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SJVASC Update

December 2015

Welcome to the San Joaquin Valley Agricultural Sciences Center (SJVASC) Update. It's been over four years since the last SJVASC Update, and this Update will capture some of the highlights over that time. Dr. Ed Civerolo retired four years ago as Center Director, and I came to SJVASC in April 2013. I've been with ARS for 30 years, starting as a Research Entomologist working on stored-product insects in Savannah, GA, and then transferring that research program to Manhattan, KS, in 1994. I was Research Leader of the Stored Product Insect Research Unit in Manhattan from 1997 to 2013. Part of the attraction in coming to Parlier was the impact on agriculture of the research conducted in Parlier and the close ties between SJVASC and producers, commodity organizations, and industry. This Update provides some select accomplishments from the past year that demonstrate that impact.

Jim Throne, SJVASC Director **Contact:** James.Throne@ars.usda.gov

Research Highlight

Vibrational Communication of the Glassy-Winged Sharpshooter (GWSS)

Contact: Rodrigo Krugner

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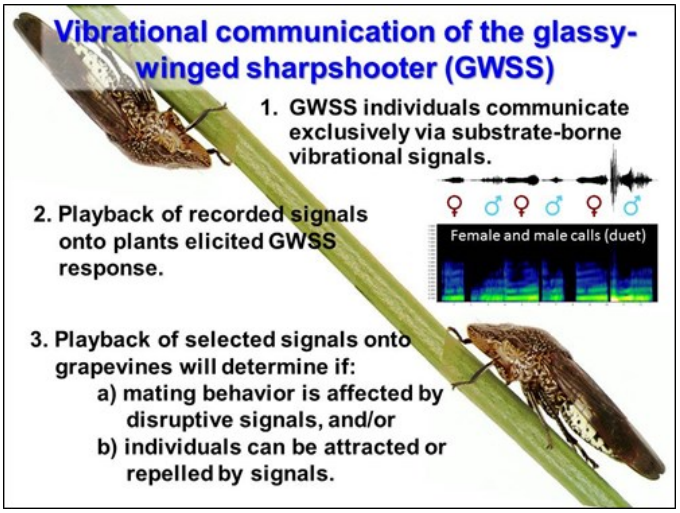


Leafhoppers and sharpshooters communicate via vibrational signals transmitted through the plant. Signals are very low frequency and intensity "sound" waves that conventional recording equipment and the human ear can't detect. Yet it could be the key to a novel control method that is compatible with chemical and biological control of leafhopper and sharpshooter pests of grapevines. Dr. Rodrigo Krugner and colleagues in the Crop Diseases, Pests and Genetics Research Unit are using a laser-Doppler vibrometer to identify and describe signals used by the GWSS, *Homalodisca vitripennis*, to communicate with each other. The work has shown that the GWSS uses signals in intra- and inter-gender communication, and specific signals are required for GWSS to achieve mating.

Bioassays using paired virgin males and females on plants revealed that GWSS males search for females on plants while females wait for males to approach. Visual signals, physical contact, and specific vibrational signals are used by GWSS to establish male and female hierarchy and, thus, preferential access to mates. However, GWSS females can

also be "choosy", suggesting that both intrasexual (male-male combat) and intersexual (mate choice) interactions may occur in GWSS. While GWSS rivalry calls negatively impact courtship behaviors, it is not known yet if the overall reproductive success of individuals can be artificially affected by playbacks.

Since what they "say" to each other has a big effect on their actions, signals may be exploited as an attractant, repellent, and/or disruptive signal which could be a useful, non-chemical control method for suppressing GWSS populations. Can these sounds be reproduced to manipulate GWSS behaviors? The answer is: Yes. In the laboratory, mini-shakers and speakers deliver pre-recorded natural sounds or synthetic sounds to plants through a wire, like a trellis wire, thereby artificially stimulating individuals to produce natural responses to signals. In preliminary trials, Krugner and colleagues were able to establish communication (duets, trios, and quartets) with GWSS males and females using pre-recorded calls. The ability to establish a communication channel and elicit GWSS response to select signals represents an important step towards the next goal, which is to identify signals capable of influencing GWSS behavior for applicative purposes (e.g., disruption of mating communication, attraction). We envision disrupting GWSS mating by sending signals through trellis wires.


Research Updates


'Sunpreme' raisin quality and timing as affected by irrigation treatment and pruning style

Author: C. Ledbetter
Submitted to: Australian Journal of Grape and Wine Research

Winter rains can bring an abrupt end to the raisin season if the arrival is prior to removal of dry product from the vineyard. Raisin harvest timing is influenced by many factors: crop load, degree days received during the growing season, irrigation regime, and the specific grape cultivar used for drying. 'Sunpreme,' a recently-bred raisin cultivar from the Crop Diseases, Pests and Genetics Research Unit in Parlier, CA, is capable of drying naturally on the vine without cane cutting. It is a vigorous vine and heavy raisin producer, factors that generally delay harvest timing. We examined the harvest timing and resulting raisin quality in 'Sunpreme' vines when cultured with various irrigation regimes and pruning styles. 'Sunpreme' could be harvested earlier, and without any loss of product quality, using a reduced or deficit irrigation schedule. Pruning style had little effect on harvest timing or raisin quality. These results are important in terms of irrigation water savings as well as the potential savings in raisin tonnage, through earlier harvests, in years when winter rains come early and have potential to damage product still in the vineyard.
Contact: Craig Ledbetter, Craig.Ledbetter@ars.usda.gov, (559) 596-2817

Optimizing postharvest methyl bromide treatments to control spotted wing drosophila, *Drosophila suzukii*, in sweet cherries from Western USA

Authors: S. Walse, L. Jimenez, W. Hall, J. Tebbets, D. Obenland

Submitted to: Journal of Asia-Pacific Entomology

Spotted wing drosophila has impacted the export of key fruit crops from the United States. Several importing countries regulate spotted wing drosophila as a quarantine pest and require the postharvest treatment (e.g., fumigation, radiation, heat, cold, etc.) of potential fresh fruit hosts prior to importation from the Western USA. This work addressed the need to develop a postharvest methyl bromide fumigation treatment to control this pest in sweet cherry exports. The fumigation parameters required for control were determined and then provided to trade partners to demonstrate that a properly conducted fumigation mitigates the threat associated with the importation of sweet cherries potentially infested with spotted wing drosophila.

Contact: Spencer Walse, Spencer.Walse@ars.usda.gov, (559) 596-2750

Movement of *Diaphorina citri* Kuwayama (Hemiptera: Liviidae) adults between huanglongbing-affected and healthy citrus

Authors: F. Wu, Y. Cen, X. Deng, J. Chen, Y. Xia, G. Liang

Submitted to: Florida Entomologist

Asian citrus psyllid (ACP) is an insect vector transmitting the pathogen of citrus huanglongbing (HLB, also called yellow shoot disease or citrus greening disease). HLB-affected citrus trees typically have leaf yellowing symptoms. This study evaluated the effect of leaf yellowing on the behavior of ACP adults. Yellow color (e.g., young shoots or HLB-affected leaves) played an initial role in attracting ACP adults. However, ACP eventually abandoned HLB-affected leaves and turned to asymptomatic green leaves, an indication of either poor nutrition or a feeding barrier in HLB-affected mature leaves. This behavior facilitates HLB pathogen spread and should be further investigated.

Contact: Jianchi Chen, Jianchi.Chen@ars.usda.gov, (559) 596-2924

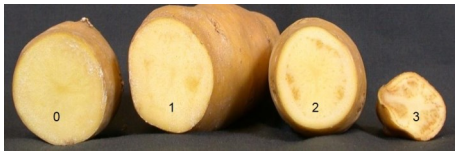
Development of a high-throughput 10-plex assay for simultaneous detection of RNA pathogens of citrus

Authors: J. Wang, T. Dang, R. Lee, R. Yokomi, G. Vidalakis

Submitted to: Journal of Virological Methods

Citrus is a high value perennial crop produced from budwood source trees certified as being true-to-type and pathogen-free. Citrus nurseries usually maintain their own registered source trees and increase budwood in nursery blocks from which budwood is harvested to propagate citrus plants for sale. Increase blocks are maintained for approximately 18 months and then replaced with new increase trees freshly propagated from the original mother source tree. Source and increase block trees are subjected to mandatory annual testing by the California Department of Food and Agriculture for infection by pathogens such as Citrus tristeza virus, "Ca. Liberibacter asiaticus", and, periodically, for citrus viroids (Citrus exocortis viroid, Citrus bent leaf virus, Hop stunt viroid, Citrus viroid III, Citrus viroid IV), Citrus tatterleaf virus, and Citrus psorosis virus. A need exists for a cost-effective citrus pathogen detection assay that can test for many pathogens in a single sample assay. In collaboration with a biotech company, a Quanti-Gene Luminex-based assay system was developed for sensitive and simultaneous detection, identification, and quantification of nine citrus pathogens and a housekeeping citrus gene as an internal control. The Quantigene assay is a non-PCR-based diagnostic method which increases each target 2400-fold per RNA copy by branched DNA signal amplification technology. The Quantigene assay is the first diagnostic method to detect up to 10 plant pathogen targets in a simultaneous, user-friendly, high-throughput assay, and enabled direct use of crude tissue extract without complicated nucleic acid extraction and purification. The Quantigene assay can be used in surveillance, certification, and management programs for plant pathogens.

Contact: Ray Yokomi, Ray.Yokomi@ars.usda.gov, (559) 596-2990



Candidatus Liberibacter solanacearum' infection effects on potato tuber chemistry of promising germplasm exhibiting tolerance to zebra chip disease

Authors: C. Wallis, J. Munyaneza, J. Chen, R. Novy, G. Bester, J. Buchman, J. Norgaard, P. Van Hest

Submitted to: Phytopathology

Zebra chip disease (ZC) is a major threat to worldwide potato production. Development of potato germplasm with tolerance or resistance is key to sustainable and environmentally friendly management of ZC. Therefore, 283 potato breeding lines were screened for tolerance to infection by the ZC causal agent, 'Candidatus Liberibacter solanacearum' (Lso). Five potato breeding clones consistently did not exhibit fresh or fried ZC symptoms when infected with Lso and, therefore, were deemed tolerant. Compared to the susceptible variety 'Atlantic', these five breeding clones underwent significantly smaller shifts in host biochemistry upon Lso infection, which was consistent with the absence of ZC symptoms. The five tolerant potato clones will be used to develop commercially-viable varieties. Knowledge gained about tolerance mechanisms could be used to search for additional potato varieties that remain symptomless when Lso-infected.

Contact: Chris Wallis, Christopher.Wallis@ars.usda.gov, (559) 596-2805

Determining the period of susceptibility of almonds to aflatoxin contamination during development in the orchard

Authors: A. Picot, R. Puckett, M. Donner, J. Siegel, T. Michailides

Submitted to: Journal of Phytopathology

Almonds are the largest tree nut crop grown in California, and there are currently one million acres planted in California. Crop quality is essential to ensure a healthy domestic and export market. One of the greatest quality threats to all tree nuts, and other commodities such as peanuts, is aflatoxin contamination. Aflatoxins are poisons produced by two species of fungi, *Aspergillus flavus* and *A. parasiticus*, that colonize almonds in the tree once the almond hull has split, and then develop and produce aflatoxins in the nuts before harvest. Aflatoxins are frequently associated with nut damage by the navel orangeworm, which is the principal insect pest of almonds in California. The purpose of this study was to determine if there is a specific time that nuts are most vulnerable to aflatoxin contamination after hull split, and whether navel orangeworm damage is always necessary in order for almonds to become colonized by the two species of *Aspergillus*. *Aspergillus* fungi were able to successfully develop in all stages of the almonds tested, and become established even in undamaged nuts. However, aflatoxin contamination was eleven times higher when navel orangeworm fed on the nuts than the levels on nuts that were undamaged, and the levels of aflatoxin were highest when the fungi had the longest opportunity to develop in the field. This study established that almonds are susceptible to *Aspergillus* infection from hull split until harvest, and it is important to control navel orangeworm throughout this period. This information underscores the necessity of insect control to ensure high nut quality.

Contact: Joel Siegel, Joel.Siegel@ars.usda.gov, (559) 596-2735

Development of a persistent pheromone lure for the navel orangeworm, *Amyelois transitella* (Lepidoptera: Pyralidae)

Authors: B. Higbee, C. Burks, T. Larsen

Submitted to: Insects

The lack of an effective pheromone lure has made it more difficult to monitor and manage the navel orangeworm, *Amyelois transitella*. Producing a lure that is effective in the field long enough for practical use proved difficult, even after an attractive blend was identified in the laboratory. A series of experiments was conducted to optimize the release device, formulation, and load. The resulting lure was attractive in the field for at least 40 days. These experiments provided the first artificial pheromone lure useful for practical monitoring of navel orangeworm in the field. Availability of this lure may improve management and decrease insecticide treatments applied on a precautionary basis to almonds, pistachios, and walnuts; crops worth > $5 billion annually (unprocessed).

Contact: Charles Burks, Charles.Burks@ars.usda.gov, (559) 596-2757

***Pythium araceacium*: a new species causes root rot of *Zantedeschia hybrida* in California**

Authors: W. Li, S. Dangi, B. Hanson, J. Gerik

Submitted to: Plant Disease

A severe root rot disease of calla lily occurs on the central coast of California. The purpose of this study was to determine the cause of this disease. Diseased specimens were collected and returned to the lab. Isolates of *Pythium* spp. were recovered from the disease samples by isolation on a specific growth medium. Greenhouse grown calla lilies were inoculated with the isolates, and disease symptoms were observed. *Pythium* isolates were recovered from the diseased tissue completing Koch's postulates. The isolates were identified using molecular techniques. Fifty-four of 59 isolates that caused serious disease had identical molecular profiles that did not correspond with any known *Pythium* species in the databases, indicating the pathogen is a previously undescribed species. We propose to name the pathogen *Pythium araceacium* after the flowering plant family Araceae, which contains the calla lilies.

Contact: James Gerik, James.Gerik@ars.usda.gov, (559) 596-2865

Etiology of Alternaria fruit rot in blueberry in the Central Valley of California

Authors: X. Q. Zhu and C. L. Xiao

Submitted to: Phytopathology

Recent establishment of low-chill southern highbush blueberry cultivars in California's warm climate has significantly increased the acreage of blueberry production in Central California, which is now a major southern highbush blueberry production region in the U.S. However, fruit rot caused by *Alternaria* spp. is one of the most important factors affecting the postharvest quality and shelf life of blueberry fruits. In this study, 283 isolates of Alternaria spp. were obtained from decayed blueberry fruit to determine which *Alternaria* spp. are responsible for *Alternaria* fruit rot using morphological and DNA fingerprinting approaches. Of the 283 isolates, 61.5% were identified as *A. alternata*, 32.9% were *A. arborescens*, 5.0% were *A. tenuissima*, and only one isolate of *A. infectoria* and one isolate of *A. rosae* were found. All five *Alternaria* spp. were able to cause decay on fruit inoculated with the fungus. Previously *A. tenuissima* has been reported to be the major causal agent of *Alternaria* fruit rot of blueberry worldwide. The results of this study indicate that the species composition of *Alternaria* responsible for *Alternaria* fruit rot in blueberry can be dependent on geographical region and that *A. alternata* and *A. arborescens* are the primary causal agents of *Alternaria* fruit rot in blueberry in California. Control of *Alternaria* rot in blueberry in the Central Valley of California should target these two species.

Contact: Chang-Lin Xiao, Chang-Lin.Xiao@ars.usda.gov, (559) 596-2722

Chloropicrin emission reduction by soil amendment with biochar

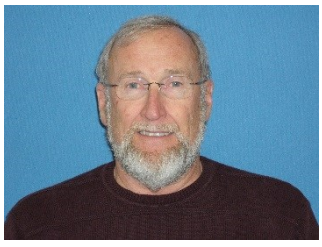
Authors: Q. Wang, P. Liu, L. Mao, D. Wang, D. Yan, W. Fang, Y. Li, C. Ouyang, A. Cao

Submitted to: PLoS One

Soil amendment has been considered one of the options in soil fumigation for reducing possible environmental concerns by reducing volatile toxic fumigant chemicals from escaping into the air. A series of laboratory experiments were carried out to evaluate the effect of amending surface soils with biochar, a carbon-enriched and porous material produced by heating organic materials under limited or no oxygen. These lab tests showed that, with biochar, emissions of the fumigant chloropicrin were drastically reduced, degradation of the fumigant in soil was increased, and biocidal activity of the fumigant on soil-borne plant pathogens and nematodes was not affected. Additional studies are needed to extend the laboratory findings for adopting biochar as a viable soil fumigation amendment.

Contact: Dong Wang, Dong.Wang@ars.usda.gov, (559) 596-2852

AWARDS



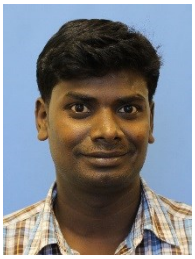
Dr. Jim Ayars received the 2014 US Council for Irrigation and Drainage Professionals Merriam Improved Irrigation Award in appreciation of his meritorious contributions for research on irrigation and water management.

Dr. Elaine Backus received the 2015 Plant-Insect Ecosystems Award from the Pacific Branch of the Entomological Society of America for her outstanding research on hemipteran-plant interactions and her role in the development and applications of electropenetrography.

New Scientist

Dr. Rachel Naegele joined the Crop Diseases, Pests and Genetics Research Unit as a Research Horticulturist focusing on genetic improvement of grapes in response to biotic and abiotic stress. Dr. Naegele completed her MSc and PhD at Michigan State University (MSU) in Plant Breeding, Genetics and Biotechnology. Her graduate research sought to develop improved cultivars through the identification of molecular markers for host resistance to pathogens and abiotic stress. Since completion of her PhD, Dr. Naegele has conducted research on potato transcriptomics (MSU), management of bacterial and fungal plant pathogens (MSU), and cucurbit breeding for fruit quality and human health components (North Carolina State University).

Visiting Scientists



Dr. Vijay Anand Raj. Selvaraj is a visiting scholar who started working with Dr. Ray Yokomi in the Crop Diseases, Pests and Genetics Research Unit in July 2015. Vijay is a molecular virologist and started his career as a Senior Research Fellow in Tamil Nadu Agricultural University, Coimbatore, India, conducting research on RNA silencing in sunflower to develop resistance to sunflower necrosis disease caused by tobacco streak virus. Vijay's research at SJVASC is to develop full-length recombinant complimentary (c) DNA clones to California strains of Citrus tristeza virus (CTV). These infectious cDNA clones of CTV will be used to mutate and/or substitute to identify and characterize determinants of disease expression and aphid transmission. The recombinant cDNA clones can also be engineered to deliver antimicrobial peptides against "Candidatus Liberibacter asiaticus" (CLas), the presumed causal agent of huanglongbing (HLB) and RNA Interference against the Asian citrus psyllid, the vector of CLas.

Dr. Bin Wu is an associate professor at the Institute of Commodity Storage and Processing, Xinjiang Academy of Agricultural Sciences, Urumchi, Xinjiang, China. Dr. Wu's research in China has focused on postharvest technologies for storage and processing of grapes, apricots, and other fruits. Dr. Wu is collaborating with Drs. Chang-Lin Xiao and Spencer Walse in the Commodity Protection and Quality Research Unit to evaluate postharvest fumigation with nitric oxide as an alternative to conventional fungicides for control of postharvest diseases and maintenance of fruit quality of blueberries and and table grapes.

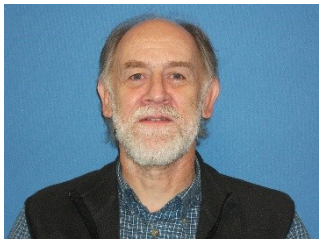
Dr. Xiangyang Shi is a postdoctoral research associate who started working with Dr. Hong Lin in the Crop Diseases, Pests and Genetics Research Unit in 2012. He graduated from the University of California-Riverside with a major in plant pathology. His research interests are mainly on bacterial virulence genes and Pierce's Disease of grape. His current research is on functional identification of virulence genes in several important plant pathogens including *Xylella fastidiosa* (Xf) and *Candidatus* Liberibacter spp. He has analyzed several key virulence genes in both Xf and Liberibacters, and is now in the process of developing a target gene basis molecular therapeutic strategy for controlling diseases.

Ms. Yang Ying is a visiting scientist from the Grape Research Institute at Guangxi Academy of Agriculture Sciences, China. She is working with Dr. Hong Lin in the Crop Diseases, Pests and Genetics Research Unit for one year starting January 2015. She is interested in crop breeding, trait selection, and molecular QTL mapping. In her current research, she has used molecular markers to establish linkage groups from backcrosses of grape breeding populations. She also works on greenhouse screening for resistance to Pierce's disease.

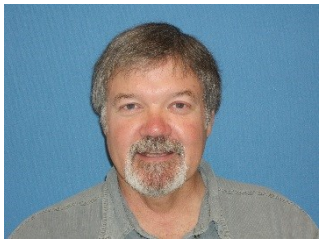
Departed Scientists

Dr. Don Makus (1944 – 2014) passed away on 26 May 2014. Don began his career with ARS in 1981 in Booneville, AR, and was transferred in 1995 to Weslaco, TX. He was transferred to Parlier, CA, when the Weslaco facility was closed in 2012. Don conducted research on improving production of asparagus and blueberries in Arkansas, vegetables and cotton in Texas, and pomegranates in Parlier. Don is survived by his wife Judy and their children Michelle, Joel, and Dennis.

Dr. Judy Johnson retired in January 2015 after 30 years as a Research Entomologist with ARS in Fresno and Parlier. The focus of her research was on use of physical treatments, particularly heat and cold, and biological control for control of postharvest insect pests particularly in dried fruits and nuts. A highlight of Judy's career was being part of a team that received the Secretary of Agriculture's Group Honor Award for Personal and Professional Excellence as part of the Japan Varietal Testing World Trade Organization Team for exceptional performance, creativity, and perseverance in successfully challenging Japan's long-standing varietal testing trade restrictions within the World Trade Organization in 1999. The team developed the scientific rationale in support of the successful case brought before the World Trade Organization by the Office of the U.S. Trade Representative against the requirement by Japan for extensive testing of individual varieties in the development of quarantine commodity treatments. Judy enjoys photography, and incorporated this into her research, for example by making videos of parasitoids to help understand their behavior. She was also very involved in science outreach, and won the USDA-ARS Pacific West Area Outreach, Diversity and Equal Opportunity Award in 2009.



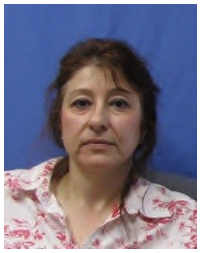
Dr. Bas Kuenen retired in June 2015 after 17 years with ARS in Fresno and Parlier. He conducted research on insect behavior and chemical ecology, and perhaps the highlight of his career was elucidation of navel orangeworm sex pheromone components, which had eluded others for 30 years. This work led to the development of a pheromone monitoring system for this major nut pest.



Dr. Joe Smilanick was a Research Plant Pathologist with ARS from 1983 until he retired in January 2014. He conducted research to evaluate the impact of preharvest practices and packinghouse treatments on postharvest quality and fungal decay of citrus fruit and table grapes, including research on fungicide applications, sulfur dioxide fumigation, biological control, ozone treatments, and hot water treatments.

Dr. Vicki Yokoyama retired in January 2015 after 30 years with ARS in Fresno and Parlier. Vicki is highly respected nationally and internationally for achievements in the development of quarantine treatments and strategies to control regulatory pests. Her research has resulted in enhanced markets with U.S. trade partners for stone fruit and hay, and optimized control of olive fruit fly.

Dr. Elizabeth Rogers moved to the ARS Foreign Disease-Weed Science Research Unit in Fort Detrick, MD, in August 2015.



Dr. Gabriela Romano, curator for the National Arid Land Plant Genetic Resources Unit, left SJVASC in September 2013. We are currently in the process of selecting a new curator.

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