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SJVASC Update October 2017

Research Updates

Sulfuryl fluoride fumigation to control brown marmorated stinkbug (Hemiptera: Pentatomidae)

Submitted to: Postharvest Biology and Technology

Authors: A. Abrams, J. Kawagoe, S. Walse

Brown marmorated stinkbug (BMSB) is a recent invasive pest that causes considerable damage to certain crops grown in Eastern USA. Moreover, this pest causes urban disturbance in its preparation for overwintering, as it forms large groups in sheltered areas, including houses, garages, and vehicles. The US exports ~ $1 billion annually in vehicles to Australia and New Zealand, and these countries require that BMSB is controlled in these shipments. Postharvest fumigation provides a biological safeguard against insect and microbiological pests and, in many scenarios, is the only available tool for government and industry to guarantee pest-free security. This work addresses the need to develop a postharvest fumigation treatment to control this pest in vehicles and shipping containers. The results describe how the fumigant, sulfuryl fluoride, can be used to control BMSB. Moreover, this research provides an alternative to methyl bromide fumigation, a critical need for the United States per the international regulatory requirements of the Montreal Protocol.

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Postharvest fumigation of fresh citrus with cylinderized phosphine to control bean thrips (Thysanoptera: Thripidae)

Submitted to: Postharvest Biology and Technology

Authors: S. Walse, L. Jimenez

Postharvest fumigation provides a biological safeguard against insect and microbiological pests and, in many scenarios, is the only available tool for government and industry to guarantee pest-free security. This research involved the development of a phosphine fumigation treatment to control an insect pest, bean thrips, in navel oranges exported from California to Australia. The results indicate that the treatment is efficacious per international phytosanitary standards, and as such, this research has provided the first opportunity for the United States to propose a phosphine fumigation of fresh fruit for quarantine purposes. This work addresses a critical need for the United States to implement postharvest alternatives to methyl bromide fumigation per the international regulatory requirements of the Montreal Protocol.

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Postharvest methyl bromide fumigation of Japanese plums to control codling moth (Lepidoptera: Tortricidae)

Submitted to: Journal of Asia Pacific Entomology

Authors: S. Walse, J. Tebbets, J. Leesch

Codling moth is an insect pest that has impacted the export of key fruit crops, including fresh Japanese plums, from the United States to Japan. Postharvest fumigation provides a biological safeguard against insect and microbiological pests and, in many scenarios, is the only available tool for government and industry to guarantee pest-free security. This work addresses the need to develop a postharvest methyl bromide fumigation treatment to control

this pest in multiple varieties of fresh Japanese plums that are of export interest to California growers. This work describes the fumigation parameters required for control and, importantly, also demonstrates that palletized cartons of fresh fruit can be shrouded with screen mesh prior to the fumigation to safeguard from further infestation. Moreover, the results of this research will promote more strategic technical and economic Quarantine Pre-shipment (QPS) uses of methyl bromide, a critical need for the United States per the international regulatory requirements of the Montreal Protocol.

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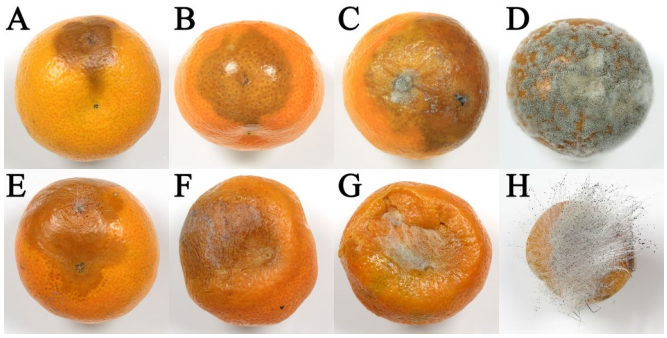

Prevalence of postharvest diseases of mandarin fruit in California

Submitted to: Plant Health Progress

Authors: S. Saito, C. Xiao

In recent years, storing mandarin fruit in cold facilities has become a common practice to retain fruit quality and expand the marketing window. However, postharvest diseases can limit the storage of the fruit and cause significant economic losses if left uncontrolled. Understanding which postharvest diseases affect mandarin fruit during storage would help identify the targets for disease control leading to development of relevant control measures to reduce losses resulting from these postharvest diseases. We conducted a survey to determine the prevalence of postharvest diseases affecting stored mandarins. Decayed fruit were collected from various grower lots either at pre-sorting or after cold storage in 2015 and 2016. Fungal isolation and identification were attempted for all decayed fruit. We found that Alternaria rot caused by *Alternaria* spp. was most prevalent on the non-stored fruit that were collected at pre-sorting, accounting for 53.5% and 83.1% in 2015 and 2016, respectively. On the stored fruit that were collected after cold storage, green mold caused by *Penicillium digitatum* (36.3%) was most prevalent followed by Mucor rot caused by *Mucor piriformis* (27.7%) and blue mold caused by *P. italicum* (23.3%) in 2015, while gray mold caused by *Botrytis cinerea* (29.7%) was most prevalent followed by Mucor rot (27.1%) and sour rot caused by *Geotrichum citri-aurantii* (18.7%) in 2016. Our results indicate that gray mold and Mucor rot are two emerging postharvest diseases of mandarin fruit in California and that postharvest disease-control programs for mandarin fruit should target not only common postharvest diseases such as green mold, blue mold, and sour rot but also emerging diseases Mucor rot and gray mold.

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Determinants of sensory acceptability in grapefruit

Submitted to: Journal of the Science of Food and Agriculture

Authors: D. Obenland, S. Campisi-Pinto, M. Arpaia

Grapefruit consumption in the United States has declined, at least partly as a result of increasing competition with other fruit in the marketplace and consumers being more demanding for greater fruit quality. In order to determine ways to improve grapefruit flavor quality, a study was undertaken to evaluate both sensory and other quality attributes in a diverse group of grapefruit obtained from California, Texas, and Florida over a nine-month period. Seven different harvest dates of fruit were acquired, sometimes obtaining fruit from multiple states at the same time. It was found that likeability was most closely linked to sweetness, with bitterness having a smaller role. Tartness was not an important factor in determining how well a fruit was liked. In accordance with the sensory results regarding sweetness, fruit with high soluble solids, a measure of the sugar within the fruit, had better flavor than did fruit with low soluble solids. The ratio of soluble solids to acidity, a commonly-used measure of maturity and flavor in grapefruit did not relate as well to likeability as the California standard, a newer measure of maturity utilized for navel oranges. Surveys of purchase intent that were conducted for each sample indicated that it would require grapefruit of very high flavor quality to induce the panelists to purchase grapefruit more often in the future. The results of this study suggest that revising the current ma-

turity standards to raise the concentration of soluble solids in the fruit would likely increase both consumer satisfaction and the sale of grapefruit.

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Evaluation of host resistance to Botrytis bunch rot in *Vitis* spp. and its correlation with Botrytis leaf spot

Submitted to: HortScience

Author: R. Naegele

Botrytis cinerea is the number one postharvest pathogen of fresh market table grapes, and causes losses in the field on both wine and table grapes. Managing this disease requires the regular use of fungicides, which are detrimental to the environment and expensive for growers. Plant host resistance to *Botrytis* is needed to reduce chemical inputs. Twenty-seven lines of grape (*Vitis* spp.) were evaluated for potential resistance to *Botrytis*-induced bunch rot and leaf spot. Most lines tested were susceptible to both isolates used in this study. One source of resistance with poor fruit quality was identified, and additional sources with reduced susceptibility and moderate fruit quality were identified. Leaf spot and fruit rot resistance were positively correlated, suggesting leaf testing may be a suitable alternative for evaluating berry resistance.

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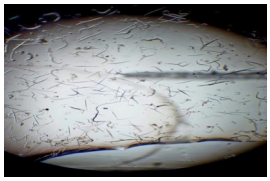

Determining roles of grapevine (*Vitis* spp.) stilbenoids on providing host resistance to root knot nematodes, *Meloidogyne incognita*

Submitted to: Phytopathology

Author: C. Wallis

Root knot nematodes can severely decrease grapevine yields and necessitate vineyard replanting. Although resistant grapevine rootstocks exist, the mechanisms of resistance remain unknown. This study examined potential roles of stilbenoids in providing resistance, as these compounds have exhibited a variety of antibiotic activity against other pathogens. A resistant rootstock, Freedom, was observed to have greater levels of stilbenoid trimer and tetramer levels than a susceptible rootstock, O39-16, which may suggest stilbenoid polymers provide resistance to nematodes. Thus, the ability of grapevine rootstocks to produce these compounds could be a desired trait to target in nematode resistance breeding programs.

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Alfalfa and pastures: sources of pests or generalist natural enemies?

Submitted to: Environmental Entomology

Authors: M. Sisterson, S. Uchima, D. Dwyer

Pierce's disease and almond leaf scorch disease are both caused by the bacterial pathogen *Xylella fastidiosa*. The Central Valley of California is the only region in California that commercially produces almonds and grapevines. In the Central Valley of California, the most common vector of *X. fastidiosa* is the green sharpshooter. Green sharpshooters are known to develop large populations in pastures and weedy alfalfa fields. As a result, it is recommended that almond and grape growers distance orchards and vineyards from pastures and alfalfa fields to reduce risk of Pierce's disease and almond leaf scorch disease. In this study, the potential risk of pastures and alfalfa fields serving as sources of green sharpshooters was compared to the potential benefit of pastures and alfalfa fields serving as sources of generalist natural enemies. Green sharpshooter abundance was low in well maintained alfalfa fields, whereas generalist natural enemy abundance was high. Accordingly, well maintained alfalfa fields were more likely to serve as a source of generalist natural enemies than green sharpshooters. In contrast, green sharpshooter abundance was high in pastures, whereas generalist natural enemy numbers were low. Thus, pastures were more likely to serve as a source of green sharpshooters than generalist natural enemies. Results provide growers with information needed to evaluate potential risks and benefits of cultivating almonds or grapevine in proximity to alfalfa fields and pastures.

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Effects of energy reserves and diet on glassy-winged sharpshooter egg maturation

Submitted to: Journal of Economic Entomology

Authors: M. Sisterson, R. Krugner, C. Wallis, D. Stenger

Epidemics of Pierce's disease of grapevine in California were due to introduction of the invasive glassy-winged sharpshooter. To reduce levels of Pierce's disease, a glassy-winged sharpshooter area-wide suppression program was initiated in the early 2000's. However, sharpshooter numbers have increased in some locations, with evidence that sharpshooters may have evolved resistance to commonly applied insecticides. Accordingly, control strategies that do not rely on insecticides are needed. To understand regulation of egg production in the glassy-winged sharpshooter, effects of energy reserves and diet on glassy-winged sharpshooter egg maturation were studied. Females with large energy reserves produced more eggs over a six-day feeding period than females with small energy reserves. In addition, females held on host plants with high amino acid concentrations produced more eggs than females held on plants with low amino acid concentrations. These results improve basic understanding of how glassy-winged sharpshooter females use incoming and stored energetic reserves to produce mature eggs. Identification of factors contributing to glassy-winged sharpshooter egg production will improve ability to forecast population growth rates and may aid in identifying novel targets for pest control.

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Impact of agricultural adjuvants on the toxicity of the diamide insecticides chlorantraniliprole and flubendiamide toward different life stages of navel orangeworm (*Amyelois transitella*) (Lepidoptera: Pyralidae)

Submitted to: Journal of Pest Science

Authors: M. Demkovich, J. Siegel, S. Walse, M. Berenbaum

In California orchards the navel orangeworm, *Amyelois transitella*, is the primary pest of almonds and pistachios as well as a serious pest of walnuts, figs, and pomegranates. Larvae cause direct damage when they consume the nutmeat and generate large quantities of frass and webbing, and cause indirect damage by leaving nuts susceptible to infection by fungi that produce aflatoxins. Control is extremely challenging and requires a strategy to manage immigrating pests as well as an internal population. Insecticides play a major role in the control of this pest, and these are mixed into orchard sprayers with adjuvants. An important class of narrow spectrum insecticides used to control this pest is known as the diamides. These formulated insecticides are mixed with adjuvants, which are products designed to modify the physical properties of the spray mixture; the effect of adjuvants on the toxicity of diamides is unknown. Our laboratory study investigated the intrinsic toxicity of five adjuvants as well as the toxicity resulting from the combination of unformulated diamides (purity of 90% or higher) with adjuvant. Our targets were navel orangeworm adults and eggs. We then validated the laboratory study by assessing two adjuvants in the field using formulated insecticides, and found that the toxicity of the two adjuvants was dependent on the diamide insecticide used. We noted considerable variability in the response of this insect, which could be due to inherent differences between unformulated and formulated insecticide as well as differences in insecticide coverage between laboratory and field. This latter problem is well known, and research on improving insecticide coverage is ongoing. We view our laboratory data as demonstrating potential benefits of certain classes of adjuvants, but this must be validated in the field.

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Water management of irrigated early season table grape (Sugraone) in arid areas

Submitted to: Irrigation Science

Authors: I. Abrisqieta, J. Ayars

A four-year study was conducted in the Coachella Valley to evaluate the impact of reduced irrigation on Sugraone grapes. We evaluated the grower's irrigation scheduling practices to determine if the crop was fully irrigated and whether there were opportunities to reduce the applied irrigation water. We did this by irrigating at a percentage of the grower practice in two different treatments. We determined that the crop was fully irrigated prior to harvest and deficit irrigated following harvest. We could reduce the total irrigation by 10% to

26% compared to the grower practice without impacting either yields or quality. The reduced irrigations resulted in smaller vines and a lower growth rate of the vines but still did not impact the yields in any of the treatments in the last two years of the project. However, there were year-to-year variations in the yield that were not explained by simply the irrigation treatments. The lower irrigation rates did not impact the quality of the grapes after three weeks of storage compared to the grower practice.

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Deep injection and the potential of biochar to reduce fumigant emissions and effects on nematode control

Submitted to: Science of the Total Environment

Authors: S. Gao, D. Doll, M. Stanghellini, B. Westerdahl, D. Wang, B. Hanson

Soil fumigation is used to control nematodes and other pests before replanting orchards. Low permeability tarps are used to effectively reduce fumigant emissions after soil fumigation, but the costs are high and disposal of tarps after use is required. This research in an almond orchard, evaluated whether deep fumigant injection and biochar soil amendments can reduce emissions, improve fumigant distribution in soil, and provide acceptable control of plant parasitic nematodes. Data showed that deep injection to 65 cm soil depth enhanced fumigant movement to below 60 cm that the regular injection at 45 cm depth could not deliver, and also resulted in significantly lower emissions. Biochar amendment at 40 ton/ha had the lowest emission among all treatments, more effectively reduced emission than a low permeability film, and did not negatively impact nematode control. This research illustrated the potential of using biochar to mitigate fumigant emissions, but more cost effective materials from local orchard feedstock are needed.

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Evaluation of potassium thiosulfate as a nitrification inhibitor to reduce nitrous oxide emissions

Submitted to: Biology and Fertility of Soils

Authors: Z. Cai, S. Gao, M. Xu, B. Hanson

Reducing nitrous oxide (N2O) emissions from agriculture has significant impact on climate change because agriculture is the largest source for this potent greenhouse gas. This study examined the effects of potassium thiosulfate, a fertilizer for potassium and sulfur, to potentially reduce N2O emissions. Thiosulfate functions as a nitrification inhibitor that inhibits transformation of ammonium to nitrate during which N2O can form. By comparing with commercial inhibitors, potassium thiosulfate was found to reduce N2O emissions significantly and by 50% when application rate increased to 102 mg S/kg soil. The results show that potassium thiosulfate can be equally effective as a commercial inhibitor in reducing N2O emissions. As fertilizer, however, potassium thiosulfate provides nutrients, and can ultimately lead to reduced total chemical input in agronomic systems if it can replace some of the commercial inhibitors for reducing N2O emissions and improving overall nutrient management.

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