Use of a Host Plant Volatile Blend to Monitor Navel Orangeworm Populations During IPM Treatments in Almond Orchards

Project No.: **16-ENTO04-Cheng/Beck (COC)**

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Objectives:

To determine over a multi-year experiment if a recently developed blend of synthetic host plant volatiles can efficiently monitor male and female navel orangeworm populations during mating disruption studies in MD-treated almond orchards

Interpretive Summary:

The final year of this study has accumulated all of the data from the numerous studies of the host plant volatile (HPV)-based synthetic blend and its efficacy to attract male and female navel orangeworm (NOW) moths in both conventional (CONV) and mating disruption (MD) orchards. Overall the HPV blend attracted greater than 50x more moths than the control standard, almond meal. The HPV blend clearly delineated four flights of NOW in the 2014, 2015 and 2016 seasons between early February and early October. Early flight NOW infestation and damage in almonds of varying varieties was assessed in relation to trap capture numbers by the HPV blend. For the first two flights and in Non-Pariel, total moth trap capture demonstrated a modest correlation to both % NOW damage and NOW infestation.

Materials and Methods:

Using well established protocols by Wonderful Orchards (formerly Paramount Farming) personnel and large plots of almond orchards undergoing MD treatments (Higbee and Burks, 2008), the HPV blend, placed in 8 mL Nalgene bottles with a 3.0 mm hole drilled in the cap

(Beck et al., 2012) was placed in pre-established locations – edges paired with interior areas in the Lost Hills Areawide NOW MD project, at a density of one trap per 50 acres. The number of moths captured by the blend was compared to those of almond meal-baited traps. A total of 2,500 acres of almonds containing both CONV and MD managed areas were monitored for 30 weeks with 60 vials every two weeks used. Ranch personnel placed and monitored delta traps throughout the experiment. ARS personnel prepared the vials (Beck and Higbee, 2013) and shipped to Wonderful Orchards for placement into traps in the field.

Results and Discussion:

Previous reports summarize the results obtained from the 2014, 2015 and 2016 growing seasons, which evaluated the efficacy of the HPV blend (Beck and Higbee, 2015; 2017) in both CONV and MD almond orchards. Briefly, the study sought to determine if a recently developed synthetic HPV blend reliably attracted male and female navel orangeworm adult moths in MD treated orchards, as well as evaluate potential correlations between moth trap captures by the HPV blend to NOW damage and infestation. Trapping studies performed during the 2011-2013 growing seasons demonstrated that the HPV blend was more effective than the current monitoring standard, almond meal, for capturing NOW adult moths in CONV almond orchards (Beck et al., 2012; Beck and Higbee, 2013). Moreover, unlike almond meal, the HPV blend captured male NOW adult moths.

Initial data analysis of these results suggested that the HPV blend-baited trap is likely to contribute to a predictive model that also uses other data to alert when corrective action is required to keep damage below a threshold. The researchers of this project have taken on a new collaborator to sift through the data to confirm results and provide input for the two upcoming publications (Beck at al, 2018; Wilson et al., 2018).

The blend was recently licensed to a commercial semiochemical company.

Research Effort Recent Publications:

Beck JJ, Gee WS, Cheng LW, Higbee BS, Wilson H, Daane KM. 2018. Investigating host plant-based semiochemicals for attracting the leaffooted bug (Hemiptera: Coreidae), an insect pest of California agriculture. In *Roles of Natural Products for Biorational Pesticides in Agriculture*, ACS Symposium Series. Beck JJ, Rering CC, Duke SO. (eds). American Chemical Society, Washington, DC. In press

Beck JJ, Alborn HT, Block AK, Christensen SA, Hunter CT, Rering CC, Seidel-Adams I, Stuhl CJ, Torto B, Tumlinson JH. 2018. Interactions among plants, insects, and microbes: elucidation of inter-organismal chemical communication in agricultural ecology. *J Agric Food Chem* 66:6663-6674.

Beck JJ, Torto B, Vannette RL. 2017. Eavesdropping on plant-insect-microbe chemical communications in agriculture ecology – a virtual issue on semiochemicals. *J Agric Food Chem* 65:5101-5103.

Beck JJ, Willett DS, Mahoney NE, Gee WS. 2017. Silo-stored pistachios at varying humidity levels produce distinct volatile biomarkers. *J Agric Food Chem* 65:551-556.

Beck JJ, Vannette RL. 2017. Harnessing insect-microbe chemical communications to control insect pests of agricultural systems. *J Agric Food Chem* 65:23-28.

Beck JJ, Willett DS, Gee WS, Mahoney NE, Higbee, B.S. 2016. Differentiation of volatile profiles from stockpiled almonds at varying relative humidity levels using benchtop and portable GC-MS. *J Agric Food Chem* 64:9286-9292.

Beck JJ, Higbee BS. 2015. Chapter 9 – Plant- or fungal-produced conophthorin as an important component of host plant volatile-based attractants for agricultural lepidopteran insect pests. In *Discovery and Synthesis of Crop Protection Products*, ACS Symposium Series. Maienfisch, P.; Stevenson, T.M. (eds). American Chemical Society, Washington, D.C. Vol 1204, pp. 111-127.

San Román I, Bartolomé L, Gee WS, Alonso RM, Beck JJ. 2015. Comparison of *ex situ* volatile emissions from intact and mechanically damaged walnuts. *Food Res Inter* 72:198-207.

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Beck JJ, Higbee BS. 2013. Volatile natural products for monitoring the California tree nut insect pest *Amyelois transitella*. In *Pest Management with Natural Products*, ACS Symposium Series. Beck JJ, Coats JR, Duke SO, Koivunen ME. (eds). American Chemical Society, Washington, DC. Vol 1141, pp. 59-72.

Beck JJ, Higbee BS. 2015. Volatile blends and the effects thereof on the navel orangeworm moth. Patent No. 9,220,261; issued 12/29/2015.

Beck JJ, Higbee BS. 2017. Volatile blends and the effects thereof on the navel orangeworm moth. Patent No. 9,655,366; issued 05/23/2017.

Beck JJ, Higbee BS, Light DM, Gee WS, Merrill GB, Hayashi JM. 2012. Hull split and damaged almond volatiles attract male and female navel orangeworm. *J Agric Food Chem* 6**:**8090-8096.

Beck JJ, Higbee BS, Willett DS, Wilson H. 2018. Agricultural pest management decision-making for a major California insect pest. *J. Agric. Food Chem.* In preparation

Higbee BS, Burks CS. 2008. Effects of mating disruption treatments on navel orangeworm (Lepidoptera: Pyralidae) sexual communication and damage in almonds and pistachios. *J Econ Entomol* 101:1633-1642.

Wilson H, Higbee BS, Beck JJ. 2018. Implementation and efficacy of mating disruption for control of *Amyelois transitella* (Lepidoptera: Pyralidae) in almonds. *Entomol. Exp. Appl.* In preparation