

Ant-aphid mutualism : impact of aphid semiochemicals on the foraging behaviour of ants

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Introduction

Mutualism relationships occur between some aphid and ant species. The honeydew produced by aphids is a key factor in the establishment of such relationships. While most aphid natural enemies have evolved to localize their prey using aphid semiochemicals, no previous work has addressed the possibility for ants to forage using aphid producing odors.

Objectives

The aim of this study is to identify and quantify the different odors emitted by aphids and to observe their influence on ants behavior. We used the two followings aphid and ant models : *Aphis fabae* and *Lasius niger*.

Identification and semi-quantification of honeydew semiochemicals

Material and methods

We have used two methods to collect volatile organic compounds (VOC) : the solid phase MicroExtraction (SPME) and thermal desorption (TD). The fiber (SPME) or resin (TD) were exposed in air flow enriched with VOC from honeydew.

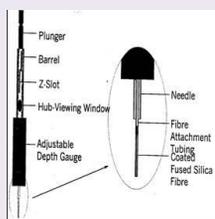


Figure 1. SPME

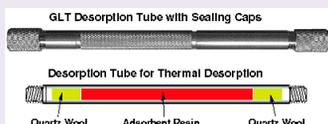


Figure 2. Thermal desorption (TD)

Results

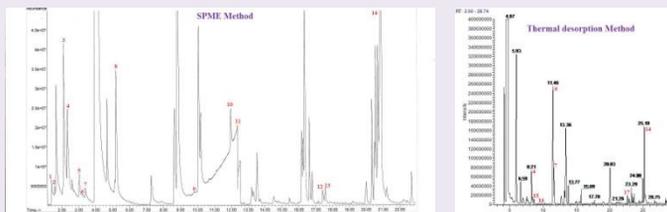


Figure 3. Chromatograms with SPME and Thermal desorption methods. Legend of volatile compounds : ethanol (1) ; acetone (2) ; acetic acid(3) ; 3-methylbutanal (4) ; 3-hydroxy-2-butanone (5) ; 3-methyl-1-butanol (6) ; 2-methyl-1-butanol (7) ; 2-methylpropanoic acid(8) ; 3-methyl-1-butanol acetate (9) ; 3-methylbutanoic acid(10) ; 2-methylbutanoic acid(11) ; limonene (12) ; pantolactone (13) ; benzeneethanol (14) ; 2-methylbutanal (15); 2-pentanone (16) ; 6-methylhept-5-ene-2-one (17).

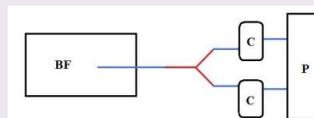
Discussion and conclusion

First, the comparison of the VOC content of *A. fabae* honeydew reveals different composition according to the method used. In the second part, we show that ant scouts preferentially choose plants with *A. fabae* while subsequent behavioral tests show that VOC from honeydew are responsible of this preference.

Behavioral observations on ant scouts in presence of aphid odors with olfactometer method

Material and methods

We have developed a closed system without visual cues to present different odors to ant scouts. Four experiments have been conducted to investigate the preference of ants exposed to : (1) infested plants VS healthy plants ; (2) plant treated with honeydew VS healthy plant ; (3) honeydew odors VS pure air ; (4) plants infested by *A. fabae* VS plants infested by *A. pisum*



Scheme 1. Double choice olfactometer. Box with ant colony (BF) ; sealed tank with plant (C) ; pump pushing air (P) ; in blue, connecting tubes ; in red, "Y system" for the double choice.

Results

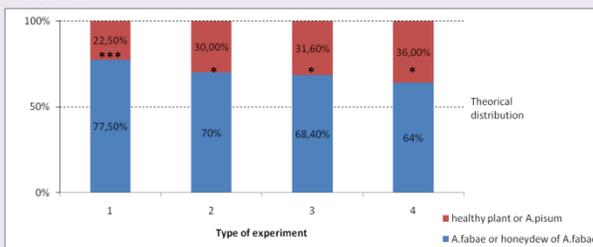


Figure 4. Distribution of ants choosing the plant infested with *A. fabae* or its honeydew for the different types of experiment described above. For the Chi-Square test : * ; ** ; *** , respectively, for P<0,05 ; P<0,01 ; P<0,001.