positive results will encourage regulatory agencies and chemical companies to register similar control methods, and that treatment sites will include nurseries. For more information about managing yellowjackets, visit the UC IPM website at

<http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7450.html>.

I would like to thank Monica Dimson, Staff Research Associate, for her assistance in preparing this article for UCNFA News.

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Fig. 1. The western yellowjacket, *Vespula pensylvanica*. Photo by J. Kabashima.

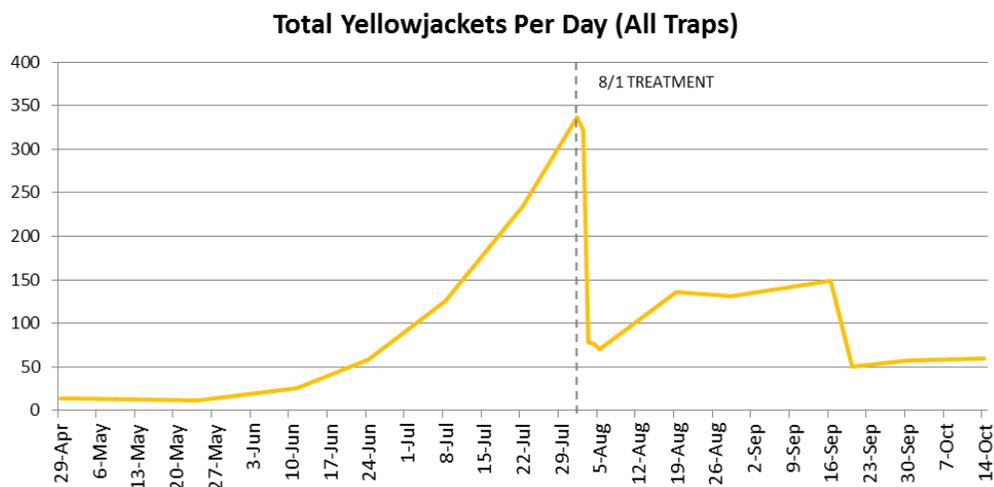


Fig. 2. Total number of yellowjackets per day collected in 56 traps throughout the 2013 season. Dotted line indicates the timing of baiting trial conducted on August 1, 2013.

REGIONAL REPORT — UC Cooperative Extension

San Diego/Riverside Counties

Steam treatment of sago palms infested with scale

by James A. Bethke

Due to the cryptic nature of many invasive species, the ornamental plant trade represents a weak link for the movement of invasive exotic arthropods, and the movement and dispersal across regions and between countries is increasing. For example, some of the Hemiptera (formerly the Homoptera), including scale insects, whiteflies, mealybugs, aphids, adelgids and psyllids, can be shipped unknowingly as eggs or immature stages on plant shoots and other plant parts, or in pots or potting media.

A good example of a pest consistently moved from off shore or interstate to local California growers is the cycad scale, *Furchadaspis zamiae* (Morgan). They can be exceptionally well hidden in plant tissues (fig.1A), later to emerge and infest new foliage growth (fig.1B). It is very difficult to clean up infested plants for a couple of reasons. First, the cycad scale is an ar-

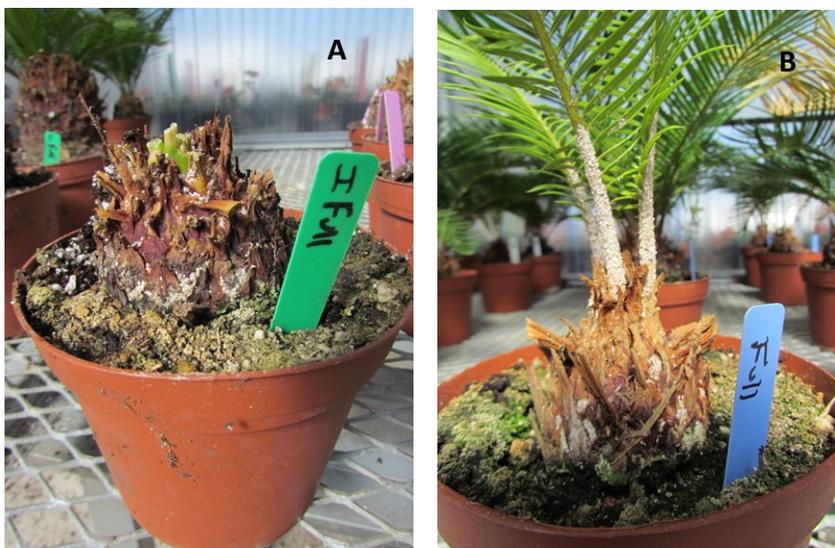


Fig. 1. Sago palm bulbs (A) and potted sago palm plant (B) infested with cycad scale insects.

Field Observations

The Coqui frog

I have been warning that if the Coqui frog gets a foothold here in Southern California, especially if in our riparian areas, it will establish and become one of our banes. If any of you have visited Hawaii, especially the big island, you have heard the Coqui frog. They make a calming bird-like coo when they croak and when I first heard them at the Hilo Airport, I started to look for the hidden birds. California inspectors have recently intercepted many shipments of ornamentals from Hawaii with either frogs or frog eggs present. The shipments are either destroyed or shipped back. In San Diego County, we have an active infestation at a local nursery that is no longer under the purview of the agricultural commissioner (because once it is detected in the nursery, and not just in a shipment, it falls under the regulatory authority of California Fish and Wildlife). We shall see if the infestation is eradicated. More recently, San Diego County inspectors intercepted Coqui frog eggs on a shipment of 100 two-gallon dracaena from Hawaii, and when they inspected the eggs under a microscope, they verified that the eggs were alive. There is no official or highly effective

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mored scale, which means they are difficult to kill with pesticides. The cover on the armored scale is not a part of the body of the insect, so it acts like a protective umbrella over the insect. Therefore, typical control strategies include applying control measures when eggs hatch and crawlers are present. The crawler stage is the most susceptible to pesticides. Secondly, once the scale insects are present in large enough numbers to make them visible, the plant becomes unattractive and unsalable. Growers typically throw the plants away rather than spend the

FIELD OBSERVATIONS:
Continued

eradication treatment, so the shipment was destroyed. If this frog gets established, it will have similar and potentially devastating impacts on nurseries in close proximity to the infestation just like any other "A" or "Q" rated pest, such as the light brown apple moth and red imported fire ant.

Table 1. Sago palms, *Cycas revoluta*, treated with steam for 5, 10, and 15 minutes and with dimethoate (positive control standard, not registered for this use on sagos) for eradication of the cycad scale, *Furchadaspis zamiae*. Applications occurred on Oct 15, 2013 and the trial is still in progress.

WHOLE PLANTS

Treatment	1 Month After Treatment			3 Months After Treatment		
	N	N Resprouted (%)	N Scale Present	N	N Re-sprouted (%)	N Scale Present
Untreated Control	9	9 (100)	9	9	9 (100)	9
Steamed 5 min ($\approx 110^\circ$ F)	8	6 (75)	0	8	7 (87)	0 ^a
Steamed 10 min ($\approx 130^\circ$ F)	8	6 (75)	0	8	6 (75)	0 ^a
Steamed 15 min ($\approx 140^\circ$ F)	8	8 (100)	0	8	8 (100)	0 ^a
Dimethoate @ 25.5 fl oz/10 gal	8	8 (100)	0	8	8 (100)	0 ^b

N= Number

^a Exposed leaves died but they are sprouting

^b Seven plants have chlorotic leaves due to treatment

BULBS ONLY

Treatment	1 Month After Treatment			3 Months After Treatment		
	N	N Resprouted (%)	N Scale Present	N	N Re-sprouted (%)	N Scale Present
Untreated Control	12	4 (33.3)	12	12	6 (50)	12
Steamed 5 min ($\approx 110^\circ$ F)	12	6 (50)	0	12	8 (67)	0
Steamed 10 min ($\approx 130^\circ$ F)	12	7 (58)	0	12	7 (58)	0
Steamed 15 min ($\approx 140^\circ$ F)	12	9 (75)	0	12	9 (75)	0

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extra mechanical effort to remove the scale. The leaves can be removed and the plant can re-flush in time, but it is likely that the scale will return and the resource investment is not worth it.

A trial is in progress at the Center for Applied Horticultural Research in Vista, California that investigates steam sterilization for eradication of cycad scale from sagos, *Cycas revoluta*. Dimethoate is a highly effective systemic insecticide against scale insects, but it is not registered for use on sagos in California. It was included as a positive control to demonstrate efficacy. We treated whole, potted infested plants, and we treated unrooted leafless bulbs. Plants or bulbs were steamed for 5, 10, or 15 minutes, and the highest temperature attained around the bulbs at the end of the cycle was recorded. Following treatment, bulbs were potted into Sunshine mix potting media in a 6-inch pot, and all treated plants were placed on raised greenhouse benches. The plants were observed for several months and observations were made for plant recovery and reinfestation.

Preliminary results suggest that all treatment regimens appear to be successful in eliminating the scale from the plants. No reinfestation has been observed for the length of the trial so far (approximately 3 months).

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New publications from Agriculture and Natural Resources

compiled by Steve Tjosvold

Weed Pest Identification and Monitoring Cards

Based on the bestselling Weeds of California and Other Western States, this is the perfect pocket-sized companion for anyone working in the field. These 48 cards cover the most common weeds, grouped into eight categories for easy identification. \$25.00.

Author: Joseph M. DiTomaso

Publication Number 3541

<http://anrcatalog.ucdavis.edu/Details.aspx?itemNo=3541>

Myoporum Thrips: Pest Notes for Home and Landscape

Myoporum thrips can damage or even kill Myoporum plants, flowering decorative shrubs and groundcovers native to Mauritius and popular as landscape plants in regions of California.

Authors: J. A. Bethke, L. M. Bates

Publication Number 74165

<http://www.ipm.ucdavis.edu/PDF/PESTNOTES/pnmyoporumthrips.pdf>

Bagrada Bug: Pest Notes for Home and Landscape

Bagrada bug, a stink bug native to Africa, is now found in Southern California where it attacks vegetables and mustards as well as sweet alyssum and other ornamentals. It is especially hard on mustard seedlings. Learn to recognize and manage this pest.

Author: D.A. Reed, et al.

Publication Number 74166

<http://www.ipm.ucdavis.edu/PDF/PESTNOTES/pnbagradabug.pdf>

Clearwing Moths: Pest Notes for Home and Landscape (Revised)

The larvae of several species of clearwing moths in the insect family Sesiidae are important wood-boring pests in landscapes. Hosts include alder, ash, birch, fir, oak, pine, poplar, sycamore, willow and stone fruit trees such as apricot, cherry, peach and plum.

Authors: J. Karlik, S. Tjosvold, and S. Dreistadt

Publication Number 7477

<http://www.ipm.ucdavis.edu/PDF/PESTNOTES/pnclearwingmoths.pdf>

Red Imported Fire Ant: Pest Notes for Home and Landscape (Revised)

Although the red imported fire ant (*Solenopsis invicta*) is common in 12 southern states, it is new to California and has recently been found infesting numerous residential and commercial areas in Orange, Los Angeles, Riverside, San Bernardino, and to a lesser extent, San Diego counties. The spread of these ants has largely been a result of the movement of infested soil to uninfested areas.

Authors: L. Greenberg, J. N. Kabashima

Publication Number 7487

<http://www.ipm.ucdavis.edu/PDF/PESTNOTES/pnredimportedfireant.pdf>

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UCNFA News is published by the University of California Nursery and Floriculture Alliance, a statewide partnership of researchers and educators, growers, floriculture associations and allied industry.

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