# Interaction between *Halyomorpha halys* Stål and its host plant: induced defense and feeding behavior

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## Introduction

*Halyomorpha halys* Stål (Heteroptera, Pentatomidae), the Brown Marmorated Stink Bug (BMSB), is native to Eastern Asia, where it feeds on a large diversity of host plants. BMSB has been accidentally introduced in Switzerland, Europe, where first observations occurred in 2007. It is probable that the pest will have colonized a large part of Europe within the next decades. Therefore it is crucial to better understand its biology to develop efficient control strategies.

Phytophagous Pentatomidae use different feeding strategies according to the plant tissue. On seeds, they apply a cell rupturing strategy, while on leaves and stems, they secrete a salivary sheath to facilitate the penetration of the stylets through the cells. Regarding their feeding strategies, they are more likely to induce mainly the jasmonic acid pathway as a plant defensive response. Yet, there is a lack of knowledge concerning the behavioral and physiological response of an insect exposed to such an elicited plant.

## Objectives

We hypothesize that BMSB invasiveness and wide host range are permitted by the ability of the pest to overcome the defense that it itself induces.

We therefore aimed to enlighten the interactions between BMSB and one of its host plants, *Vicia faba* L., focusing on:

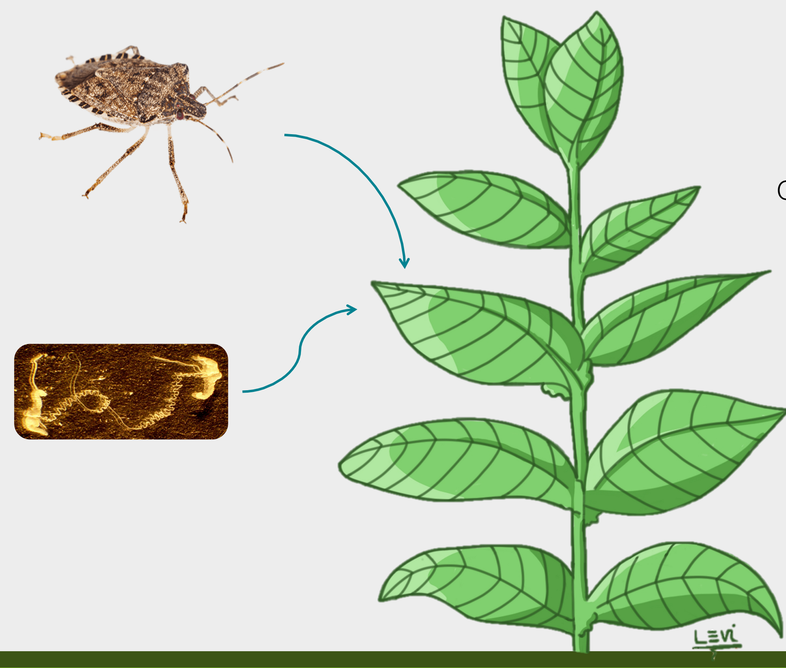
(1) the validation of the hypothesis that JA pathway is induced by this insect feeding and/or its salivary compounds, both locally and systemically;

(2) whether other individuals are subsequently able to detect that response and adapt their feeding strategy.

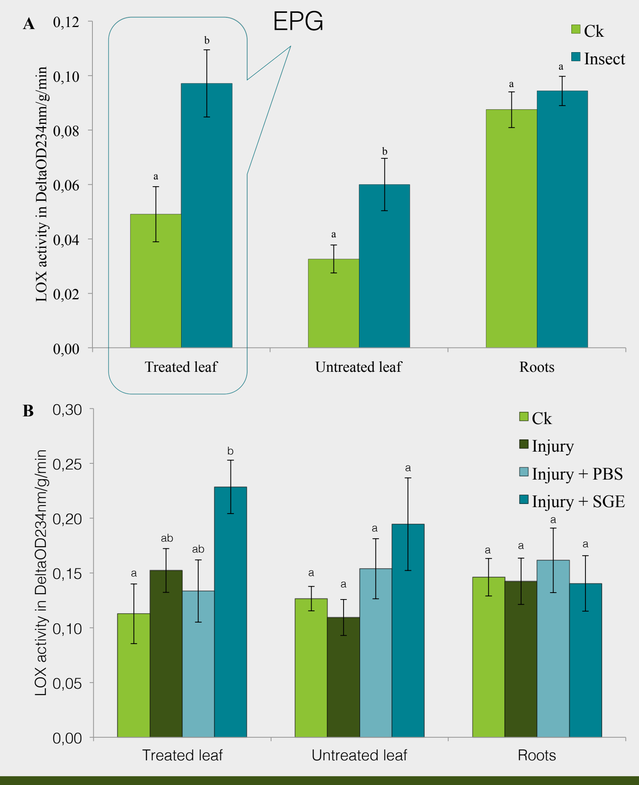
## Plant defensive response : lipoxygenase (LOX) activity

For the first experiment, two larvae have been starved for three days then restrained on the two youngest leaves of broad bean and allowed to feed for 24 hours.

For the second experiment, salivary gland extract (SGE) was injected into the plant in order to mimic a stink bug attack. That process was repeated 10 times during a period of 24 hours.



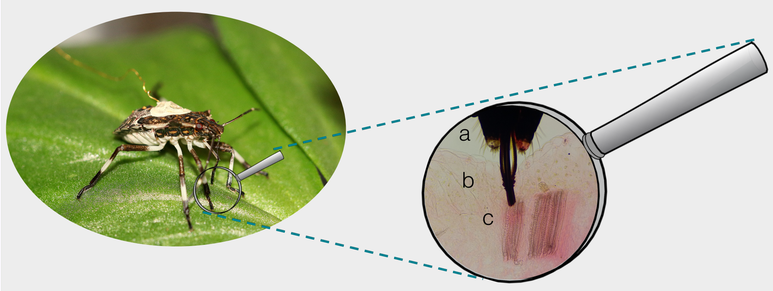
Quantification of LOX activity




## Insect feeding behavior: electrical penetration graph (EPG)

BMSB larvae were wired in a Giga-8d DC-EPG system and have been recorded for 6 hours on the treated broad bean leaf.

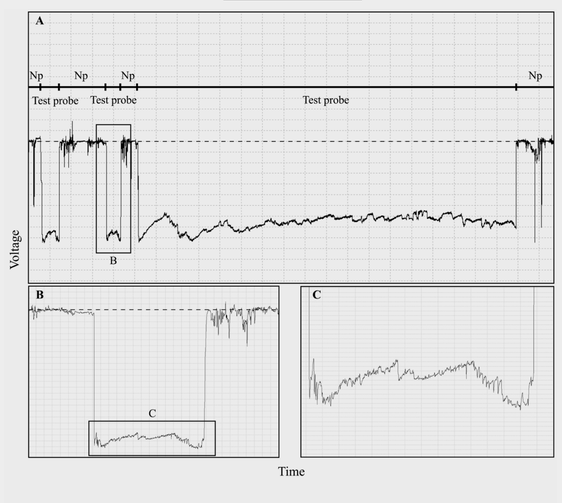
Resulting EPG waveforms have been grouped into a few main phases : non-probing, pathway and xylem or phloem ingestion.



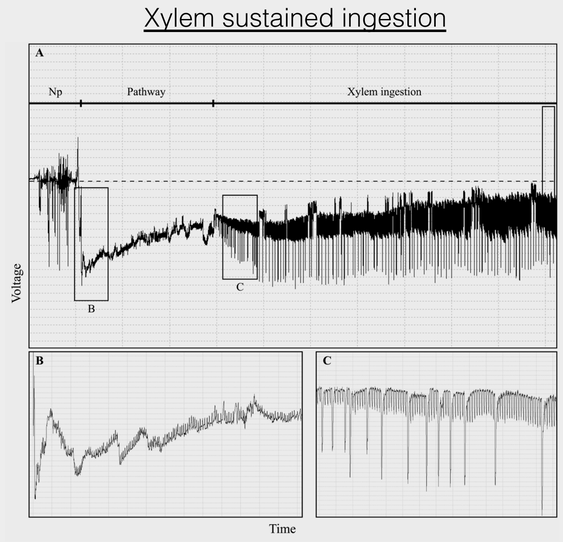

Dozens of EPG parameters were calculated, as indicators of plant suitability regarding surface (a), epidermis/mesophyll (b) and xylem/phloem (c) factors.

Then we could assess the impact of local plant defense – elicited by BMSB attack – on the feeding behavior of another subsequent individual.

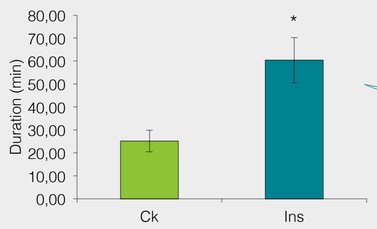
Test probes




Xylem sustained ingestion

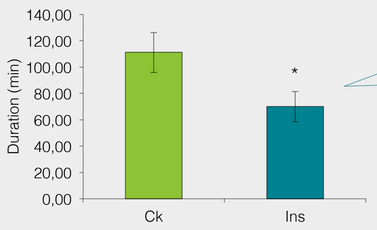



Time from the start to the 1st sustained feeding probe



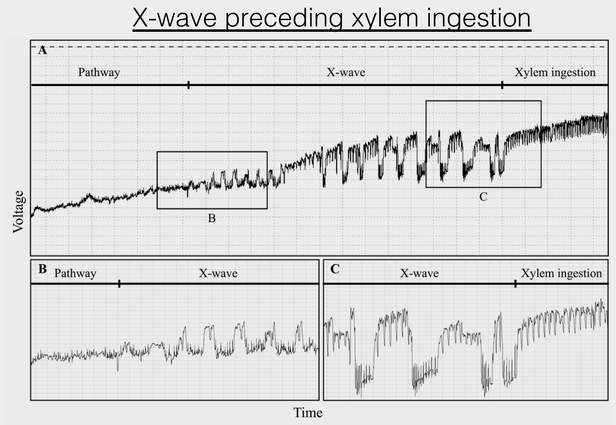

Insects placed on an elicited leaf took a longer time to start probing.

Duration of sustained ingestion events (when present)




And when they finally feed sustainably, it globally lasted less time than for insects on naïve plants.

X-wave preceding xylem ingestion




## Take-away message

- Our results support the hypothesis that plant defenses are induced by the combination of feeding injury and injected salivary compounds but with a key-role of the latest.
- BMSB feeding triggers at least defensive pathways that are closely related to lipoxygenase enzyme. These pathways would most likely produce non-appetent or toxic secondary metabolites and volatile organic compounds.
- This EPG study on a Heteropteran pest proposes a list of parameters consistent with the most impacting feeding behaviors on plant yields or fruit quality.
- BMSB seemed to be slightly perturbed by the earlier feeding of congeners.
  → Delayed probes could be due to semiochemicals applied on the leaf surface by the previous insects or to plant metabolites, such as volatiles resulting from LOX and JA pathway.
  → Some non-appetent compounds could be released in vascular ducts, such as xylem, and detected by the insect during feeding.

ECE 2018 NAPOLI

The participation to this congress has been possible thanks to subsidies granted by Liege University