

Use Of Pheromone Baited Netting As An Attract And Kill Substrate For Brown Marmorated Stink Bug *Halyomorpha halys*.

P. Jentsch & T. Lampasona, Cornell University, HVRL, Highland, NY 12528

Abstract: The invasive Brown Marmorated Stink Bug *Halyomorpha halys* (BMSB) is a newly invasive insect pest of agriculture and urban environs. Management of this pest has required frequent and long residual insecticides for effective control. This 1st-year study demonstrates the efficacy of combining commercial synthetic pheromone bait with commercially available insecticide embedded netting in a comparison trial with hand applied insecticide to insect exclusion netting, employed as attract and kill stations for BMSB management near manmade structures to reduce home infestations. In three rural home sites bordering commercial farms, comparative trials demonstrated in late season capture of BMSB, efficacy of insecticide embedded net resulting in \approx 68% of Adult BMSB and 70% nymph captures compared to 32% adult and 30% nymph captures observed in hand applied insecticide to insect exclusion netting. Record low populations from field monitoring stations over the past three years were observed in 2016, resulting in no infestation in homes of all three sites.

Introduction: The newly invasive Brown Marmorated Stink Bug (BMSB) is both an urban and agricultural insect pest. As arboreal insects, the BMSB adult migrates to and from forest and urban structures, inhabiting urban, suburban and rural homes throughout the United States where the insect has established. Synthetic pheromone aggregation lures employ dual components of (3S,6S,7R,10S)-10,11-epoxy-1-bisabolen-3-ol (3) and(3R,6S,7R,10S)-10,11-epoxy-1-bisabolen-3-ol, with methyl (E,E,Z)-2-4-6-decatrienoate, which attracted female, male, and nymphal *H. halys* in agricultural monitoring programs. The use of lures and insecticide treated

netting that employs the pyrethroid Bifenthrin provides an aggregation substrate to attract and kill BMSB of all life stages have been used in agricultural management programs to monitor population density while reducing populations resulting in reduced insecticide use and minimizing injury to crops.

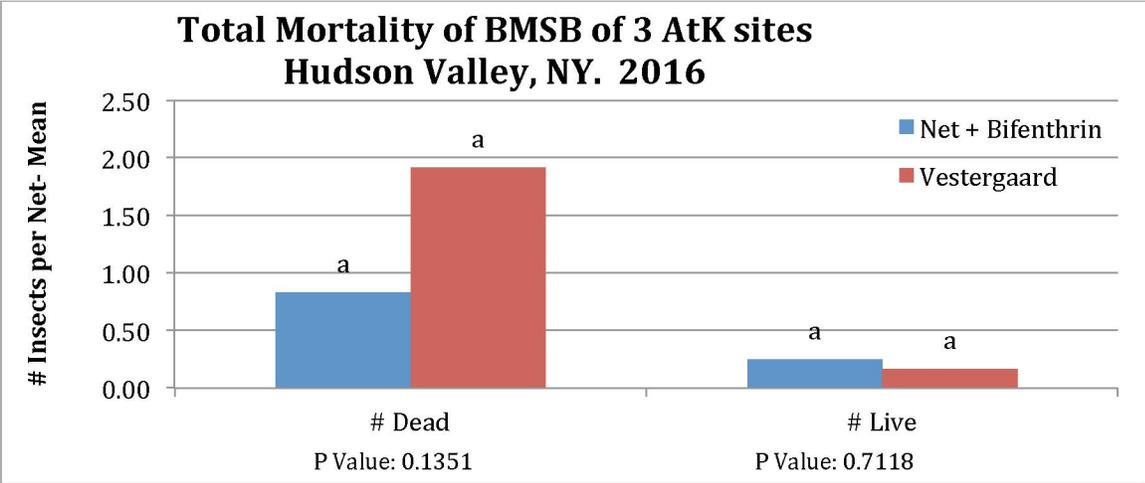
In the urban setting, insecticide sprays for controlling BMSB are often inadequate owing to a long migration period and limited residual of commercially available insecticides for structural application, while having potentially harmful effects to homeowners and pets. As Attract and Kill systems (AtK) have demonstrated the use of pheromones paired with insecticide-treated netting to effectively lure and kill both adult and nymph BMSB during movement to host crops, employing AtK systems in the urban environment BMSB could also be used to intercept as they travel from forest to homes in late summer and fall. The application of this type of AtK system would reduce the need to spray dwellings and structures where BMSB overwinter.

Materials and Methods: In this 2016 study, we compared three home sites in Ulster and Orange Counties where BMSB populations were present in agricultural crops. Nets were cut to size, 3” x 6”, and hung vertically, labeled as “Pennings 1,” “Pennings 2,” and “Hepworth”. We included one orchard site (“Campbell Hall”) to assess the difference in population density over the past three years. We assessed the efficacy of Vestergaard “ZeroFly,” polyethylene netting embedded with 0.4% Deltamethrin, compared to the hand applied insecticide Bifenture EC (bifenthrin) treated net, applied weekly employing a labeled dilute rate of 0.125 fl.oz./ gallon. Each site held one set of one Vestergaard and one Bifenthrin treated exclusion net treatment that received bi-weekly lure changes and weekly counts of BMSB, assessing life stage, adult sex, living or dead upon capture on each net at each site. Nets were fixed to a high tensile wire using heavy

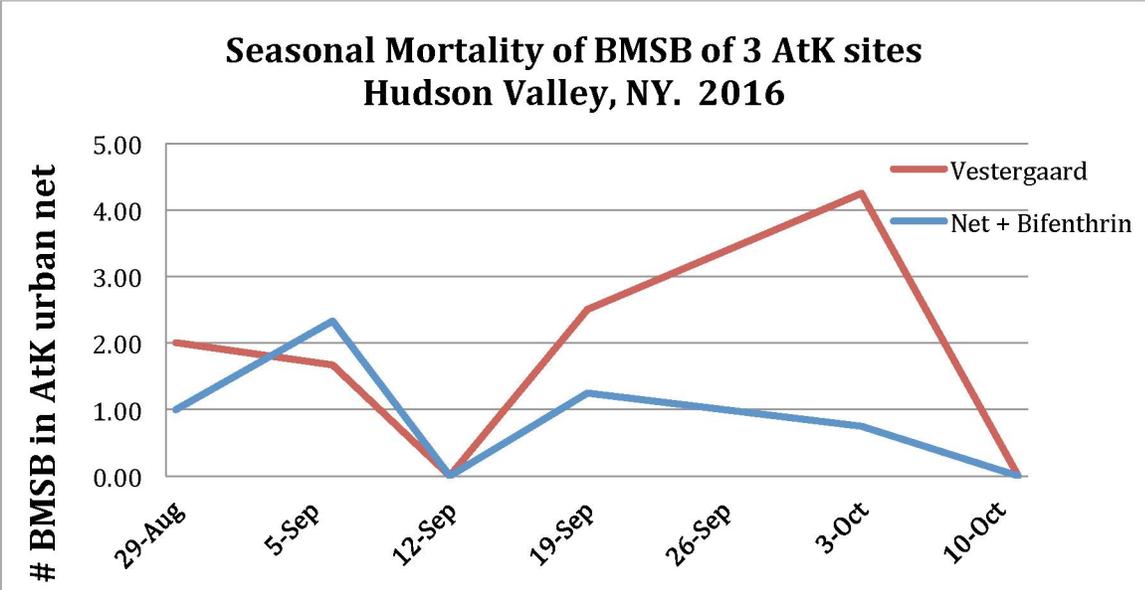
duty binder clips with the base draped and secured using landscape cloth staples to collect fallen insects, allowing nymphs to climb the net, hung 1 meter apart.

Results: Netting sprayed weekly with Bifenthrin collected 56.8% fewer BMSB over the season than the Vestergaard embedded net (*Graph. 1*). In comparison to the previous seasons, BMSB populations were 100 fold lower, resulting in no observed urban infestations in the three home sites used in the study (*Graph 3.*). Data analyzed using Fisher's protected LSD, with a significance factor of 0.05. Record low populations from field monitoring stations over the past three years were observed in 2016, resulting in no infestation in homes of all three sites.

Discussion: As the Vestegaard netting proved to be more effective at capturing BMSB, less costly in time and effort, low applicator risk of pesticide exposure while providing a more environmental friendly presence, it appears to have greater potential for use in attract and kill systems. Field applied pyrethroids generally have a degree of repellency, with weekly applications of Bifenthrin possibly contributing to the repellency of BMSB, likely causing lower number of BMSB compared to the Deltamethrin embedded Vestegaard net having no detectable odor (by human standards). The home sites all had introduced populations of *Ailanthus altissima*, Tree of Heaven, an Asian invasive plant and favored host of BMSB. Numbers of tree ranged from 8 to 49 within a 500 yard radius of home sites, contributing to large home infestations in recent years. Low temperature on February 14th of 2016 followed by temperature swings on April 4th – 5th may have adversely impacted BMSB populations in 2016. In Marlboro (Hepworth site) the Asian parasitoid wasp *Trissolcus japonicus* had been detected in a late summer sentinel egg study conducted by our lab. The presence of the wasp may have also contributed to the regional decline of BMSB or locally at the Marlboro (Hepworth) site.

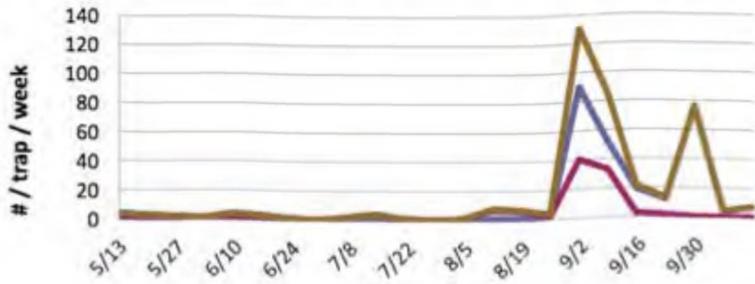


Graph 1. Three site urban study

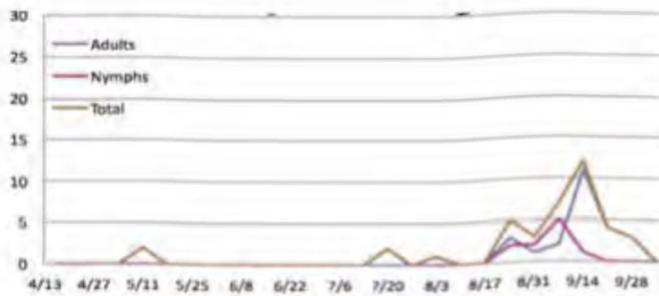


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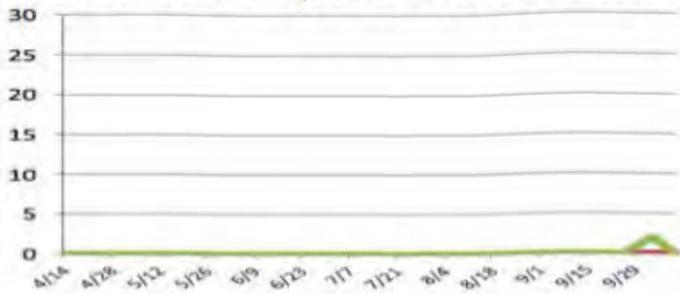
BMSB - Campbell Hall, NY 2014



BMSB - Campbell Hall, NY 2015



BMSB - Campbell Hall, NY 2016



Graph 3. Historical BMSB populations 2014-2016

References:

Ashot Khimian*†, Aijun Zhang†, Donald C. Weber†, Hsiao-Yung Ho‡, Jeffrey R. Aldrich†, Karl E. Vermillion⊥, Maxime A. Siegler||, Shyam Shirali†, Filadelfo Guzman†, and Tracy C. Leskey. Discovery of the Aggregation Pheromone of the Brown Marmorated Stink Bug (*Halyomorpha halys*) through the Creation of Stereoisomeric Libraries of 1-Bisabolen-3-ols. *J. Nat. Prod.*, 2014, 77 (7), pp 1708-1717. June 25, 2014
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