UNIVERSITÉ DE LIÈGE
Gembloux Agro-Bio Tech

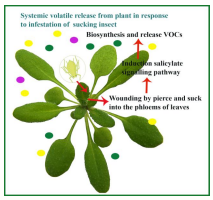
INTERNATIONAL SOCIETY OF CHEMICAL ECOLOGY
28th Annual Meeting, Vilnius, Lithuania
July 22 - 26, 2012

Impact of *Myzus persicae* infestation on the volatile emission of *Arabidopsis thaliana* Col-0.

Truong TD HIEN[1, 2*], Delaplace P[3], Francis F[4], Lognay G[1]

[1] *University of Liège, Gembloux Agro-Biotech, Unit of Analysis Quality and Risk, Laboratory of Analytical Chemistry, Gembloux, Belgium*
[2] *Binh Duong University, Biotechnology Faculty, Binh Duong, Vietnam*
[3] *University of Liège, Gembloux Agro-Biotech, Unit of Plant Biology, Gembloux, Belgium*
[4] *University of Liège, Gembloux Agro-Biotech, Unit of Functional & Evolutionary Entomology, Gembloux, Belgium*
*ttdhien@doct.ulg.ac.be

INTRODUCTION AND OBJECTIVES



Being members of complex communities, plants often emit a wide range of volatile organic compounds to defend themselves against insect invasions. Although many studies exist on insect-induced plant volatile emission, most of them either compare the influences of various herbivore species on one plant species or the impact of a given herbivore on several host plant species. However, information related to the influence of the insect density as well as the infestation duration are less documented. In this context, this study aims at measuring:

- The volatile emission pattern of plant (*A.thaliana*) under infestation of different numbers of sucking insect (*M.persicae*).

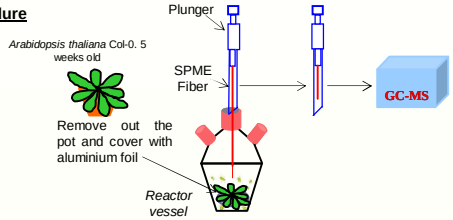
- The effect of residence duration of *M.persicae* on volatile emission from leaves *A.thaliana*.

MATERIALS AND METHODS

Growth Conditions

- *Arabidopsis thaliana* Columbia 0 (Lehle company): 20:4 Light/Dark, 22 ^{0}C, and ± 65% Relative humidity
- *Myzus persicae* ('Gembloux' clone): reared on the bean plants; 16:8 L/D, 22 ^{0}C, and ± 65% RH

VOCs Extraction Procedure



VOCs Analysis

Sampling	• SPME fiber (PDMS/DVB/CAR; PDMS/DVB; PDMS/CAR); 3 & 6 hours, 22^{0}C • *A.thaliana* Col-0. 5 weeks old: grinded, undamaged and damaged by *M.persicae*
Injector	Splitless 220^{0}C
Column	An apolar column (Restek Rtx-502.2; 5%phenyl/95%methylpolysiloxane, USA): 30m, ID: 0,25mm, 0,25µm film thickness Carrier gas: He. 0.5ml/min
Temperature program	40^{0}C 1min; 4^{0}C/min; 220^{0}C; 100^{0}C/min, 10min; 320^{0}C
Detector	MS; EI: 70 eV; source at 230^{0}C; interface at 250^{0}C Full scan: m/z = 39 - 400

RESULTS and DISCUSSION

A. HS-SPME Fibers Optimization

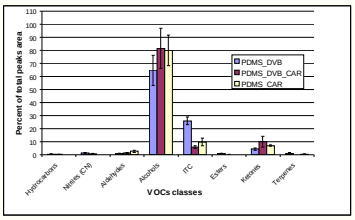


Figure 1. Effect of SPME fibers on the percent of total peaks area of volatile classes (hydrocarbons, nitriles, aldehydes, alcohols, isothiocyanates, esters, ketones & terpenes), extracted from crushed shoot tissues 5 weeks old *A.thaliana* (mean ± standard deviation (SD), n = 3) with 3 hours of collection time at 22^{0}C.

B. Analysis of VOCs Emitted by *A.thaliana* Col-0.

In all experiments HS were sampled with PDMS-DVB fiber in 6h at 22^{0}C.

• Induction of shoot tissues volatiles is dependent on the number of feeding aphids

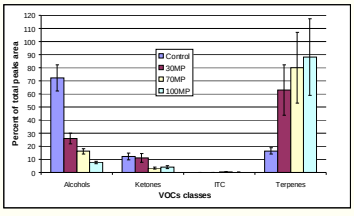


Figure 2. Effect of numbers of aphids on the percent of total peaks area of volatile classes (alcohols, ketones, isothiocyanate and terpenes) extracted from 5 weeks old *A.thaliana* (mean ± SD, n= 3). Control = undamaged plants; 30MP, 70MP & 100MP where respectively 30, 70 & 100 adults *M.persicae* infested leaves during 48h.

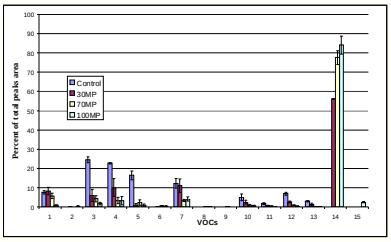


Figure 3. Percent of total peaks area of individual volatile compounds emitted by *M.persicae* infested on leaves of *A.thaliana* in 48h with different numbers of aphids (mean ± SD, n = 3). Control = undamaged plants; 30MP, 70MP & 100MP where respectively 30, 70 & 100 adults *M.persicae* feeding on leaves. *1 = 2,2-Dimethyl-1-butanol; 2 = 1-octen-3-ol; 3 = 4-Methyl-1-penten-3-ol; 4 = 2-Ethyl-1-hexanol; 5 = 5-Methyl-3-hexanol; 6 = 3-decanol; 7 = 6-Methyl-5-heptene-2-one; 8 = 4-methylpentyl isothiocyanate; 9 = 3,5,5-Trimethyl-1-hexene; 10 = α-limonene; 11 = β-Terpineol; 12 = menthol; 13 = α-terpineol; 14 = β-Farnesene; 15 = (Z,E)-α-Farnesene.*

• Aphids induce differential volatile emission in shoot tissues of A.thaliana according to their residence duration

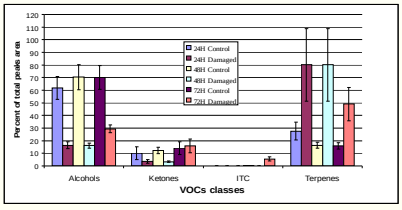


Figure 4. Effect of residence duration of aphids on the percent of total peaks area of volatile classes (alcohols, ketones, isothiocyanate (ITC) & terpenes) extracted from 5 weeks old *A.thaliana* (mean ± SD, n = 3).

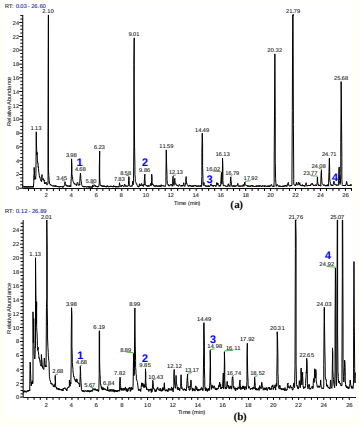


Figure 5. Chromatograms of VOCs extracted from 5 weeks old *A.thaliana* undamaged (a) and damaged (b) by *M.persicae* plants within 72h. *1 = 2,2-Dimethyl-1-butanol; 2 = 4-Methyl-1-penten-3-ol; 3 = 4-Methylpentyl isothiocyanate; 4 = β-Farnesene* (peak 3 and 4 were detected only in infested *A.thaliana* plants in 72h).

C. Assessment the influence of piercing-sucking insects on VOCs emission from vegetative parts of *A.thaliana* Col-0.

➢ Volatile compounds were released according to degree of aphid stresses.

➢ 4-methylpentyl ITC was detected from headspace of *A.thaliana* Col-0. infested plant. It was considered as one of the key chemical defenses of plants against infested piercing-sucking insects (*de Vos & Jander, 2010*).

➢ (E)-β-farnesene (aphid pheromone) was present in the volatile chemical blend associated with aphid-infested *A.thaliana (Francis et al., 2005).*

CONCLUSIONS

❖ The selection of the PDMS/DVB in the extraction of VOCs from *A.thaliana* undamaged and damaged plants was based on the percent of total peaks area of all the compounds identified in the sample ((Isothiocyanates (ITC), terpenes, nitriles and esters classes) Figure 1).

❖ The comparison between the volatile compounds of control and infested *A.thaliana* Col-0. plants showed that qualitative and overall proportion of volatile components greatly depended on the number and residence duration of aphids on leaves (Figures: 2 & 4).

❖ A total of 15 compounds were detected from control and infested *A.thaliana* plants. They can be divided into 4 groups: alcohols, ketones, isothiocyanates and terpenes. In general, five new volatile compounds were induced (1-octen-3-ol; 3-decanol; 4-methylpentyl ITC; β-Farnesene & (Z,E)-α-Farnesene), sum of peaks area of terpenes increased, and alcohols, ketones classes reduced according to the density and residence time of sucking insects (Figures: 2 - 5).

REFERENCES

1. de Vos et al., 2010. *Biotic interactions. Plant Biology*, 13:366-371.
2. Francis F et al., 2005. *J Appl Entomol*, 129(1):6-11.
3. Giorgi et al., 2012. *J Plant Biology*, 55:251-260.
4. Pareja, M. et al., 2012. *Plos one*, 7(2):1-11.
5. Snoeren, A.L.T2010. *Journal of Experimental Botany*, 61(11):3041–3056.

ACKNOWLEDGEMENTS

Government of Vietnam