Gembloux Agro-Bio Tech
Université de Liège

Investigation on dispersion and feeding behavior of non-native stink bugs, related to interactions with their environment

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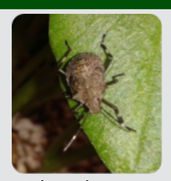
The Brown Marmorated Stink Bug (BMSB)



Highly polyphagous, *Halyomorpha halys* (Stål) is able to settle in orchards, crop fields and ornamental plantations, causing yield losses and quality depreciation. Moreover, it overwinters inside houses in groups of dozens. Besides the olfactory nuisance, some cases of allergy have been reported in USA.

Management in Europe

BMSB is spreading throughout Europe and we must be prepared to limit its impact on our agriculture. As chemical control of this pest has reached its limits and as very few natural predators and parasitoids can be found in our countries, we choose to study the use of entomopathogenic fungi as a biological agent.
The exploitation of plant natural defence is also an alternative way to control the pest, but more characterization of its feeding behavior and salivary compounds are first needed.
American scientists have discovered BMSB's aggregation pheromone, which can be used to enhance the efficiency of the different management strategies (Morrison et al., 2016).

US and Europe invasion route

1996 2005 2013

www.cabi.org

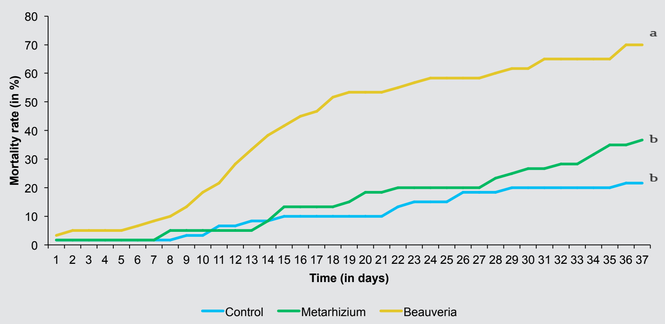
Twenty years ago, BMSB was accidentally introduced in Pennsylvania (USA), coming from East Asia. Since, it has spread along the whole country. In Europe, the first observation occurred in Switzerland in 2004. The weather conditions of these parts of the world are suitable for the pest installation (Zhu et al., 2012). According to INRA and ANSES, the situation in Europe is therefore already irreversible. No measure can suffice to stop the pest expansion and installation in the European countries.

2004 2014

Different axes developed in the lab

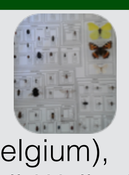
Entomopathogenic fungi for biological control

Two fungi at a concentration of 10^7 conidia/mL – *Beauveria bassiana* strain GHA (isolated from a certified commercial product) and an unknown strain of *Metarhizium acridum* – and a control solution were applied on second larval stage BMSB.



The commercial strain of GHA causes insect mortality, which is consistent with previous studies (Gouli et al., 2012; Parker et al., 2015). These results highlight the potential benefit of using the fungus in biological control of the pest.

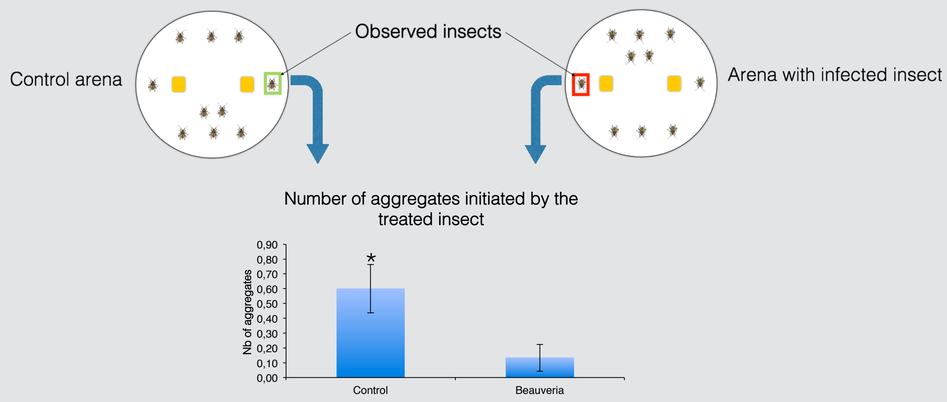
Monitoring through students work



Every year in Gembloux (Wallonia, Belgium), more than 30,000 insects are centralized, collected by students from all Wallonia and Brussels. That provides a regular survey of the potential apparition of BMSB in our region.
In the collection of the last 3 years, no *H. halys* has been identified.
Even if these collects are interesting, we should propose to a larger public a system of monitoring as it is organized by INRA in France.

Entomopathogenic fungi and social behavior

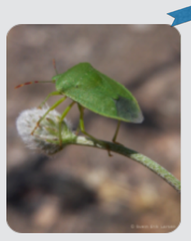
Impacts of the fungus on the insect social behavior are being investigated to maximize the natural dissemination of conidia. We have placed 10 individuals in arenas for 3 hours, including one observed insect (treated with GHA or with the control solution for the control arena).

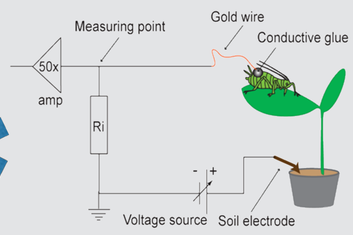


This suggests that healthy insects could be repelled by infected ones, which could decrease the efficiency of fungus auto-dissemination, by exclusion of infected insects. In order to validate that hypothesis, we are planning analyzes of volatile organic compounds and olfactory experiments.

Feeding behavior

In order to better understand the interaction between the invasive pest and its environment, including its host plant, we set feeding behavior experiments, based on electropenetrography (EPG). Therefore we aimed to compare *H. halys* with another stink bug, *Nezara viridula* L., that already succeeded to settle in our countries.





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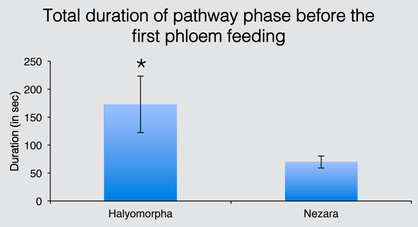
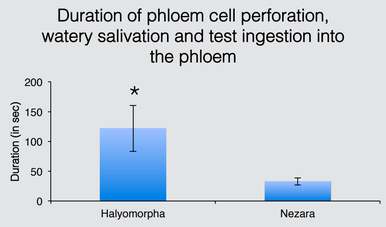


Among all the recorded parameters (number of test probes, duration of feeding…), only one pointed a difference between the two pests : *H. halys* showed a longer probing phase just before the first phloem feeding event of the recording.



With more detailed analysis and comparison with the work of Backus et al. (2013), we can say that this is due to a longer period of phloem cell perforation, watery salivation and test ingestion of the phloem ("J wave"), and not to the period of plant perforation, gelling saliva secretion and the pathway itself. More experiments will focus on insects' saliva injected into the phloem, which could play a role in adaptation to the plant.

Backus E.A., Rangasamy M., Stamm M., McAuslane H. & Cherry R., 2013. Waveform library for chinch bugs (Hemiptera: Heteroptera: Blissidae): Characterization of electrical penetration graph waveforms at multiple input inpedances. *Annals of the Entomological Society of America*, **106**(4): 524-539.
Gouli V., Gouli S., Skinner M., Hamilton G., Kim J.S. & Parker B.L., 2012. Virulence of select entomopathogenic fungi to the brown marmorated stink bug, *Halyomorpha halys* (Stål) (Heteroptera : Pentatomidae). *Pest Manag Sci*, **68**: 155-157.
Morrison W.R., Lee D.H., Short B.D., Khrimian A. & Leskey T.C., 2016. Establishing the behavioral basis for an attract-and-kill strategy to manage the invasive *Halyomorpha halys* in apple orchards. *J Pest Sci*, **89**: 81-96.
Parker B.L., Skinner M., Gouli S., Gouli V. & Kim J.S., 2015. Virulence of BotaniGard® to second instar brown marmorated stink bug, *Halyomorpha halys* (Stål) (Heteroptera: Pentatomidae). *Insects*, **6**(2), 319–324.
Zhu G., Bu W., Gao Y. & Liu G., 2012. Potential geographic distribution of brown marmorated stink bug invasion (*Halyomorpha halys*). *PLoS ONE*, **7**(2): e31246.

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