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IOBC-WPRS general assembly
Meeting of the WGs Integrated protection in viticulture, Induced resistance in plants against insects and diseases and Multitrophic interactions in soil

15-20 October 2017, Riva del Garda, Italy

Future IPM 3.0

BOOK OF ABSTRACTS

Sponsored by the OECD Co-operative Research Programme: Biological Resource Management for Sustainable Agricultural Systems

First characterisation of herbivore-induced volatiles released by grapevine (cv. Pinot noir) under attack of *Empoasca vitis* (Hemiptera: Cicadellidae)

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Highlights

- When attacked by *Empoasca vitis*, Pinot noir grapevines released several herbivore-induced volatiles not present in the headspace of undamaged or mechanically damaged plants
- Therefore, these volatiles might play a key ecological role as attractants or repellents and could be exploited through novel push & pull, attract & reward, or attract & kill strategies

Introduction

Plants subjected to insect feeding release a subset of volatile organic compounds (VOCs), called herbivore-induced plant volatiles (HIPVs), which are powerful signals involved in both plant-insect and plant-plant communication (Dicke, 2009; Rodriguez-Saona et al., 2013). HIPVs can attract the natural enemies of the attacking herbivore and/or repel the pest insects. Moreover, neighbouring plants may "eavesdrop" on these volatiles to enhance their defences against subsequent attacks. The HIPV composition can be highly specific for each plant species and for the type of plant-herbivore interaction. Because of this potential variability, the HIPVs of each specific plant-herbivore interaction is expected to have its own distinctive traits, which should be experimentally investigated before planning any VOC-based method for controlling pest insects. In this work we characterised and quantified the HIPVs released by grapevines in response to the feeding damage of the leafhopper *E. vitis*.

Material and methods

Experiments were performed on one-year-old grapevines (*Vitis vinifera* L., cv. Pinot noir, grafted on SO4 rootstock). The VOCs were collected from the headspace of grapevines in three time periods of the infestation with *E. vitis*: after 1 h and again 24 and 48 h later in five plant replicates plus a negative control, using the closed-loop-stripping-analysis (CLSA) technique (Kunert et al., 2009). A shoot portion of each plant was enclosed within a plastic bag (Cuki® oven bag, Cofresco, Volpiano, Italy), and a distal shoot portion bearing 4 fully expanded leaves was selected. Air samples were collected using an adsorbent trap loaded with activated charcoal. Each trap was fitted to a vacuum pump that circulated air within the sampling bag. Samples were collected daily from 10 am to 1 pm; at the end of each VOC collection, leaves from the shoots inside each collection bag were excised and their area measured. The collected VOC samples were eluted from the adsorbent traps with 100 µl GC grade dichloromethane and were analysed by gas chromatography-mass spectrometry (GC-MS). The identity of compounds was confirmed by comparing the mass spectra and the retention times with those of authentic standard compounds. The amount of volatiles emitted during the collection period was normalised to the leaf area. For comparison, control experiments were carried out on undamaged and on mechanically damaged plants, using the protocol described above.

Results and discussion

In control experiments on undamaged grapevines ten VOCs were detected in the VOC collections of constitutive emission, including the green-leaf-volatiles (GLVs) (Z)-3-hexenol, (Z)-3-hexenyl acetate and (Z)-3-hexenyl butyrate, the aromatics benzaldehyde, phenylacetonitrile and 2-phenylethanol, and eight terpenes. Infestation with the leafhopper *E. vitis* generally led to a progressive increase in VOC emissions and to the release of VOCs detected neither in constitutive blends nor in mechanically damaged plants. This observation proves that there is emission of HIPV. Terpenoid and aromatic emission in particular changed dramatically. Twenty-three VOCs were detected in the VOC collections from grapevines infested with the leafhopper *E. vitis*, meaning that thirteen VOCs were uniquely induced by the herbivore feeding. These volatiles comprised, among others, the aromatics methyl salicylate and indole, and the terpenes (E,E)-2,6-dimethyl-1,3,5,7-octatetraene, (E)-β-farnesene and nerolidol. To the best of our knowledge, this is the first report of the terpenes (E,E)-2,6-dimethyl-1,3,5,7-octatetraene, neo-allo-ocimene and α-curcumene as HIPVs released by grapevine. This study allowed identifying for the first time potential natural tools to be used in IPM as eco-friendly alternatives to pesticides.

References

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