

STUDY OF THE AGGREGATION PHEROMONE OF THE BANANA WEEVIL *COSMOPOLITES SORDIDUS* GERMAR 1824 (COLEOPTERA: CURCULIONIDAE)

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ABSTRACT

The banana weevil *Cosmopolites sordidus* (Germar) is one of the main pests in most of banana plantations in the world. In order to isolate and identify the aggregation pheromone, volatile compounds emitted by stimulated insects were trapped on adsorbent polymers Porapak-Q and Supelpack-2. An air stream was drawn 10 minutes per hour during 15 days, into flasks with and without insects. Compounds were desorbed from the polymers with acetone, and bioassays were undertaken to confirm biological activity. Extracts were analyzed by Gas Chromatography - Mass Spectrometry (GC-MS). A methyl-branched nonenol was tentatively identified as one of the aggregation pheromone components.

INTRODUCTION

The banana weevil *Cosmopolites sordidus* (Germar) is one of the main pests in banana plantations. The female adult weevil lays eggs in the rhizome of the plant, which the larvae feed on, causing severe damage, weakening the plant (Budenberg *et al.*, 1993). In previous studies, bioassays using live males and trapped volatiles from males showed evidence of a male-produced aggregation pheromone for this weevil (Budenberg *et al.*, 1993a). More recently, the major component (proposed name: sordidin) of a male-produced pheromone was identified using volatile collection from weevils (Beauhaire *et al.*, 1995). However another five male-specific biologically active compounds were present in the sample. Here we report another possible component of the aggregation pheromone of this beetle.

METHODS AND MATERIALS

Approximately 300 individuals of *Cosmopolites sordidus* were collected from pseudostem traps in a banana plantation located in Estación Experimental Río Negro of Universidad Simón Rodríguez in Río Negro town, 42 meters above sea level, Venezuela. These weevils were kept in appropriate containers at 25 ° C, and 12 h. light-12 h. dark cycle.

Rhizome and pseudostem from *Musa acuminata* (triploid AAA) were collected at the same location to perform the experiments.

Volatiles were collected from two flasks: the first one contained 30 male and female weevils stimulated with chopped rhizome, and the other one contained only rhizome tissue. Air was drawn 10 minutes per hour during 15 days. Volatile compounds were trapped at the outlet in two columns packed with 1 g. of Porapak-Q and Supelpack-2 for each flask.

Compounds were desorbed by eluting 2 ml of acetone and then eluates were concentrated to approximately 0.2 ml. by blowing a gentle stream of nitrogen. Volatile collection was carried out at Laboratorio de Control de Plagas at Universidad Simón Rodríguez.

Gas Chromatography-Mass Spectrometry was carried out on a Perkin-Elmer GC Autosystem 2000 fitted to a Perkin-Elmer Mass Spectrometer QMass-910. GC was equipped with a 25 m., 0.18 mm ID, DB-5 fused silica capillary column. The GC oven temperature was programmed from 40 °C (4min) to 150 °C at 6 °C/min, and final temperature was maintained for 15 min. GC-MS analysis was performed at Laboratorio de Comportamiento, Universidad Simón Bolívar.

Bioassays were undertaken using a dual-choice olfactometer (Cerde *et al.*, submitted).

RESULTS

Volatiles collected from Porapak-Q and Supelpack-2 of each flask, were tested with male and female weevils on a dual-choice olfactometer. Results are shown in Table 1.

Table 1. Responses of male and female weevils to volatiles from Porapak-Q and Supelpack-2 using a dual olfactometer

LABORATORY BIOASSAYS

SUPELPACK-2		PORAPAK-Q	
Rhizome + weevils	27	Rhizome + weevils	12
Rhizome	13	Rhizome	8
p = 0.0016		p = 0.252	

Comparing the gas chromatograms of both eluates (rhizome+weevils; rhizome) from Porapak-Q, no significant differences were observed. Those chromatograms of volatiles collected on Supelpack-2 showed a main peak on rhizome + male weevils-rhizome + female sample, which were absent in the control consisting of rhizome only.

EI-mass spectrum obtained of the most prominent peak gave the ions: 43(100); 55(25); 59(80); 67(8); 83(38); 95(9); 98(4); 123(10); 138(9);141(20).

DISCUSSION

Results suggest evidence of statistically significant biological activity only of volatiles collected from rhizome+weevils on Supelpack-2, which was possibly more effective at trapping the compounds than Porapak-Q. This is also confirmed on the gas chromatograms obtained. Mass spectrum of the main peak suggests a methyl-branched monounsaturated alcohol structure. Presence of ion 59 ($C_2H_5CH=OH^+$) is characteristic of an alcohol with hydroxyl on carbon 3. The highest ions observed suggest a molecular ion at m/z 156 corresponding to a 10 carbon monounsaturated alcohol. Loss of H_2O ($M^+ - 18 = 138$) could confirm an alcohol structure. A $M^+ - 15$ fragment ($m/z = 141$) due to loss of a methyl group was also observed, and the base peak at $m/z = 43$ ($C_3H_7^+$) could be explained as a cleavage on a terminal methyl-branched group (8-methyl). Position of the double bond on carbon 5 could contribute to this cleavage.

CONCLUSION

The compound 8-methyl-5-nonen-3-ol was tentatively identified by GC-MS as one of the components of the aggregation pheromone of the banana weevil *Cosmopolites sordidus*. It is necessary to isolate this compound by preparative GC, to obtain 1H and ^{13}C NMR, IR and mass spectra, and then synthesize it to confirm molecular weight, mass fragmentation pattern and retention time.

REFERENCES

- Beauhaire J., Ducrot P., Malosse C., Rochat D., Ndiege I. and Otieno D. (1995) Identification and synthesis of sordidin, a male pheromone emitted by *Cosmopolites sordidus*. *Tetrahedron Letters* **36**: 1043-1046.
- Budenberg W., Ndiege I., Karago F. and Hansson B. (1993) Behavioral and electrophysiological responses of the banana weevil *Cosmopolites sordidus*. *J.Chem. Ecol.* **19**: 267 - 277.
- Budenberg W., Ndiege I. and Karago F. (1993a) responses of the banana weevil *Cosmopolites sordidus*. *J.Chem. Ecol.* **19**: 1905 - 1916.
- Cerda H.; López A.; Fernández G.; Sánchez P and Jaffé K. Technique olfatométrique et réponse olfactive du charançon des bananiers *Cosmopolites sordidus* Germar 1824, submitted to *Fruits*.

- Jaffé K, Bazire-Benazet M. and Howse P.E. (1979) An integumentary pheromone-secreting gland in *Atta* sp: Territorial marking with colony-specific pheromone in *Atta cephalotes*. *J. Insect Physiol.* **25**: 833-839.
- Jaffé K. (1980) Chemical communication among workers of leaf-cutting ant (Hymenoptera: Formicidae). Ph. D. Thesis, University of Southampton, 183 pp.
- Jaffé K. (1984). Negentropy and evolution of chemical recruitment in ants (Hymenoptera: Formicidae). *J. Theor. Biol.* **106**: 587-604.
- Nowbahari E.; Lenoir A., Clement J-L., Lange C., A.G. Bagnères A,G, and Joulie C. (1990) Individual geographical and experimental variation of cuticular hydrocarbons of the ant *Cataglyphis cursor* (Hymenoptera: Formicidae): Their use in nest and subspecies recognition. *Biochem. Syst. Ecol.* **18**: 63-73.
- Oliveira J., Martinez O., Carnieri N., E. Vilela E. and Reis H. (1990) Componentes do feromônio de trilha das formigas cortadeiras *Atta laevigata* F. Smith e *Atta bisphaerica* Forel (Formicidae: Attini). *Ann. Soc. Entomol. Bras.* **19**: 143-154.
- Salzemann A. and Jaffé K. (1990) On the territorial behaviour of field colonies of the leaf-cutting ant *Atta laevigata* (Hymenoptera: Myrmicinae). *J. Insect Physiol.* **36**: 133-138.
- Salzemann A., Nagnan P., Tellier F. and Jaffé K. (1992) Leaf-cutting ant *Atta laevigata* (FORMICIDAE: ATTINI) Marks its territory with colony specific dufour gland secretion. *J. of Chem. Ecol.* **18**: 183-196.
- Tumlinson J.H., Silverstein R.M., Moser J.C., Brownlee R.G. and Ruth J.M. (1971) Identification of the trail pheromone of a leaf-cutting ant *Atta texana*. *Nat.* **234**: 348-349.
- Whitehouse M. and K. Jaffé K. (1995) Nest mate recognition in the leaf-cutting ant *Atta laevigata*. *Ins. Soc.* **42**: 157-166.