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N O T E

First Report of an Established Brown Marmorated Stink Bug (Hemiptera: Pentatomidae) Population in California Agricultural Crops[1]

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The brown marmorated stink bug, *Halyomorpha halys* (Stål), is an economically damaging, invasive insect pest native to East Asia. Since its accidental introduction in Allentown, PA, in the late 1990s, *H. halys* has spread to 43 U.S. states and has become a severe agricultural and nuisance problem in much of the country. A sudden occurrence of a high population in the Mid-Atlantic states in 2010 resulted in significant crop losses (~$37 million by the apple industry alone) in tree fruits and other crops (Leskey et al. 2012, Psyche: J. Entomol. doi:10.1155/2012/ 535062). *Halyomorpha halys* was first reported in California in 2002 (Lara et al. 2015, California Agric. 70: 15–23) but, until now, established populations have not been reported within agricultural fields.

Halyomorpha halys is a polyphagous insect with a wide host range (>179 plant species) that includes agricultural, ornamental, and landscape plants. Major reported host crops include apples, peaches, nectarines, pears, peppers, tomatoes, corn, beans, and soybean (www.stopbmsb.org, accessed: 10 May 2017). Because there has been limited exposure of *H. halys* to major nut crops, including almonds, walnuts, and pistachios, which are grown almost exclusively in California, its potential impact on these crops is unknown. Direct damage of *H. halys* to fruits is characterized by the presence of a depressed area, a discolored surface, and necrotic spots typically beneath the fruit surface (Acebes-Doria et al. 2016, Crop Prot. 89: 58–65; Joseph et al. 2015, J. Econ. Entomol. 108: 592–599). Feeding can cause significant damage on young and mature peaches by developing discolored necrotic areas inside the fruit (Joseph et al. 2015; Leskey et al. 2012), which results in unmarketable fruits for both fresh and canning purposes.

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A significantly large natural population of *H. halys* was discovered in the Midtown area of Sacramento, CA, in September 2013 and established *H. halys* populations have subsequently been reported in several urban locations in the city of Sacramento and other nearby areas (Ingels 2014, CAPCA Adviser 17(2): 42–44). To date, *H. halys* has been detected in 29 California counties, including Butte, Sutter, Yolo, Sacramento, San Joaquin, Santa Clara, Los Angeles, Siskiyou, and Stanislaus counties (Lara et al. 2016). In November 2016, *H. halys* was detected in the urban area of Merced (Merced Co.) based on the submission of a specimen by the public to the Agricultural Commissioner's Office (Sean Runyon, Merced Co. Ag. Comm. Office, pers. comm.). There are no reports of a consistent *H. halys* occurrence within the agricultural areas in California before the study reported herein.

In Stanislaus Co., a reproducing population of *H. halys* was detected in July 2015 in trees of heaven (*Ailanthus altissima* [Miller] Swingle) near the major north–south highway (U.S. 99) which passes through the city of Modesto (http://www.modbee.com/news/article30007908.html). Modesto is located ~120 km south of Sacramento, which has been the center of *H. halys* infestation in California since its detection in 2013. Following the first finding in Modesto, the local Agricultural Commissioner's Office and the University of California Cooperative Extension have received reports of finding *H. halys* in at least five locations in the Modesto metropolitan area. During late Fall 2015, a live *H. halys* adult was found near a house next to a peach orchard about ~12 km east of the first detection site. Given the indication of spreading *H. halys* in Modesto and nearby areas, and having commercial peach orchards as close as 3 km from the infested residential area, there have been concerns among peach and other fruit and nut tree growers of the threat of *H. halys* to commercial agriculture. Given that peach is one of its favorite hosts, *H. halys* potentially poses a serious threat to the cling peach industry if populations become established in the agricultural areas of California. Detection monitoring was conducted in several peach orchards in Stanislaus Co. in 2014 and 2015, but no *H. halys* was detected (Duncan 2015, Annu. Rep. California Cling Peach Board, 4 p.). In 2016, detection monitoring was conducted in nine peach orchards in Stanislaus and Merced counties using the standard black pyramid traps.

Black pyramid traps (~1.2 m tall, Dead-Inn Traps, AgBio Inc. Westminster, CO) baited with the Trécé lure (Trécé Inc, Adair, OK) consisting of *H. halys* aggregation pheromone combined with the methyl (E, E, Z)-2, 4, 6-decatrionate (MDT) were used for *H. halys* monitoring (Leskey et al. 2015, Environ. Entomol. 44: 746–756; Weber et al. 2014, J. Econ. Entomol. 107: 1061–1068). An insecticide strip, Vaportape II (Hercon Environmental, Emigsville, PA) was placed inside the container to prevent stink bugs from escaping. Lures were changed at 4-wk intervals, and the insecticide strips were changed biweekly. Initially, one pyramid trap was deployed in each of nine orchards located in Stanislaus ($n = 8$) and Merced ($n = 1$) counties. All the orchards surveyed were located within 15 km of U.S. Highway 99. Weekly monitoring was conducted beginning 25 April. Visual inspection of trees and beat tray sampling also were conducted. After catching one adult in July in one of the nine peach orchards surveyed, trap numbers at that site were increased to a total of eight (i.e., four traps baited with the Trécé lure; four traps baited with the Alpha Scents lure (Alpha Scents, Inc., West Linn, OR)). Traps

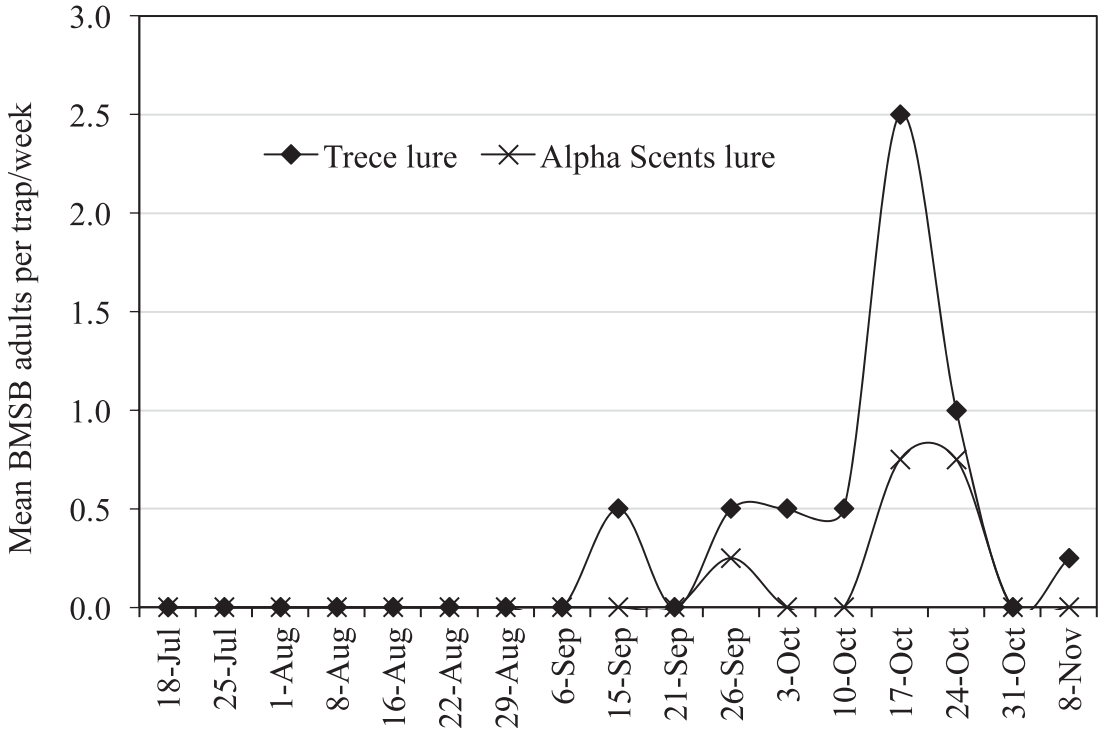

Fig. 1. Weekly *Halyomorpha halys* capture from a peach orchard in traps baited with Trécé and Alpha Scents lures, Modesto, Stanislaus Co., CA, 2016.

were placed along the edges of the peach orchard ~20 m apart. Also, two pyramid traps baited with a Trécé lure were deployed at the first *H. halys* detection site (i.e., an urban area dominated by trees of heaven) near midtown Modesto.

No *H. halys* were detected in eight of the nine peach orchards surveyed throughout the season (April–November) in 2016. One female adult was captured in a trap on 5 July, a site located ~12 km east of the first detection site in 2015 (Stanislaus Co.). Beginning mid-September, we started catching *H. halys* adults again on those pyramid traps. The highest mean capture was on 17 October, when 2.5 adults/trap/week were captured in traps baited with the Trécé lure, while 0.75 adults/trap/week were captured using the Alpha Scents lure (Fig. 1). The cumulative numbers of adults captured during the monitoring period (18 July–8 November) in four Trécé and four Alpha Scents lures were 23 and 7, respectively. To our knowledge, this is the first report of a consistent *H. halys* capture from any agricultural crops in California. No *H. halys* was recorded from any sites based on visual and beat tray samples. Other stink bugs (Hemiptera: Pentatomidae), including *Murgantia histrionica* (Hahn), *Thyanta custator* (Fabricius), and *Euschistus conspersus* Uhler, were occasionally captured in traps.

Two traps baited with the Trécé lure were deployed in September in the first detection site of Modesto where there was a group of trees of heaven. The average *H. halys* adult count was the highest (~170.5 adults/trap/week) on 22 September while nymph counts were at the peak (116.5 nymphs/trap/week) on 8 September

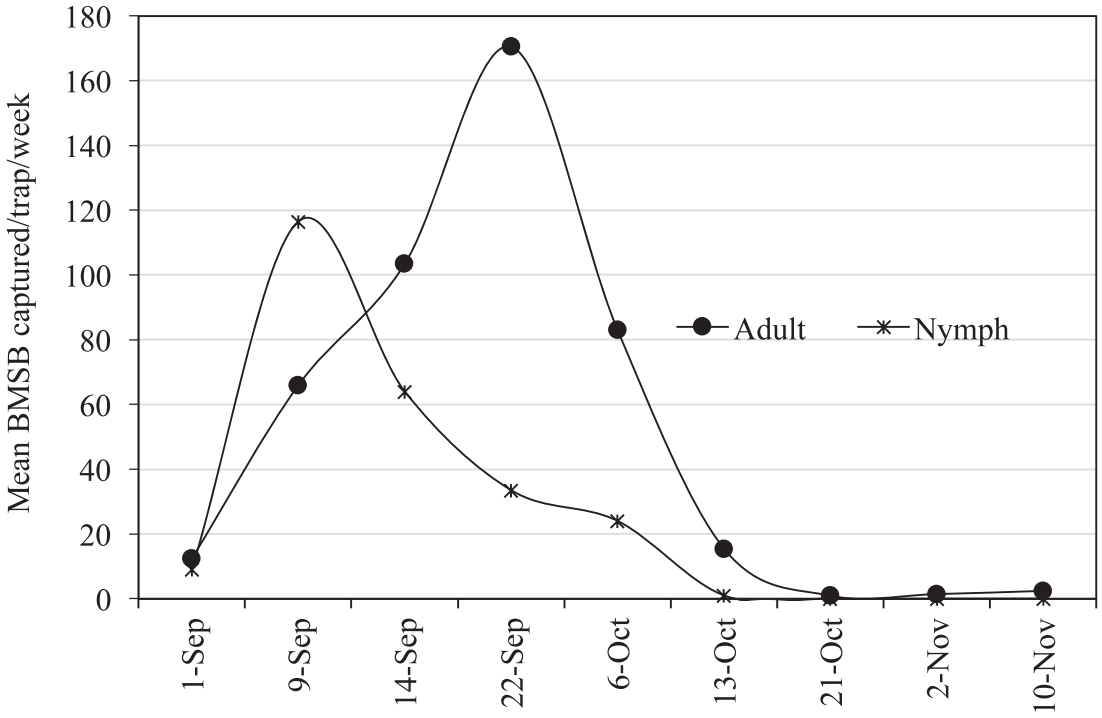

Fig. 2. Average *Halyomorpha halys* adults and nymphs captured in an urban site dominated by trees of heaven, Modesto, Stanislaus Co., CA, 2016.

(Fig. 2). This high number of counts supports our previous observation of an established *H. halys* population in the Modesto area.

Based on direct contact with growers, the specimen submitted to the Stanislaus Co. Ag Commissioner's Office, and University of California Cooperative Extension, there is evidence of *H. halys* moving into houses in city areas, particularly houses near city parks. Also, residents in the area where *H. halys* was found in peaches reported infestations in their homes during late fall through winter.

This study clearly indicates that a *H. halys* population has been established in and/or nearby peach orchards in Stanislaus Co., and this is the first report of a consistent finding of *H. halys* in any agricultural area in California in *H. halys* traps. Since peach is considered as a high-risk crop for *H. halys* attack, it is critical that growers and Pest Control Advisors (PCAs) remain attentive when monitoring peach orchards. Regular visual observations and placement of a few *H. halys* pheromone traps in border rows of peach orchards will help to detect a significant infestation. Although *H. halys* traps are not as good as other pheromone-based traps in attracting *H. halys* from a long distance, it has been successfully used to detect the *H. halys* infestation within a local orchard. In order to increase assurance of discovering *H. halys* presence before it has increased to large numbers, a detection survey will be continued in peach and other tree fruit and nut orchards in the Northern San Joaquin Valley region. Understanding the phenology of *H. halys* in the Northern San Joaquin Valley is critical to determine the number of generations and to implement control tactics. Based on the 3-yr monitoring data in the Sacramento urban area, there seem to be two generations per year (Ingels et al. 2014, Ann. Rep. Pear Advisory Board, 9 p). However, the weather and host crop composition in

agricultural areas within the Northern San Joaquin Valley differ from the Sacramento area. Therefore, future study is needed to determine *H. halys* phenology in the Modesto area. Given that peach is one of the preferred hosts of *H. halys*, it is critical to continue monitoring for insects and fruit damage. Beginning from mid-March 2017, *H. halys* has been captured in traps placed within border rows of peaches, almonds, and walnuts (J.P.R. unpubl. data). Most peach orchards in the Northern San Joaquin Valley are either adjacent to or within close proximity to high-value nut crops including almonds and walnuts. The risk of economic losses due to *H. halys* feeding injury in these nut crops is unknown and needs to be examined.

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