Analyses of mitogenome sequences revealed that Asian citrus psyllid (Diaphorina citri) from California was related to those from Florida but different from those in Southern China

Submitted to: Scientific Reports

Authors: F. Wu, L. Kumagai, Y. Cen, J. Chen, C. Wallis, M. Polek, H. Jiang, G. Liang, X. Deng

Asian citrus psyllid (ACP) transmits the pathogen of citrus Huanglongbing (HLB, also called yellow shoot disease or citrus greening disease). HLB is currently threatening citrus production in all citrus growing regions, including California. To develop effective HLB control strategies, knowledge of ACP is necessary. In this study, mitochondrial genome (mitogenome) sequences of ACP from California and Florida were acquired and compared with those from China in an attempt to infer relationships between Californian, Floridian, and Chinese ACP. Based on mitogenome sequence analyses, the Californian ACP was found to be identical to the Floridian ACP, but different from the ACP in China. This suggests that ACP in California likely was introduced from southeastern USA, potentially through cross-continent transportation of citrus materials. This is the first report on the geographical origin of California ACP, and the information will have direct impact on HLB control practice in California.

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Trialing apricots in Riverside, California: Identifying cultivars suitable for culture in a low-chill environment

Submitted to: HortTechnology

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Apricot is enjoyed by many consumers, but the tree is not widely adapted to climatic conditions around the country. It is grown primarily in the San Joaquin Valley, with production now centered near Patterson, California. Apricot varieties vary in chilling requirement, and there are production problems when trees are grown in areas that receive inadequate chilling. For several million Southern California consumers, there are currently no recommendations for apricots capable of growing and producing fruit in that region. Because of this lack of information, an apricot variety trial was established in Riverside, California, where chill hour accumulation is approximately 1/3 of that received near Patterson, California. Bloom strength and fruit production potential of six diverse apricot varieties were scored over the course of four harvest seasons. Five of the
six apricot varieties performed poorly at the low-chill site, expressing irregular vegetative bud break and pre-bloom floral bud shedding that led to poor fruit production. The Blenheim variety, however, remained productive throughout the study, producing full crops even after dormant periods with as few as 161 chill hours. This information is important to Southern California consumers with interest in apricot production. The Blenheim variety can be recommended to these consumers for planting at low-chill sites.

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Water management of irrigated Cabernet Sauvignon grapevines in semi-arid areas

Submitted to: American Journal of Enology and Viticulture

Authors: J. Ayars, I. Abrisqueta, C. Parry, A. Perry, A. McElrone

As the demand for water increases to meet the needs of agriculture, municipalities, and the environment, it is incumbent on the largest water user (agriculture) to develop improved irrigation technologies and strategies to reduce its overall water footprint. This is of particular importance during periods of drought. The strategies are significantly different between annual and perennial crops. For annual crops, not planting the crop will eliminate the need for irrigation, thus providing for the competing demands. However, perennial crops will have to be irrigated at least to keep them alive. Deficit irrigation is one strategy that has been evaluated for perennial crop to sustain the plant. Strategies that have been implemented include sustained deficit and regulated deficit irrigation. Sustained deficit reduces the applied water by a uniform percentage of full irrigation throughout the year. Regulated deficit irrigation varies the depth of irrigation based on the plant growth stage with deficit being imposed during periods that have minimal impact on yield. We evaluated the regulated deficit irrigation strategies on Cabernet Sauvignon wine grapes being grown on the Central Coast of California. Three levels of full irrigation (35, 50, and 65%) were applied after fruit set until harvest. This resulted in a 50% reduction in yield compared to the fully irrigated vines. However, the resulting yields met the producer’s yield goals. Grape quality, not yield, is of primary importance in wine grape production. The changes were noted after approximately 5 years of deficit irrigation. The water savings was in the range of 16 to 33% compared to the 65% treatment. The savings increased when compared to the fully irrigated crop. The 50% irrigation treatment represents a sustainable irrigation strategy for irrigated Cabernet Sauvignon that will save water and provide acceptable yields.

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Biophysical response of young pomegranate trees to surface and sub-surface drip irrigation and deficit irrigation

Submitted to: Irrigation Science

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Pomegranate has recently been recognized for its human nutritional benefits resulting in an increase in production around the world. In general, pomegranate is regarded as a drought tolerant crop. However, limited literature is available on its response to water requirements and types of irrigation systems under commercial conditions. A two-year field study was carried out to characterize crop response to surface and sub-surface drip irrigation and deficit irrigation treatments in two different orchards. Trees receiving less water had higher canopy temperatures than those receiving more irrigation. Tree size was found to correlate with vegetation index, and strong correlations were developed to determine crop coefficient. The relationships can be used by farmers and water managers for irrigation management of pomegranate production.

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Mating disruption of the navel orangeworm (Lepidoptera: Pyralidae) using widely spaced, aerosol dispensers: is the pheromone blend the most efficacious disruptant?

Submitted to: Journal of Economic Entomology

Authors: B. Higbee, C. Burks, R. Cardé

The navel orangeworm, Amyelois transitella, is a key pest of almonds and pistachios and is sometimes controlled using mating disruption as part of a program of integrated management. This study compared the current non-attractive mating disruption formulation with two aerosol
formulations containing additional compounds that are attractive in laboratory and field trials. In pistachio, where abundance was higher, the more complete blends resulted in higher suppression of males captured in female-baited traps, and of mating in sentinel female assays. In almond, all three formulations provided over 99% suppression of males captured and females mated, and all resulted in lower crop damage compared to the non-mating disruption control. These findings suggest that it may be possible to make mating disruption more cost-effective by using attractive aerosol formulations to reduce the number of dispensers per hectare required.

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The glassy-winged sharpshooter (GWSS) is a major pest of grapevines in California, spreading the bacterium Xylella fastidiosa, which causes Pierce’s disease. While broadcast application of insecticides works to an extent, GWSS movement and ability as a generalist feeder leave the grape industry in need of finding additional means of control. By studying GWSS communication, the groundwork is being set to develop a pesticide-free method of control. GWSS communication involves sending and receiving vibrational signals through the plant host. This study used artificial playback of both white noise and a natural female call to test whether mating could be disrupted. Results determined that both signals significantly interrupted mating compared to silent control. Furthermore, when tested individually, females responded to artificial female calls with a call of their own. Finally, when white noise was terminated there was an increase in female calling. Altogether, these results identified signals that disrupt mating communication in laboratory conditions. As a stepping stone, these data support development of methods to transmit such signals for control of GWSS in vineyard wide applications.

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Pierce’s disease is an economically important problem in grape growing regions of the southern U.S. Pierce’s disease is caused by Xylella fastidiosa, a bacterium transmitted from plant to plant by insect vectors, including the glassy-winged sharpshooter, Homalodisca vitripennis. For this species to thrive in crops, males and females must communicate using vibrational signals transmitted through the plant. Vibrational signals of glassy-winged sharpshooter include harmonic frequencies starting around 80 Hz and repeating every 100 Hz creating at least 10 harmonics (over 1 kHz). Manipulation of natural signals with deletions from the signal spectrum to reduce harmonic repeats resulted in a lower male response rate to a female call. Furthermore, adding an 80 Hz pure tone signal to plants while glassy-winged sharpshooters were trying to communicate suppressed male signaling. Therefore, an 80 Hz pure tone frequency signal may be a candidate noise to use for disruption of glassy-winged sharpshooter communication on grapevines. The implication of these results is that if insect communication can be disrupted with a pure tone, then mating will not occur. If there is no mating, females will not become fertilized and population growth will be reduced.

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Xylella fastidiosa is a bacterium that causes Pierce’s disease of grapevines, which can severely damage plants and shorten the productive life of the vineyard. Xylella fastidiosa is transmitted from plant to plant by several species of leafhoppers, including the glassy-winged sharpshooter, a relatively recent invader of California. Understanding of
the factors controlling the spread of bacteria by insect vectors is critically important to management efforts. Irrigation is the most significant input in California agriculture, and future climate projection models predict reduced water availability to farmland. Therefore, knowledge of the effects of plant water stress caused by either natural drought periods or controlled deficit irrigation on the spread of bacteria is key to develop disease management strategies. In laboratory experiments, vectors transmitted X. fastidiosa to grapevines in conditions ranging from well-watered to severely water-stressed. In no-choice tests, acquisition of X. fastidiosa by vectors increased significantly as xylem sap tension (water stress) increased in source plants, while inoculation of bacteria to plants by vectors was not affected by water status of recipient vines. However, when vectors were presented with a choice of a healthy well-watered versus an infected water-stressed grapevine, a significant reduction in transmission of bacteria to the healthy plant occurred as water stress levels increased. Further, a host-vector epidemic model indicated a non-linear relationship between water stress and pathogen spread: moderate water stress enhances pathogen spread but extreme water stress produces equivalent spread as in a water-stressed scenario. Thus, host plant conditions and vector host preference interacted to determine transmission efficiency of this plant pathogen.

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New Visiting Scientists

Inas Drais is a Ph.D. candidate from the Università degli Studi della Tuscia, Viterbo, Italy. She will be working for four months with Dr. Ray Yokomi in the Crop Diseases, Pests and Genetics Research Unit on detection of Spiroplasma citri, causal agent of citrus stubborn disease. She has developed a Loop-Mediated Isothermal Amplification (LAMP) procedure to detect S. citri in the Mediterranean Region. While in Parlier, Inas will compare detection of stubborn-affected trees from the Mediterranean and California citrus-growing regions by LAMP, conventional PCR, and real-time PCR. She also will conduct research to improve detection of S. citri using LAMP by examining gene regions other than the housekeeping gene on which her current method is based.

Zheng Zheng is a Ph.D. candidate in the Department of Plant Pathology at South China Agricultural University in Guangzhou, China. He will be working for six months with Dr. Jianchi Chen in the Crop Diseases, Pests and Genetics Research Unit on “Candidatus Liberibacter asiaticus”, a pathogen associated with citrus Huanglongbing (HLB), using a next-generation sequencing approach. He previously spent a year, from 2013 to 2014, working with Dr. Chen on genome sequencing and analyses of liberibacters. During his current visit, he will continue his exploration of HLB genomics before returning to China to complete his graduate work.