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Evaluation of an attract-and-kill strategy for the management of the brown marmorated stink bug in Northern Italy

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Extended abstract: Attract-and-kill (AK) strategies rely on the combination of an attractant and an insecticide or a killing method to suppress pest insects. In comparison with full block sprays with broad-spectrum insecticides, AK minimize the contact between pesticides and crops resulting in many benefits from the standpoints of safety for farmers and consumers, reduction of residues on agricultural products and overall impact on the environment (Gregg et al., 2018).

The brown marmorated stink bug (BSMB), *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae), is an insect pest native to Asia. It is extremely invasive and polyphagous, and has become very common in the USA and Sothern Europe. In most countries where it has been accidentally introduced, BMSB is now a major threat to agriculture causing severe economic losses especially in tree fruit crops. Current management strategies, which mostly rely on neurotoxic broad-spectrum insecticides, are neither fully effective nor environmentally sustainable (Leskey and Nielsen, 2018).

The implementation of AK techniques for BMSB management has been investigated in the USA resulting in acceptable reduction of crop damage, although economic issues were pointed out (Morrison III et al., 2019). Because of the severe impact of BMSB on orchards in Northern Italy (Francati et al., 2021), in 2021 the effectiveness of AK techniques against BMSB was evaluated in intensive fruticulture areas of Emilia-Romagna region. A wide area approach was used to tackle the dispersal capacity and broad range of host plants of BMSB nymphs and adults. Given that AK cannot be considered a stand-alone method, standard IPM spray programs recommended in Northern Italy for BMSB management were also carried out in the whole study areas, including controls.

Trinet® pyramid-like structures (BASF Inc.), which are made by an aluminium stand covered with a long-lasting insecticide net (LLIN) containing alpha-cypermethrin at 0.1 g/m², were used as AK stations (Figure 1 A). These structures were baited with a two-component aggregation pheromone (3*S*,6*S*,7*R*,10*S*)-10,11-epoxy-1-bisabolen-3-ol and (3*R*,6*S*,7*R*,10*S*)-10,11-epoxy-1-bisabolen-3-ol, and pheromone synergist, methyl (2*E*,4*E*,6*Z*)-decatrienoate (BMSB High Load Lure®, Trécé Inc.). Lures were changed every 3 months.

The experiment was run as a randomized complete block design with four blocks, each one including a pair of similar sites (5-20 ha each). In one of the sites two AK stations/ha were deployed, whereas no stations were placed in the control sites. A total of approximately 100 AK stations were set up in the four sites. To evaluate the abundance of BMSB, five black standing pyramid traps (DeadInn®, AgBio Inc.) were set up both in control and AK sites

(Figure 1 B); the traps were baited with a standard BMSB Monitoring Lure® (Trécé Inc.). Monitoring traps were served weekly from early April to the end of October 2021 to count and remove captures. Injuries due to BMSB feeding activity were also scored at the harvest of pear orchards, which were grown in both AK and control sites of three out of four blocks. The other block had peaches and nectarines in both AK and control sites.

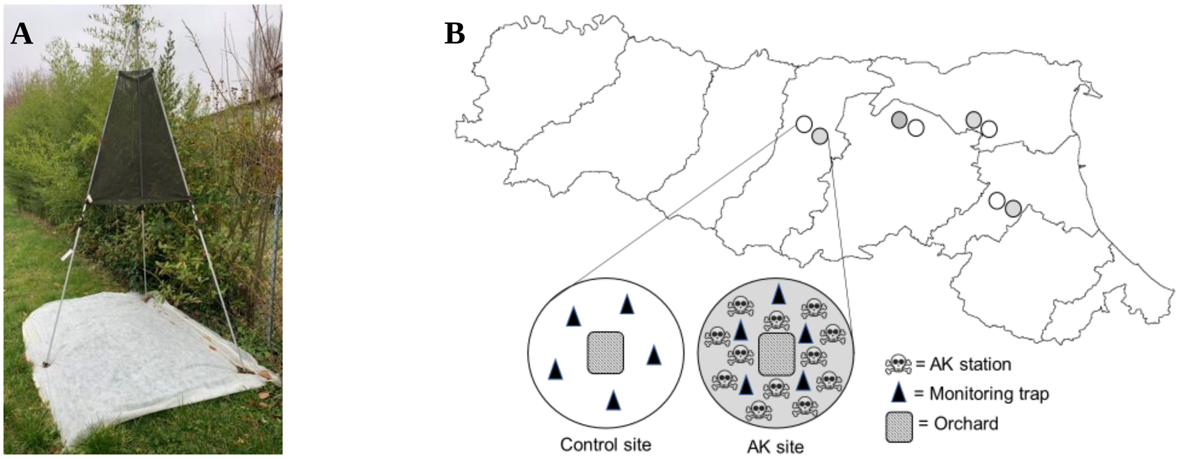

Figure 1. One of the Trinet® pyramid-like structures (A), which were selected as AK stations and the experimental design carried out to test the effects of AK stations on BMSB abundance (B).

Large fluctuations in the total monthly BMSB captures (pooling nymphs and adults) were detected among sites, as shown by the width of the standard errors (Figure 2). The trend of captures was dependent on the season. In spring and early summer no significant differences in BMSB abundance could be detected between AK and control sites (Figure 2 A). On the other hand, from August to October lower abundances of BMSB were found in the sites with AK station than in control sites (Figure 2 B). The decreased BMSB abundance did not turn in a reduction of the injuries to pear as well as to peaches and nectarines.

While the lures were highly effective, some technical issues were reported by the operators who served the AK stations. Recovery capacity of BMSB adults and the needs of prolonged contact of insects with the LLIN seemed crucial as well as quite problematic (Sabbatini Peverieri et al., 2017). Moreover, the active substance alpha-cypermethrin was banned from EU market in 2021. For these reasons, different methods to kill the insects have to be considered. Mass-trapping systems for BMSB relying on glue panels in combination with water traps seem promising and are now under evaluation.

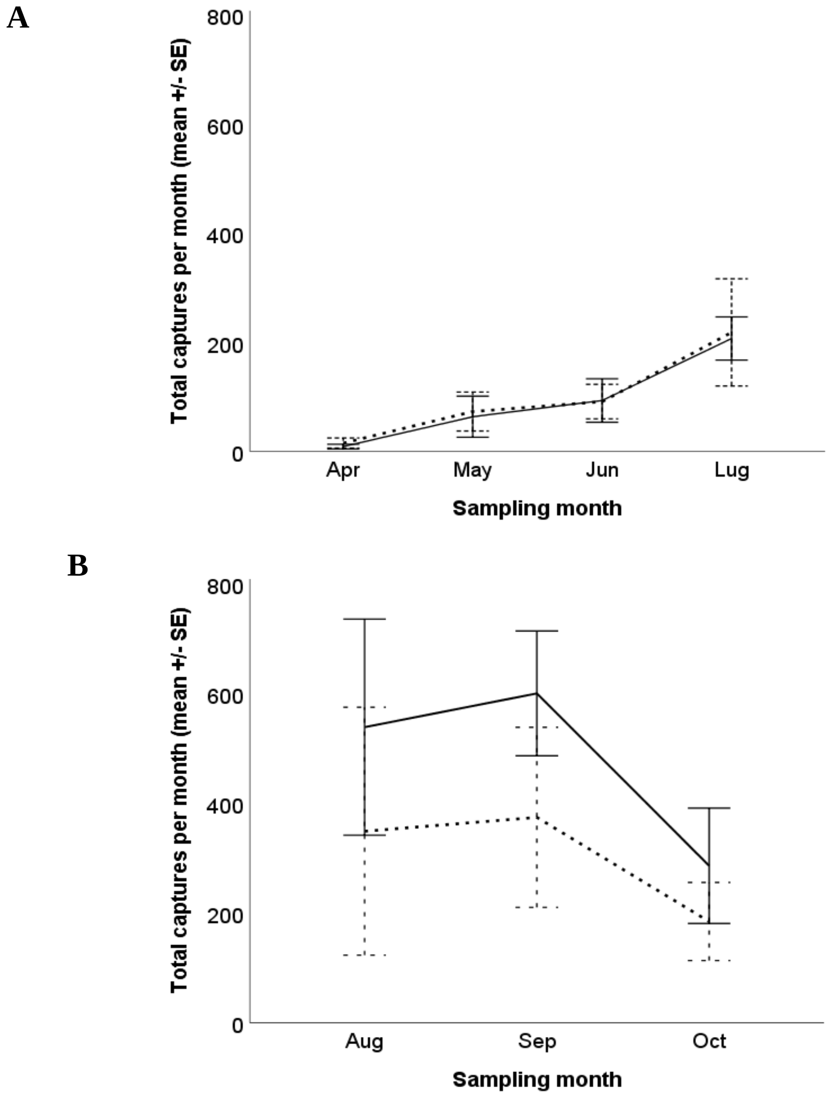

Figure 2. Trends of total captures by monitoring traps in the first (A) and in the second (B) half of the sampling season. In the second part of the season a generalized linear mixed model (with negative binomial error distribution, log link function, months as repeated measures, AR1 covariance type and degrees of freedom corrected by Kenward-Roger method) detected a significant reduction in BMSB abundance ($p = 0.021$) in sites where AK stations were deployed (dotted lines) in comparison with control sites (solid lines).

Key words: *Halyomorpha halys*, integrated pest management, pheromones, mass-trapping

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References

Francati, S., Masetti, A., Martinelli, R., Mirandola, D., Anteghini, G., Busi, R., Dalmonte, F., Spinelli, F., Burgio, G. and Dindo, M. L. 2021. *Halyomorpha halys* (Hemiptera: Pentatomidae) on kiwifruit in Northern Italy: phenology, infestation, and natural enemies assessment. J. Econ. Entom. 114: 1733-1742

Gregg, P. C., Del Socorro, A. P. and Landolt, P. J. 2018. Advances in attract-and-kill for agricultural pests: beyond pheromones. Annu. Rev. Entom. 63: 453-470.

Leskey, T. C. and Nielsen, A. L. 2018. Impact of the invasive brown marmorated stink bug in North America and Europe: history, biology, ecology, and management. Annu. Rev. Entom. 63: 599-618.

Morrison III, W. R., Blaauw, B. R., Short, B. D., Nielsen, A. L., Bergh, J. C., Krawczyk, G., Park, Y. L., Butler, B., Khrimian, A. and Leskey, T. C. 2019. Successful management of *Halyomorpha halys* (Hemiptera: Pentatomidae) in commercial apple orchards with an attract-and-kill strategy. Pest Man. Sci. 75: 104-114.

Sabbatini Peverieri, G., Binazzi, F., Marianelli, L. and Roversi, P. F. 2017. Lethal and sublethal effects of long-lasting insecticide-treated nets on the invasive bug *Halyomorpha halys*. J. Appl. Entom. 142: 141-148.