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SJVASC Update

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Research Highlight

The National Arid Land Plant Genetic Resource Unit

Contact: Claire Heinitz, Claire.Heinitz@ars.usda.gov, 559-596-2980

The San Joaquin Valley Agricultural Sciences Center is home to one of the thirty "gene banks" in the National Plant Germplasm System (NPGS). These gene banks form a network to conserve the genetic diversity of agriculturally important plants in the United States. Each site has a specialty, for example wheat (Aberdeen, ID), corn (Ames, IA), or grapes, fruit, and nut crops (Davis, CA). The National Arid Land Plant Genetic Resource Unit (NALPGRU) in Parlier focuses on new and alternative crops for arid lands, including a large and colorful collection of prickly pear cactus visible from Manning Road. Because of the excellent farming conditions in the San Joaquin Valley, this gene bank also serves as a long-season nursery to produce seed for many of the other sites with cold winters or disease pressure. At any given time, we could be farming hundreds of miniature plots of wheat, sunflowers, watermelons, garlic, or hot peppers.

Guayule

Lesquerella

Buffalo gourd

The mission of the NPGS is to collect, conserve, characterize, document, and distribute crop germplasm – in other words, serve as a living library of all useful varieties of crop plants. We maintain an online database with information about the collections, and seeds and cuttings are distributed freely to researchers and plant breeders worldwide. Curators at each site manage the collections, communicate with requestors, and do research to characterize the available plant material to make it more useful. The goal is to safeguard these seeds and plants as an important national resource for crop improvement and food security, and continue to make as many of the collections available for free distribution as possible.

The collection of crops maintained at NALPGRU contains mainly "new crops" with industrial uses that can be grown in areas with low rainfall and minimal irrigation. These crops can help fill a growing need for the domestic production of petroleum alternatives (like oils and biofuel) and other industrial products on marginal land – without displacing food crops. The main NALPGRU collections are *Parthenium* ('guayule', produces natural rubber), *Simmondsia chinensis* ('jojoba', produces liquid wax similar to whale oil), *Physaria/Paysonia* ('lesquerella' or 'bladderpod', produces oil similar to castor), *Limnanthes* ('meadowfoam', produces industrial oil), *Opuntia* ('prickly pear' cactus or 'nopales', multipurpose crop for food, animal feed, biofuels, and landscaping), and *Cucurbita foetidissima* ('buffalo gourd', drought tolerant wild relative of cultivated squash and pumpkin). Most of these crops are still in the early stages of domestication and research, so access to high-quality seeds and cuttings is crucial. In many cases, the collections here in Parlier are the only sources currently available to the public.

Currently most of our research is focused on guayule, which is seeing a surge in active

research and development due to a combination of concerns over the imported natural rubber supply, the cost of crude oil for synthetic rubber, natural latex allergies, and a need for productive crops on marginal lands that can boost rural economies. Guayule (*Parthenium argentatum*) is a perennial shrub native to the Chihuahuan Desert in Mexico and southern Texas. It produces natural hypoallergenic latex and rubber, and has been intermittently cultivated in California and the Southwest U.S. over the past 100 years, especially during times of low supply or high prices for imported natural rubber. The USDA has been an active player in the history of guayule since the Emergency Rubber Project of WWII, where commercial lines were developed and tested in Salinas, CA. Since then, the USDA has maintained the only publicly available guayule collection in the world, now held at NALPGRU. Because obtaining new wild plants from Mexico is currently unfeasible, we work very hard to provide seeds and information to university researchers, farmers, and tire companies in the U.S. and around the world. We are also working with other ARS researchers in Albany, CA, to develop a faster evaluation method for rubber content, and planning an exploration trip to look for wild guayule plants near Big Bend, Texas.

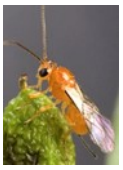
Anyone looking for more information on any of the NPGS collections, or to submit a request to receive plant material, can search the GRIN-Global database at https://npgsweb.ars-grin.gov/gringlobal/search.aspx. You can also contact the curator of the NALPGRU collection, Claire Heinitz, at 559-596-2980 or Claire.Heinitz@ars.usda.gov.

Jojoba

Meadowfoam

Prickly pear

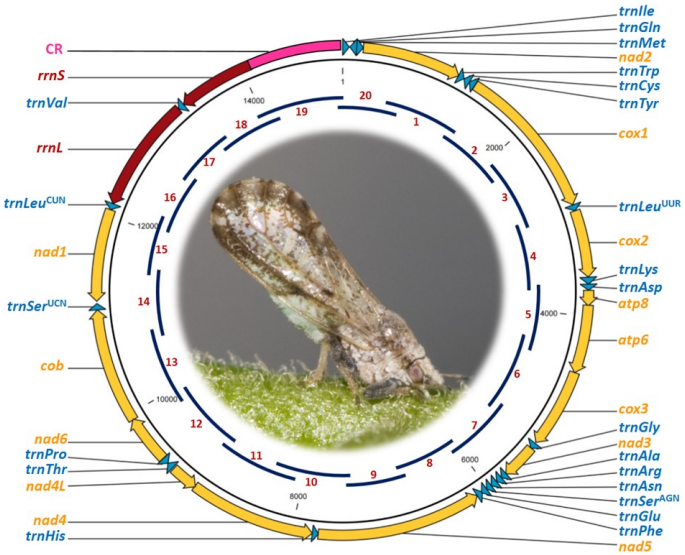

Research Updates




Population diversity of *Diaphorina citri* (Hemiptera: Liviidae) in China based on whole mitochondrial genome sequences

Submitted to: Pest Management Science

Authors: F. Wu, H. Jiang, B. Andrew, P. Holford, J. Chen, C. Wallis, Z. Zheng, X. Deng, Y. Cen



The Asian citrus psyllid (ACP, *Diaphorina citri*) transmits the pathogen that causes citrus huanglongbing (HLB), a highly destructive disease affecting citrus production worldwide. HLB and ACP have been in China for over a hundred years, and they were found in the United States ten years ago. Effective control of HLB relies on comprehensive knowledge of vector ecology and biology, including population diversity of ACP. In this study, ACP were collected from China and south/southeastern Asia. ACP population diversity was studied through analyses of mitochondrial genome sequences, a common technique for studying insect populations. Three major mitochondrial groups (MGs) were found: MG1, present in southwestern China at elevations greater than 1,000 meters; MG2, present in southeastern China and southeastern Asia (Cambodia, Indonesia, Malaysia, and Vietnam) at elevations less than 180 meters; and MG3, present in the United States and Pakistan. The information will facilitate current efforts in HLB management, in particular how the vector ACP is controlled.

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Population genetics of '*Candidatus* Liberibacter asiaticus' in Brazil: the effects of geographic region and citrus species

Submitted to: PLoS One

Authors: L. De Paula, H. Lin, E. Stuchi, C. Francisco, N. Safady, H. Coletta Filho

The bacterium '*Candidatus* Liberibacter asiaticus' (CLas) is a putative causal agent of citrus huanglongbing or citrus greening disease. The disease was first reported in Sao Paulo in 2004 and is now found in many citrus growing regions in Brazil. In this study, the genetic diversity and population structure of CLas were evaluated. 154 HLB-diseased samples were collected from three citrus-growing regions including Sao Paulo, Minas Gerais, and Paraná states. Nine molecular markers were used to estimate the genetic variation among CLas isolates. Results indicate that genetically homogeneous populations of CLas were detected in citrus growing regions of Sao Paulo State and Minas Gerais but not in Paraná, suggesting that different introduction events may have occurred in Paraná. Additionally, host selection may play a role that modulates the genetic diversity of CLas populations. Information obtained from this study helps to understand epidemiology of HLB.

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Diversity of *Xylella fastidiosa* host suitability among siblings from a non-traditional almond X peach cross

Submitted to: Euphytica

Authors: C. Ledbetter, S. Lee

Almond, a widely grown tree nut in California's central valley and consistently among the top California exports in terms of tonnage and product value, is affected by a bacterial disease called Almond Leaf Scorch that reduces tree vigor and almond yields. Both the particular almond variety and the rootstock used in the orchard can have a dramatic effect on the Almond Leaf Scorch present in the or-

chard, with peach rootstock generally being considered resistant to the bacterium responsible for Almond Leaf Scorch disease. However, the almond industry is now moving away from peach as a rootstock in favor of higher yielding and more vigorous peach-almond hybrids. In our research, we inoculated diverse peach-almond hybrids with *Xylella fastidiosa,* the bacterium responsible for Almond Leaf Scorch disease, and followed tree development and disease expression during the growing season. At the end of the season we also determined the amount of bacteria present in each of the inoculated trees. While all inoculated trees developed measurable bacteria by the end of the growing season, only about half of the peach-almond hybrids developed Almond Leaf Scorch disease symptoms. Further, concentrations of the bacteria ranged widely among the trialed peach-almond hybrids, with some non-symptomatic accessions having very high bacterial concentrations. Our work demonstrated the diversity of symptom expression and host suitability of peach-almond hybrid candidate rootstocks to *X. fastidiosa*. Almond Leaf Scorch has been a reoccurring problem throughout California's 1.1+ million acres of almonds for at least the last 50 years. With the shift toward peach-almond hybrid rootstocks in the California almond industry, it is important to determine the resistance/tolerance profile of potential new rootstocks to the wide variety of biotic and abiotic problems facing almonds in California orchards.

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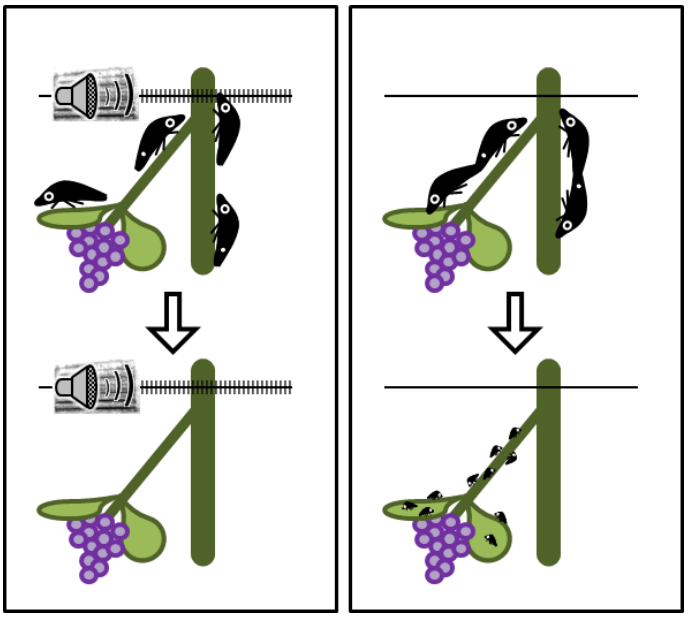
Mating disruption of *Homalodisca vitripennis* (Germar) (Hemiptera: Cicadellidae) by playback of vibrational signals in vineyard trellis

Submitted to: Pest Management Science

Authors: R. Krugner, S. Gordon

Glassy-winged sharpshooter (GWSS), *Homalodisca vitripennis*, is an important vector of the bacterium *Xylella fastidiosa*, the causal agent of Pierce's disease of grapevine. Current control methods for GWSS in California include broadcast applications of insecticides, which negatively affect biological control agents populations and have resulted in insecticide resistance in GWSS. Therefore, alternative methods of control are needed. GWSS communicate by exchanging mating calls that are transmitted through host plants as vibrational signals. Interference with GWSS communication by playback of disruptive signals should lead to reduced birth rates and population growth, but research was needed to evaluate efficacy of the novel vibrational signal playback method in disrupting GWSS mating under field conditions and to evaluate properties of signal transmission through vineyard trellis. Although playback of vibrational signals through vineyard trellis was affected by distance from signal source, the signal significantly reduced mating of GWSS on grapevines compared to control. Although further studies are needed prior to method implementation, data from this study continue to support application of vibrational mating disruption as a novel method to control GWSS populations.



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Pesticide-mediated disruption of spotted wing Drosophila flight response to raspberries

Submitted to: Journal of Applied Entomology

Authors: R. Guedes, S. Corbett, M. Rodriguez, J. Goto, S. Walse

Pesticides are used to control many types of agricultural pests, including the spotted wing drosophila (SWD). This study contributes to our understanding of under-appreciated consequences of pesticide use and how they may contribute to the overall goal of pest control. Specifically, we examined the potential for pesticide treatment to interfere with the ability of SWD to locate a fruit host. Five

pesticides (the insecticides malathion, pyrethrins, and spinetoram; and the fungicides fenhexamid and pyrimethanil) were applied at field rates to raspberries, or to SWD adults via contact exposure. The SWD attraction to raspberries was assessed in a series of two-choice flight bioassays. Pesticides exhibited little interference with the release of raspberry volatiles when the berries were treated, where only spinetoram and pyrethrins resulted in mild effects of avoidance and attraction respectively. Nonetheless, SWD adults sublethally exposed to pesticides had their flight-take off seriously impaired, as was their upwind flight in recognition to fruit volatiles. The impairment was particularly drastic when insecticides were used, although the fungicides also compromised the insect response to the raspberry volatiles. These findings suggest that even the sublethal pesticide exposure can aid in SWD control, and also indicate that pesticides may compromise sampling/trapping strategies used for this pest species.

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Genetic and pathogenic characterization of *Phacidiopycnis washingtonensis* from apple and Pacific madrone from Western United States

Submitted to: Phytopathology

Authors: P. Sikdar, M. Mazzola, C. Xiao

Phacidiopycnis washingtonensis is a recently reported fungal pathogen causing a postharvest fruit rot of apple and a leaf blight of Pacific madrone in Washington State. In this study, we used microsatellite markers to investigate the genetic relationships among the pathogen populations from different hosts and geographic areas. We found no genetic differentiation between the apple and Pacific madrone populations, but the apple population possessed higher genotypic diversity than the Pacific madrone population, suggesting that *P. washingtonensis* isolates from apple may represent an older population and could have been introduced into the native habitat of Pacific madrone through accidental movement of infected plant materials. Our findings also indicate that *P. washingtonensis* isolates are capable of infecting both apple and Pacific madrone irrespective of their host of origin.

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Desert plant for saline and drought stricken farmland: Assessment of Opuntia cactus nutritional characteristics

Submitted to: Journal of Environment and Bio Research

Authors: T. Centofanti, G. Banuelos, M. Zambrano, C. Wallis

Cactus pear is remarkable for its ability to tolerate arid saline environments that are recognized as stressful for most plant species. Consequently, cactus pear can be cultivated with minimum agriculture inputs and has great potential for cultivation and production on degraded lands. In this three-year study, we assessed the physiological responses relative to nutraceutical quality in fruit juice extracted from *Opuntia ficus-indica* (USDA accessions no. 248 and 255) that had been cultivated in saline-, selenium (Se)-, and boron (B)-rich soils in the west side of the San Joaquin Valley in Central California. Results indicate that the two selected accessions of *Opuntia ficus-indica*, can tolerate saline-, Se-, and B-impacted soils and produce fruit of nutritional value. Despite growing under high saline conditions, the nutritional characteristics in fruit juice (e.g., nutrients, total phenolics, ascorbic acid, pigments, and flavonoids) of both accessions were not affected by long-term (3 years) exposure to excessive salinity and B. In addition, juice extracted from fruits collected from plants grown on the saline-, Se-, and B-rich soil and drainage sediment showed significantly higher concentrations of Se relative to juice from fruits collected from plants grown on non-saline (control) soil. Our results demonstrate that selected accessions of *Opuntia ficus-indica* should be considered as an alternative crop for the poor-quality soils of the west side of the San Joaquin Valley.

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New Visiting Scientists

Dr. Venkat Sengoda will be working with Dr. Hong Lin in the Crop Diseases, Pests and Genetics Research Unit on host responses to bacterial-associated diseases including, but not limited to, grape Pierce's disease and citrus huanglongbing. Dr. Sengoda received his Ph.D. in Plant Pathology with a specialization in Plant Virology from Tamil Nadu Agricultural University in India. Prior to coming to SJVASC, he worked as a manager for molecular and genotyping of crop seed and plant diseases in a diagnosis lab. He also worked as a Postdoctoral Research Associate in a study of potato zebra chip disease associated with Candidatus Liberibacter solanacearum-potato psyllid with Dr. Joe Munyaneza at the USDA-ARS Yakima Agricultural Research Laboratory in Wapato, WA, through a research collaboration with Washington State University.

Mr. Zehan (Vincent) Dai is working with Drs. Jianchi Chen and Ray Yokomi in the Crop Diseases, Pests and Genetics Research Unit on development, exploration, and utilization of bioinformatics data for research related to '*Candidatus* Liberibacter asiaticus' (CLas), a putative pathogen for citrus Huanglongbing (HLB, yellow shoot disease). He is currently a Ph.D. candidate in the Department of Plant Pathology, South China Agricultural University (SCAU), Guangzhou, Guangdong Province, China. His supervisor in SCAU is Dr. Xiaoling Deng, a leading HLB researcher in China. Mr. Dai obtained his B.S. degree in Plant Protection from SCAU. He is a native of Guangdong where citrus HLB has been endemic for over a hundred years. Since his arrival in our USDA facility in August, 2017, he has been extensively involved in diversity analyses of CLas strains found in California with collaborations from California Department of Food and Agriculture, USDA-APHIS, and California Citrus Nursery Board.

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