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Feeding Damage of *Pandemis heparana* Induces the Release of Specific Volatile Compounds from Apple Plants

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Abstract

Pandemis heparana Denis & Schiffermüller (Lepidoptera, Tortricidae) is one of the most widespread tortricid leafrollers in European apple orchards and is considered a key pest of apple plants. It is widely distributed in central and north Europe as well as parts of Asia and North America. Larvae of *P. heparana* cause damages primarily on the foliage of its host plants, although they may damage fruits as well. The aim of the present study was to find out if mechanically-damaged and *P. heparana*-damaged apple plants are able to release specific volatile compounds in response to the two different damages, as an indirect defence mechanism. Herbivore-induced plant volatiles (HIPVs) are in fact known to play a critical role in tritrophic interactions.

The volatile organic compounds (VOCs) released by the leaves of one-year-old apple seedlings were collected by closed-loop-stripping-analysis and characterised by gas-chromatography mass-spectrometry. Volatiles were collected for three subsequent days from undamaged, mechanically-damaged and insect-damaged seedlings in three replicates. The mechanical damage was caused on the first day of the experiment (single wounding event). In the case of insect damaged seedlings, 12 larvae were left on the leaves of each plant, feeding for three days.

Twelve VOCs were characterised in the undamaged apple seedlings. They included (Z)-3-hexenyl acetate, nonanal, decanal, 2-ethylhexanol and 8 linear and branched hydrocarbons, ranging from C14 to C20. In case of mechanically-damaged apple seedlings, 6 more volatile compounds were found, namely acrolein diethyl acetal, (E)-4,8-dimethyl-1,3,7-nonatriene, (Z)-3-hexenyl butyrate, (Z)-3-hexenyl benzoate, indole and alpha-farnesene. In case of *P. heparana*-damaged seedlings, we were able to detect a total of 25 volatile compounds. Among these, 8 compounds were specifically induced, namely the terpenes (E)-beta-ocimene, beta-caryophyllene, germacrene D, linalool, calamenene and cadalene, and the benzenoids benzyl cyanide and methyl salicylate.

Our experiments showed for the first time that apple plants strongly respond to insect damage in a specific manner. The volatile profile of *P. heparana*-damaged apple plants included several compounds that were not detected in either undamaged or mechanically-damaged plants. These HIPVs could be important for the development of new eco-friendly techniques of insect pest control in apple orchards.

Keywords: Apple volatiles, chemical ecology, *Pandemis heparana* herbivore-induced plant volatiles, plant-insect interaction

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