Workgroup/Department: Plant Sciences
UNIVERSITY OF CALIFORNIA
DIVISION OF AGRICULTURAL SCIENCES
RESEARCH REPORT

Project Year: 2018-19 **Anticipated Duration of Project**: 1 year

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Location: UCCE Stanislaus, 3800 Cornucopia Way, Ste. A, Modesto, CA 95358
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Project Title: Monitoring of Brown Marmorated Stink Bug (BMSB) in the Northern San Joaquin Valley Peach Orchards

Background:

The brown marmorated stink bug (*Halyomorpha halys*) (BMSB) originated in East Asia and was first identified in the US in Pennsylvania in 2001 and has now spread to over 40 states (www.stopbmsb.org). In 2010, BMSB caused about $37 million in damage to fruit crops. BMSB has a host range of over 170 species, including virtually all fruit crops and vegetables with fruiting structures. Peach is one of the preferred hosts of BMSB and rated as a high-risk crop (http://www.stopbmsb.org/where-is-bmsb/crops-at-risk/). Adult and all nymphal stages can damage fruits. Physical damage to fruits includes surface deformation/depression, pitting, and scarring, sometimes leading to a mealy texture in the fruit. BMSB feeding injury on young and mature peach fruit can develop discolored necrotic areas inside the fruit (Leskey et al. 2012b), and it makes the fruit unmarketable as a fresh or canned product. BMSB usually produces one or two generations per year in cooler climates and up to five generations in warmer climates (Nielsen and Hamilton, 2009; Lee et al., 2013).

In California, a large BMSB population was discovered in Midtown Sacramento in early Sept. 2013, and subsequent studies showed that they now infest downtown, midtown, and other several locations in Sacramento County (Ingels and Daane 2017). Established populations have now been documented in Siskiyou, Butte, Glen, Sutter, Nevada, Yolo, Napa, Solano, Sacramento, San Joaquin, Stanislaus, Merced, Fresno, Santa Clara, Los Angeles, and Orange counties (https://cisr.ucr.edu/images/cisr_bmsb_distribution_large.jpg), but major population reported from residential areas. In Stanislaus for the first time, we (Jhalendra Rijal and Roger Duncan) have detected a reproducing population of BMSB (i.e., several batches of egg mass, different stages of immature, and adult) in a group of Trees of Heaven (i.e., *Ailanthus* sp), one of the favorite BMSB hosts, near Highway-99 in Modesto in July 2015 (http://www.modbee.com/news/article30007908.html). In November 2016, BMSB was detected in an urban area in Merced, Merced County (Personal communication, Merced County Ag. Commissioner Office). In 2016, the BMSB population was found in a peach orchard in Stanislaus county-the first report of finding an established population in crops in California (Rijal and Duncan 2018). In almonds, the BMSB population was first reported in infesting almonds in 2017 in Stanislaus County (Rijal and Gyawaly 2018). Since then, BMSB finds have been reported from several peach and almond orchards in Stanislaus and Merced counties. In 2018-2019, there has been a substantial crop loss in a limited number of

almond orchards in the northern San Joaquin Valley due to BMSB infestation (JPR, personal observation).

Summary of BMSB monitoring from 2018 season

In 2018 season BMSB monitoring, BMSB adults were captured from all seven sites surveyed using traps. That is a clear indication of the increased spread of BMSB in the area in agricultural areas in the northern San Joaquin Valley, particularly in Stanislaus and Merced counties. Some of these peach and almond orchards start showing injuries to the fruits, in some cases, substantial damage.

In 2018, we also evaluated mid and late season peach fruit damage by BMSB in two of the seven commercial orchards that we used for BMSB trapping. Internal injuries to the fruit include the presence of any corky tissue, necrotic lesions, and presence of the disintegrated white tissue, etc. The internal damage does not include the presence of stink bug feeding sign "pinholes." In the first site, the mean percentages of internal injury were 11.25% in orchard edge and 2.05% in interior rows during the mid-season evaluation, while 13.33% in orchard edge and 4.17% in interior rows during the late-season evaluation. In the second site, mean internal injuries to the fruit by stink bugs were 4.17% in edges and 2.50 in interior rows during the mid-season evaluation, while 6.67% in edges and 6.84% in the interior during the late-season evaluations. These are the first evidence of BMSB causing damage to peach fruits in commercial orchards in California.

Although BMSB were captured from all seven peach orchards monitored in 2018, which in itself is a new piece of information, the overall stink bug population was relatively low across the orchards monitored. We observed more stink bug damage on the fruits collected from the orchard edge compared to the interior of the orchard, which shows that BMSB is a border-driven pest and trapping on those potentially risky areas provides valuable information for the detection and control measures. There is also a potential for conducting attract-and-kill strategy as these studies are ongoing in other parts of the Country in monitoring and managing BMSB. Future research will focus on continuing the detection monitoring in peach orchards, optimizing trap types, temporal fruit damage evaluation, and exploring control options including Attract-and-kill strategy targeting BMSB in peach orchards.

Objectives for 2018-19 season

1. Conduct BMSB detection surveys and monitoring in peach orchards in the northern San Joaquin Valley
2. Conduct temporal fruit damage evaluation using exclusion cage studies
3. Disseminate the results to the growers and pest control advisers.

Plans and Procedures

BMSB monitoring. Two types of traps (pyramid and sticky panel) were used to monitor BMSB activities in selected peach orchards. Both types of traps were baited with the commercial BMSB lure (BMSB aggregation pheromone-murgantiol + pheromone synergist-methyldecatrionate; Trece Inc, Adair, OK). The pyramid trap (Fig. 1) has been the standard BMSB trap, but this trap is expensive and cumbersome for field use. Therefore, along with

other researchers working on BMSB from other parts of the country, we tested the new type of trap 'sticky panel trap' (Fig. 2) in both the 2017 and 2018 seasons in several peach orchards in the northern San Joaquin Valley. Six or eight traps (4 of each trap type in 2017, and 3 of each type in 2018) were placed in total ten peach orchards (7 in 2018, 3 in 2017) along the edge of the orchard. In 2019, six traps (3 of each trap type) were placed in seven peach orchards. Traps were installed along the border row in the orchard with alternating trap types and were separated by at least the 50 ft. distance. Traps were placed around mid-March through early November. Traps were checked and serviced as-needed basis and lures were changed at a 6-wk interval in 2017 and 12-wk interval in 2018. In the pyramid trap, an insecticide-laced strip (Hercon® Vaportape II), was placed inside the container along with the lure to prevent escaping of trapped stink bugs, and those strips were changed at a 2-wk interval. In 2019, the insecticide-laced strip (Hercon® Vaportape II) was changed to a small piece of D-Terrence® insecticide screen-net and changed at a monthly interval.

Results and Discussion

Sticky panel vs. pyramid trap capture. Combined 2017 and 2018 data showed that sticky panel traps caught significantly more adults compared to the pyramid trap. Across all the orchard sites, the population remains low. Even under low pressure, sticky panel traps performed statistically better than the pyramid trap ($t = 1.84$, $df = 18$, $P=0.040$) (Rijal 2018; Fig. 3). This might be due to the difference in the overall dispersal of the pheromone in two trap types. In the pyramid trap, the lure was placed inside the container while it was hanged on the top of the 4-ft. tall wooden stake on which the sticky panel was stapled.

Seasonal captures from year-2019 continue to show that adults were captured in larger amounts on sticky panels (Fig. 4). Also, nymphs were captured in both sticky and pyramid traps (Fig 5), but the result is inconclusive on which trap is better due to a very low nymphal capture rate across the sites. Overall, both of these two trap types are effective in trapping adults and nymph stages.

Seasonal BMSB capture of adults in 2019. Accumulated seasonal captures of BMSB adults varied from orchard to orchard, as shown in Figs. 6-10. Although BMSB populations remain active throughout the season, adult BMSB captures were different in different times of the season. For example, BMSB activity was high at the beginning of the season (April) and continued through mid-May and even until mid-June for some orchards. The early season capture, is to be due to the overwintering adults that start coming out to the orchards once the fruit set happens. There was another peak adult activity that occurred during July in a majority of the orchards but was not prominent in some orchards. This might be due to the insecticide use in commercial orchards targeting other stink bugs, and Lepidoptera pests such as Oriental fruit moth, peach twig borer might have also impacted the BMSB population especially when the overall BMSB pressure in commercial orchards is very low. Also, consistently high temperatures spanning multiple days during the mid-summer might have impacted the BMSB population. It could simply be the function of the low BMSB population in the orchard in general. The third peak of BMSB adult activity was observed during the late Fall around late September through October (Fig. 6-10).

Seasonal BMSB capture of nymphs in 2019. BMSB nymph activity remained the same throughout the different orchards (Fig. 11-14). Nymphs were captured starting early July to early August and even in mid-late September in one orchard (Fig. 11). BMSB nymph populations were captured from four sites out of the seven that we placed traps in 2019.

Extension Activities. The results of the BMSB study have been used to educate residents, growers, and other pest control professionals using several extension meetings (IPM breakfast and other extension meetings (>15 BMSB talks in 2018-19) including annual cling peach day meeting), newsletters and peer-reviewed publications, blogs (IPMCorner.com). The research results have been presented in several professional meetings as well.

Conclusions and Future Direction

Our study in peaches also in almonds clearly showed that the BMSB population has established in agricultural areas in the northern San Joaquin Valley, particularly in Stanislaus and Merced counties. Based on the BMSB trapping study of the last three years (2017-2019), it is clear that BMSB spread to agricultural areas has been expanding slowly but steadily (Fig. 15). Some of the almond orchards had a heavy BMSB pressure with substantial fruit damage.

Another significant finding from the past few years' works was the recommendation of an efficient and user-friendly trap type for BMSB monitoring. We found that sticky panel traps are more effective and reliable in trapping BMSB adults even under low population situations. Although the pyramid trap has a better capture rate for nymphs, for the population detection point of view, adult captures in sticky panel traps provided a sufficient indication of BMSB infestation in the area. Given that the sticky panel traps are effective but far cheaper and easier to use, we recommend using sticky panel traps for BMSB adult monitoring in peach and other fruit and nut crop orchards.

In addition, we observed more stink bug activity and damage on peach and almond orchards in edges, specially the ones with BMSB overwintering shelters in proximity. This is another important consideration to follow-putting traps in border rows for monitoring and/or focusing on field edges for visual sampling as edges are more prone to BMSB attack. At this point, we encourage growers and pest control advisers (PCAs) to pay close attention when monitoring fruit orchards for BMSB presence and potential damage. Early monitoring is very important, especially if the orchard is near to the areas with known infestations and areas with known tree hosts such as the tree of heaven. Visual observations of insects (egg masses, nymphs, adults) and damaged fruit (deformed fruits, fruits exuding gum) and beat tray sampling (shaking branches/twigs to dislodge insects) are early BMSB detection methods. Also, placement of a few BMSB pheromone traps in the border rows of the orchard beginning from March is recommended to detect BMSB activity and infestation. Future research will focus on continuing the detection monitoring in peach orchards, optimizing trap types, and exploring control options including attract-and-kill strategy targeting BMSB in peach orchards. In 2019, we were not able to complete Objective 2 due to the poor fruit setting in the research peach plot at UCCE-Stanislaus. We will complete this objective in 2020.

Figures

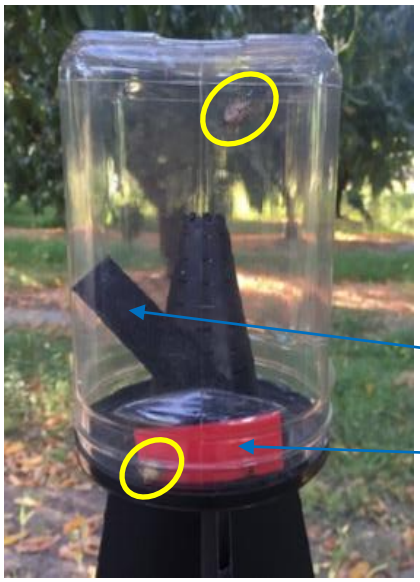

Fig. 1. Black pyramid trap used in BMSB monitoring.

Fig. 2. Clear ‘sticky panel’ trap used in BMSB monitoring.

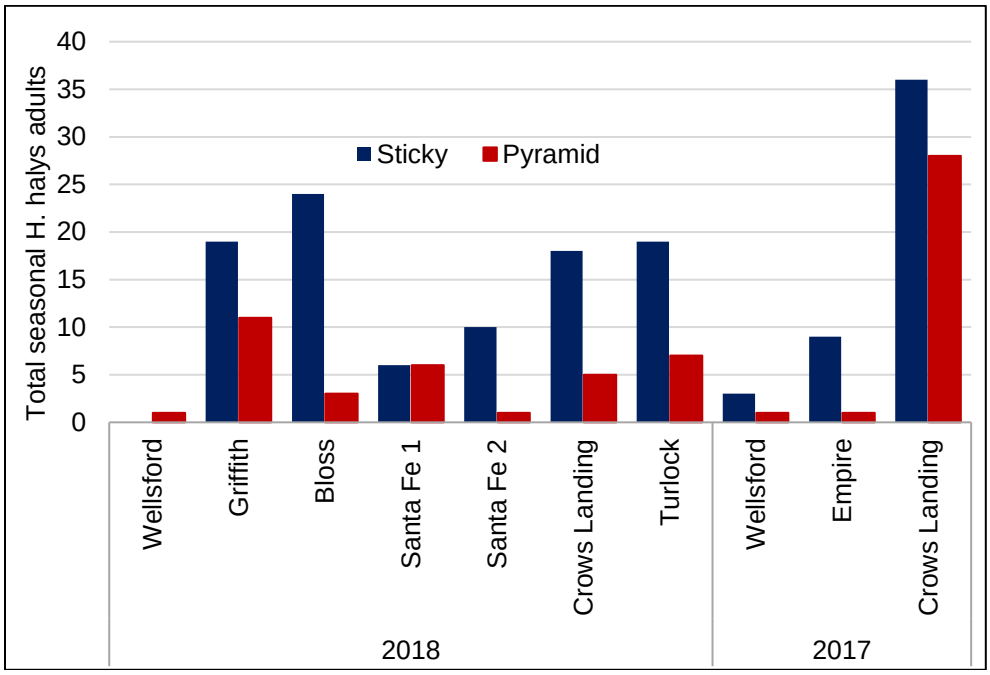

Fig. 3. Seasonal total BMSB captures in two types of traps in peach orchards, 2017-2018

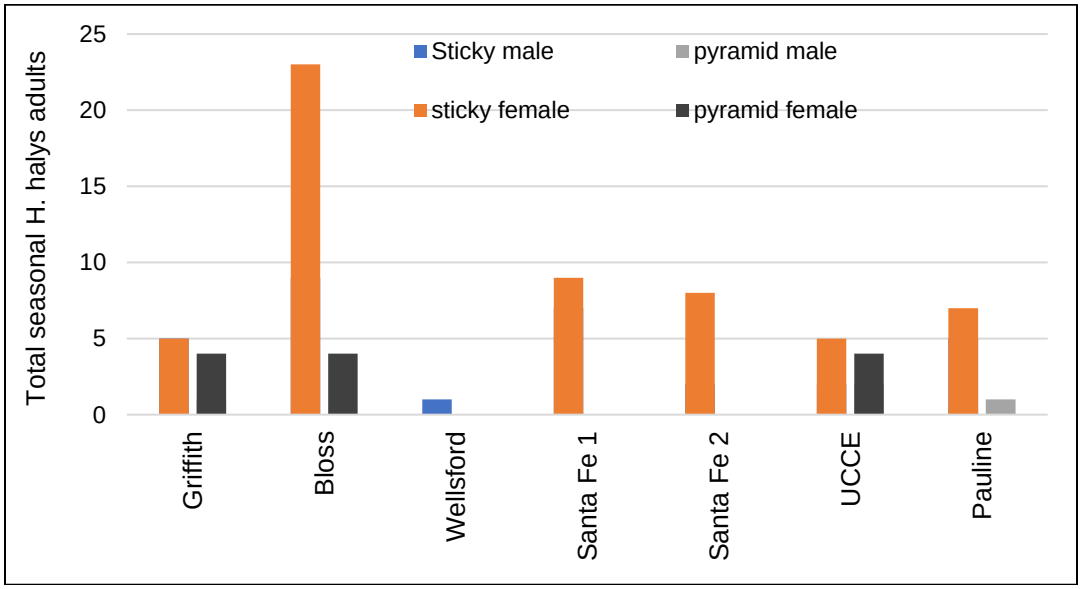

Fig. 4. Seasonal total BMSB adults captured in two types of traps across seven peach orchard sites, 20

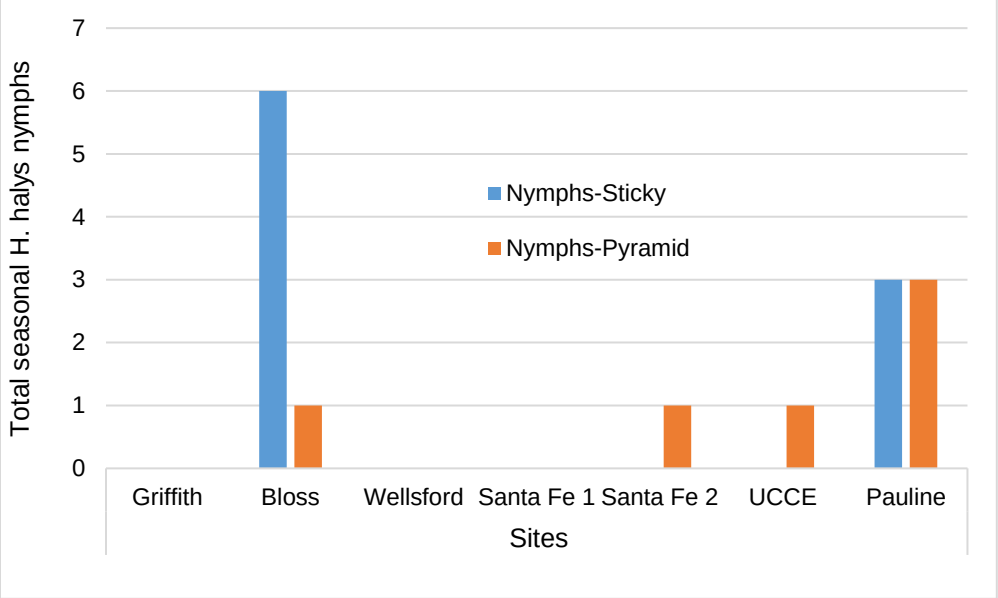

Fig. 5. Seasonal total BMSB nymphs captured in two types of traps across seven peach orchard sites, 2019

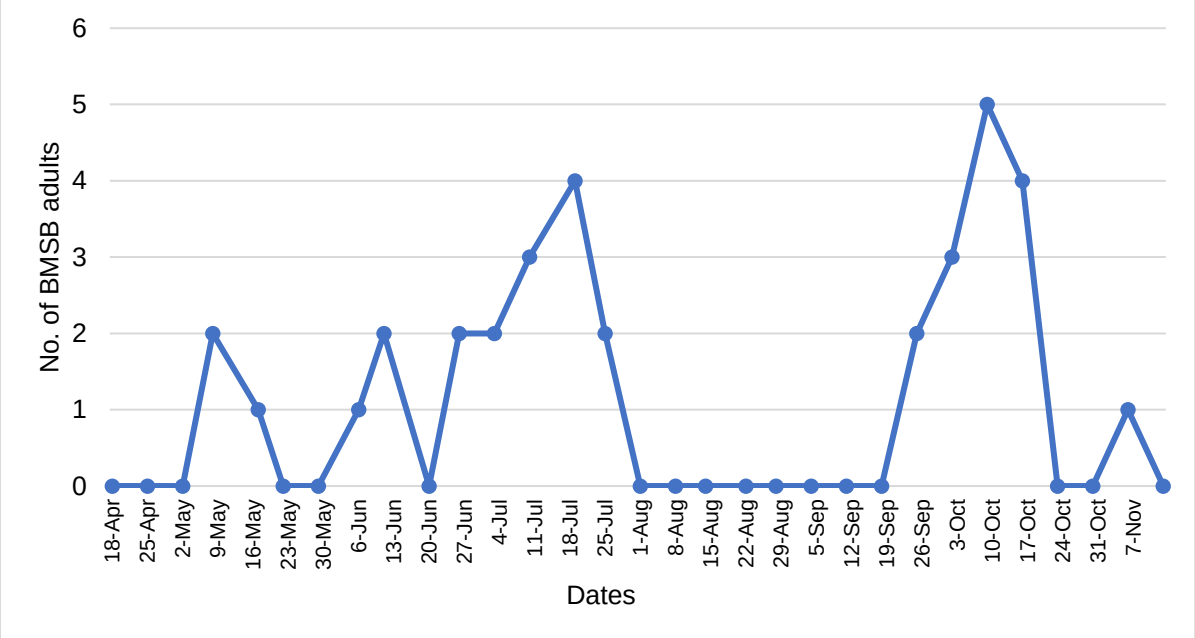

Fig. 6. Accumulated seasonal BMSB adult activity in traps-Bloss site, 2019

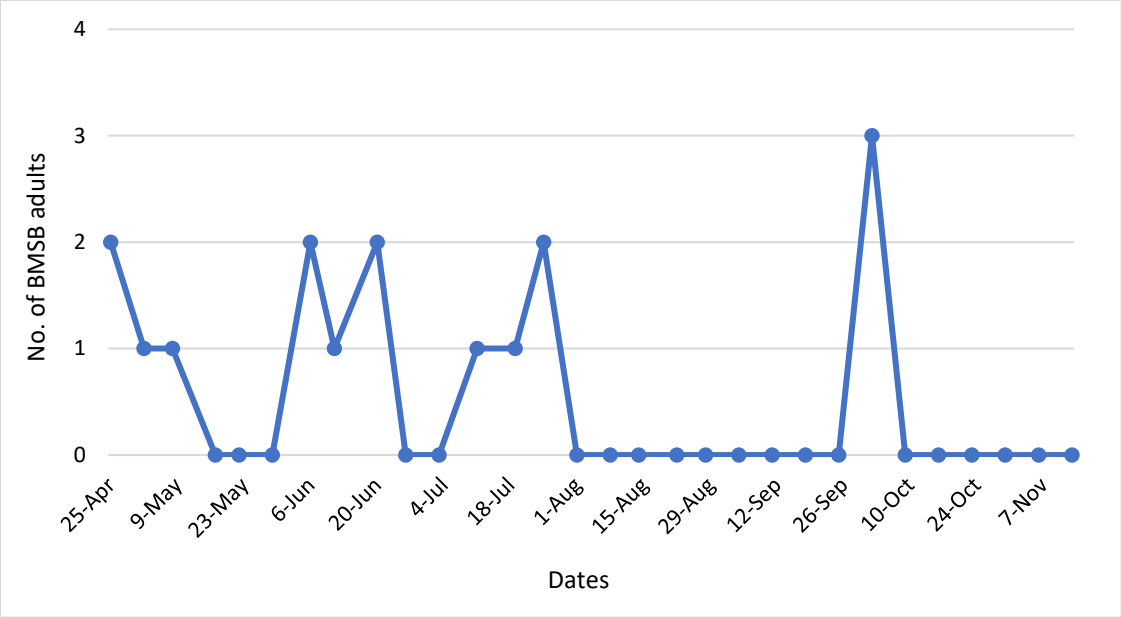

Fig. 7. Accumulated seasonal BMSB adult activity in traps-Santa Fe 1 site, 2019

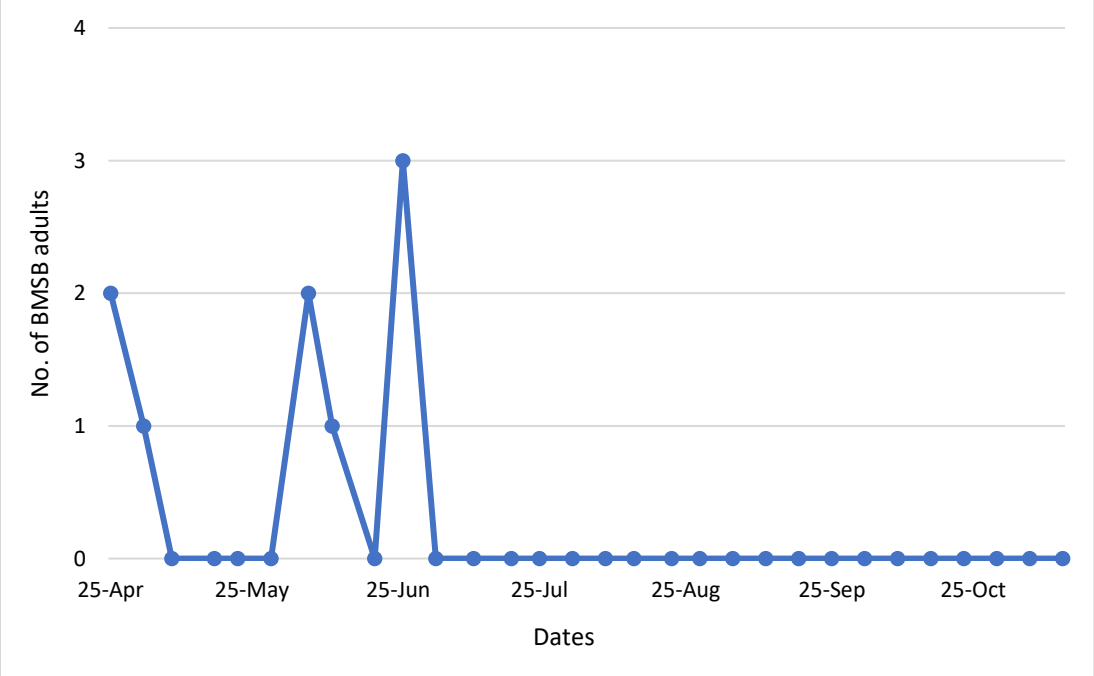

Fig. 8. Accumulated seasonal BMSB adult activity in traps-Santa Fe 2 site, 2019

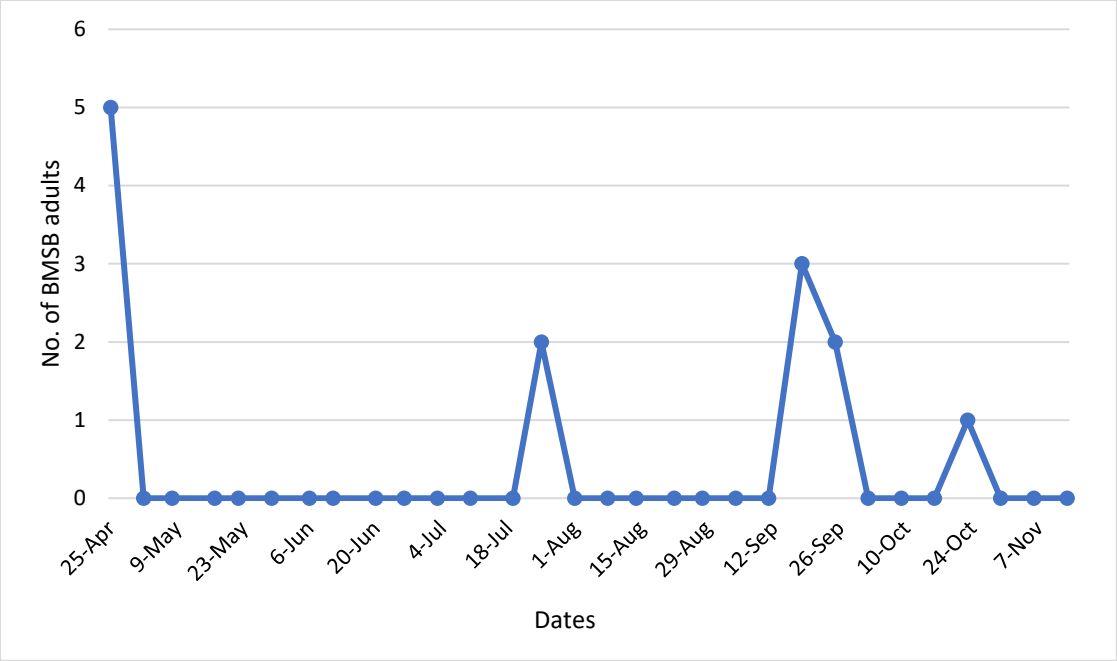

Fig. 9. Accumulated seasonal BMSB adult activity in traps-UCCE site, 2019

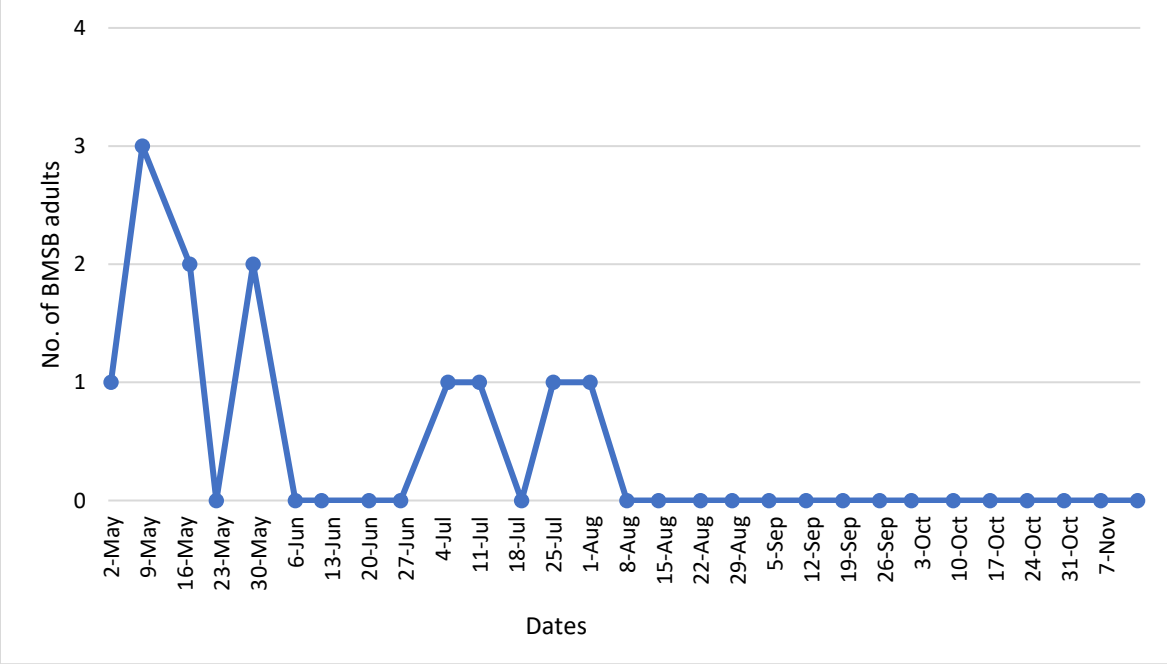

Fig. 10. Accumulated seasonal BMSB adult activity in traps-Pauline site, 2019

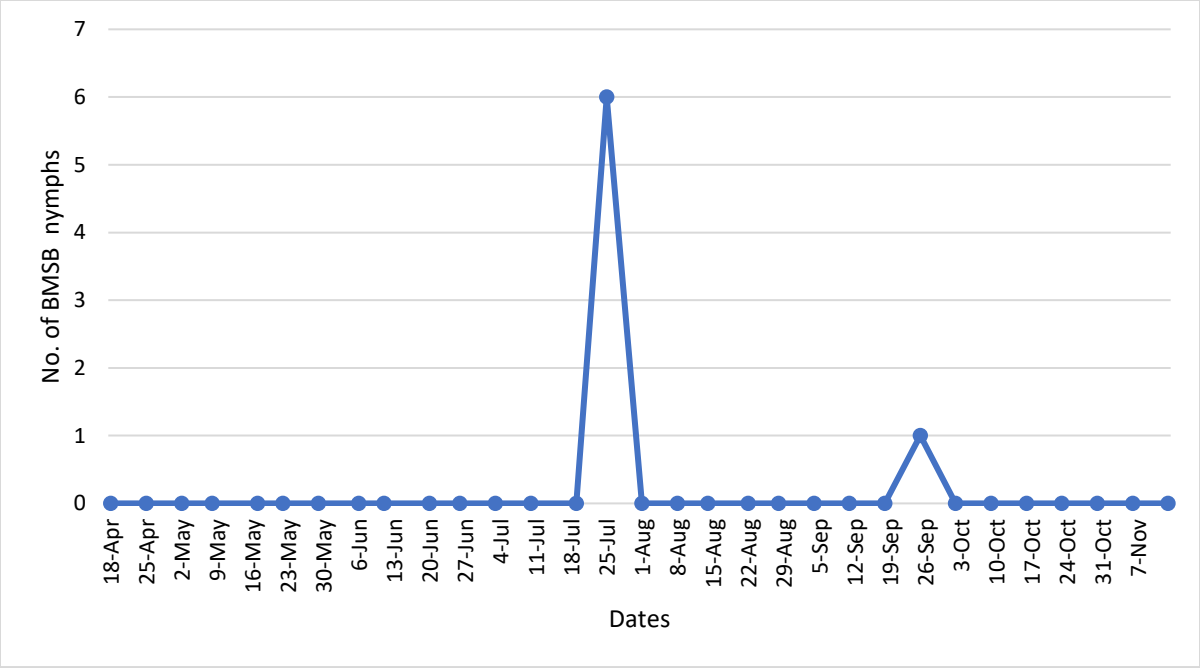

Fig. 11. Accumulated seasonal BMSB nymphal activity in traps-Bloss site, 2019

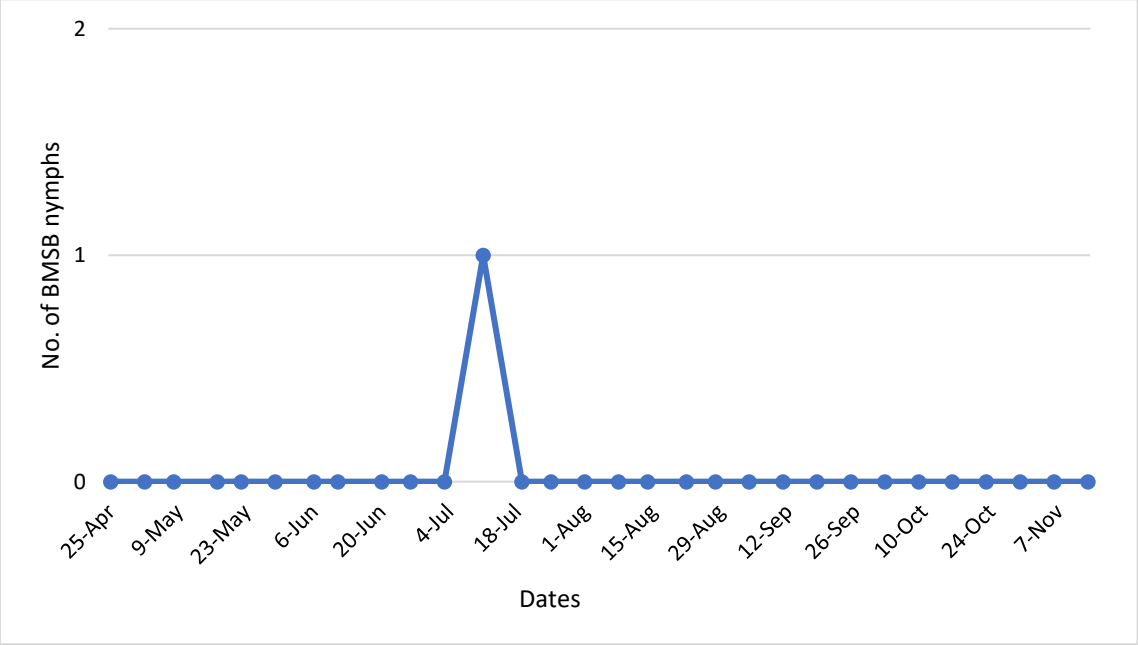

Fig. 12. Accumulated seasonal BMSB nymphal activity in traps-Santa Fe site, 2019

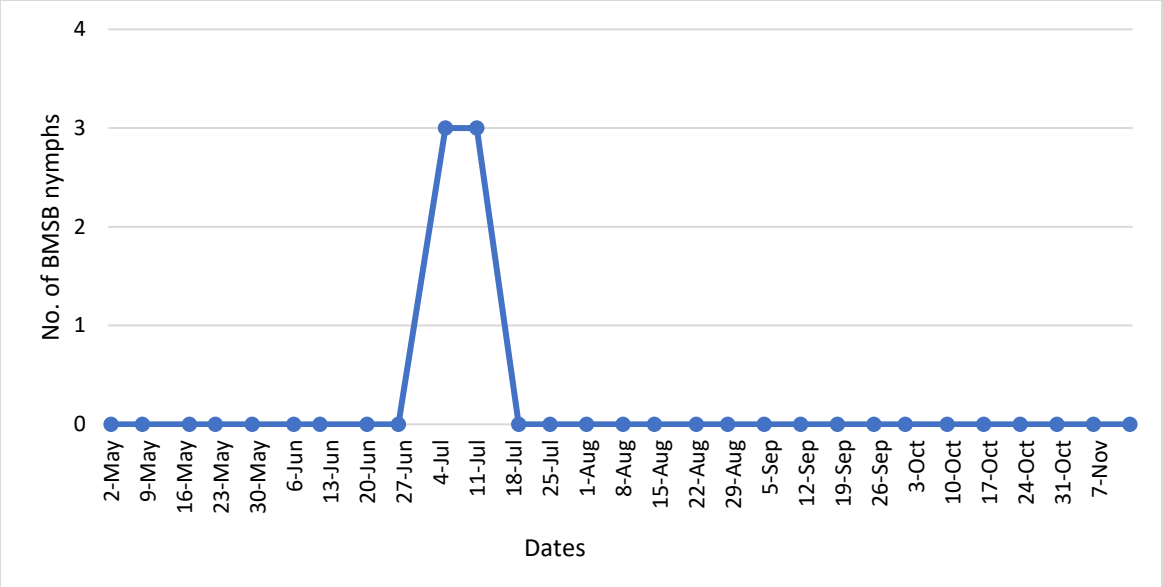

Fig. 13. Accumulated seasonal BMSB nymphal activity in traps-Pauline site, 2019

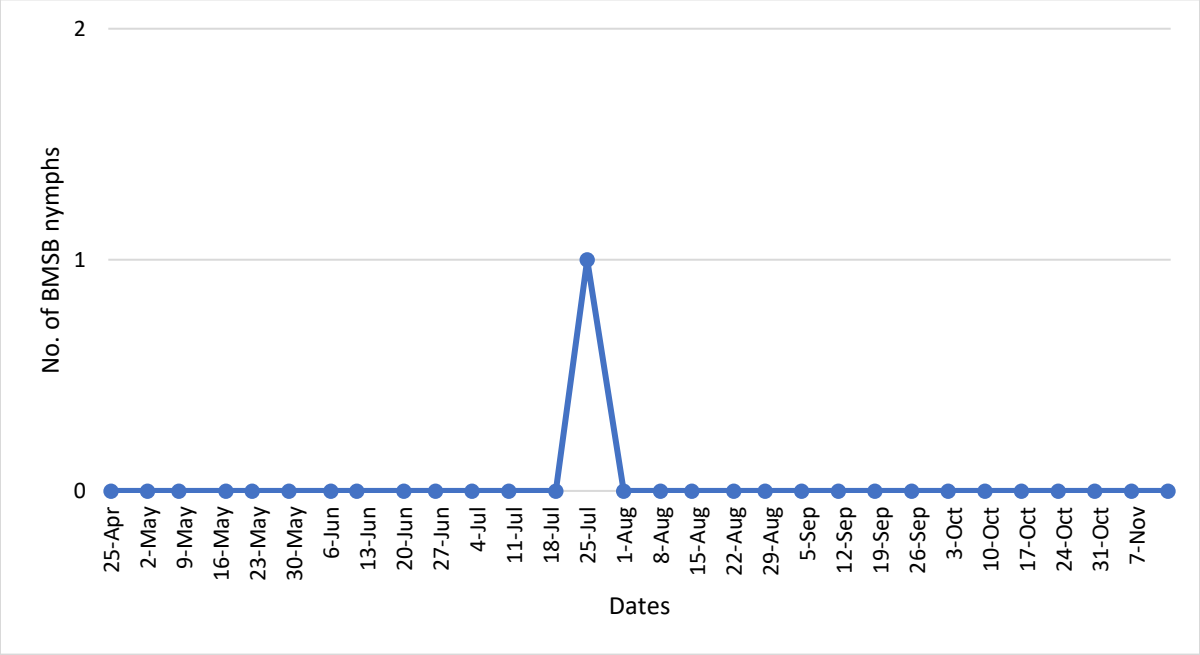

Fig. 14. Accumulated seasonal BMSB nymphal activity in traps-UCCE site, 2019

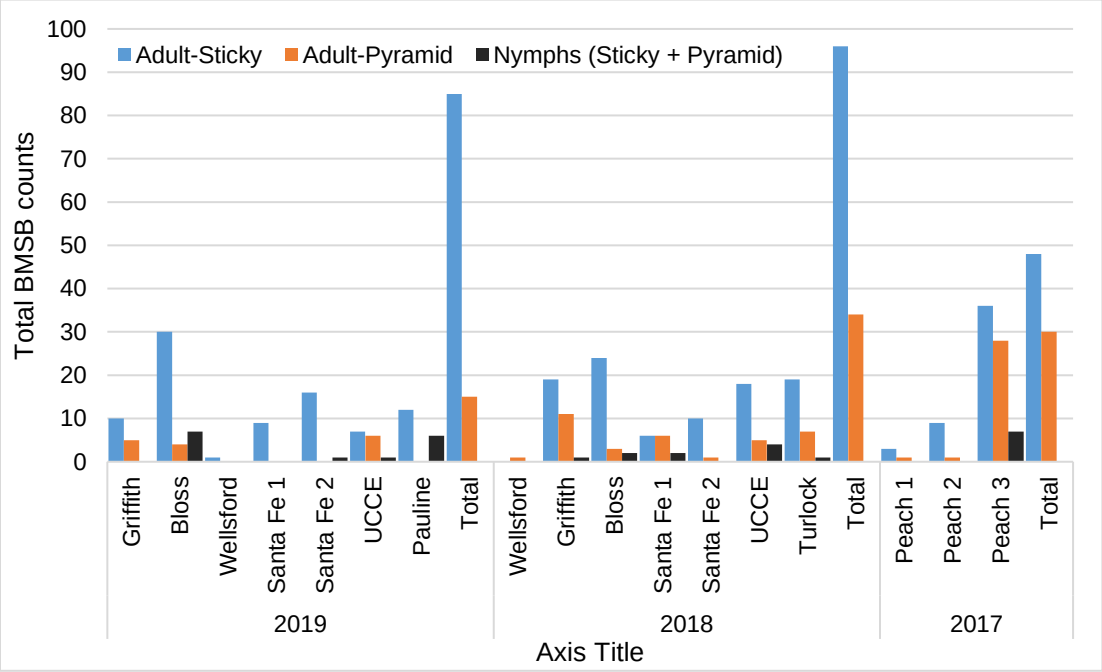

Fig. 15. Total BMSB adults and nymphs captured in several peach orchards in 2017, 2018, and 2019.

Relevant References

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