EAG and Behavioral Responses of the Caribbean Fruit Fly (Diptera: Tephritidae) to Terminal Diamines in a Food-Based Lure

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Introduction

Improved attractants are needed for *Anastrepha* fruit flies, including the Caribbean fruit fly (Fig. 1). Once restricted to the Bahamas and Greater Antilles, this invasive pest is now permanently established in south Florida, where it impacts citrus and guava production. Current monitoring programs utilize a two-component lure consisting of ammonium acetate and putrescine (1,4-diaminobutane), but results are variable. Identification of additional attractant chemicals may lead to development of more effective trapping systems for pest *Anastrepha* species.

In this study we evaluated response to putrescine and four homologous diamines, differing only in carbon chain length. Electroantennography (EAG) was used to compare antennal receptivity to the series of diamines, and field tests were conducted to evaluate potential as attractants when deployed in combination with ammonium acetate lures.

Fig. 1

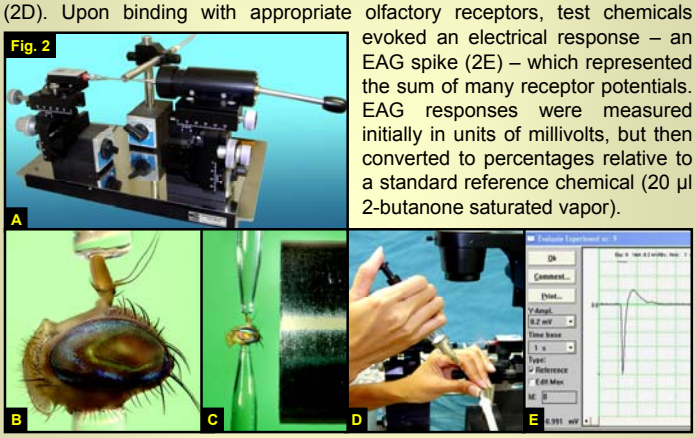
Anastrepha suspensa (Loew) ♀

Materials & Methods

Chemicals. Five terminal diamines were evaluated: 1,4-diaminobutane (putrescine), 1,5-diaminopentane (cadaverine), 1,6-diaminohexane, 1,7-diaminoheptane, and 1,8-diaminooctane (abbreviated C4-C8 diamines, respectively) (Reagent grade chemicals; Sigma-Aldrich, St. Louis, MO).

Electroantennography. Antennal signals were recorded from sexually mature females (laboratory reared) with a Syntech EAG system (Fig. 2A) using methods previously reported (Kendra et al. 2005a, 2005b). Whole fly heads, with antennae extended, were mounted between electrodes (2B) and placed under a stream of purified air (2C). Test samples consisted of 200 µl diamine in 250-ml gas-tight glass bottles fitted with septum port lids. Using gas-tight syringes, fixed doses of 2-ml saturated vapor were withdrawn from the test bottles, injected into the airstream, and delivered to the antennae (2D). Upon binding with appropriate olfactory receptors, test chemicals evoked an electrical response – an EAG spike (2E) – which represented the sum of many receptor potentials. EAG responses were measured initially in units of millivolts, but then converted to percentages relative to a standard reference chemical (20 µl 2-butanone saturated vapor).

Fig. 2



Field Tests. Tests were conducted in a commercial guava grove in Miami-Dade County. Multilure plastic McPhail traps (Better World, Miami, FL) (Fig. 3) were baited with an ammonium acetate lure (AA) (Suterra LLC, Bend, OR) plus either the C4, C5, C6, C7, or C8 diamine (50 µl loaded onto a blank Suterra patch). There were 5 replicates of each treatment, arranged in randomized complete block, and traps within a block were rotated after each sample. Traps were checked twice a week for 3 weeks, for a total of 6 sampling dates (Sep 2006).

Fig. 3

Statistical Analysis. Results were analyzed by one-way ANOVA followed by LSD mean separation using SigmaStat 3.5 (Systat, Inc., Richmond, CA).

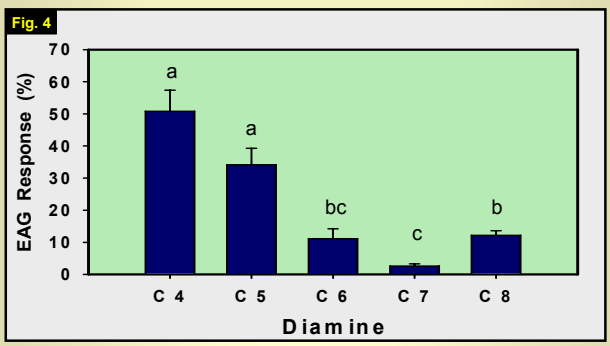
Results & Discussion

Chemical Analysis. A method was developed for separation of homologous diamines and for determination of chemical purity (Table 1) using ion chromatography analysis (R. R. Heath, A. Vázquez, unpublished methods).

Table 1 Diamine	Abbreviation	Purity (%)
1,4-diaminobutane	C4	98.22
1,5-diaminopentane	C5	95.97
1,6-diaminohexane	C6	70.62
1,7-diaminoheptane	C7	84.75
1,8-diaminooctane	C8	72.41

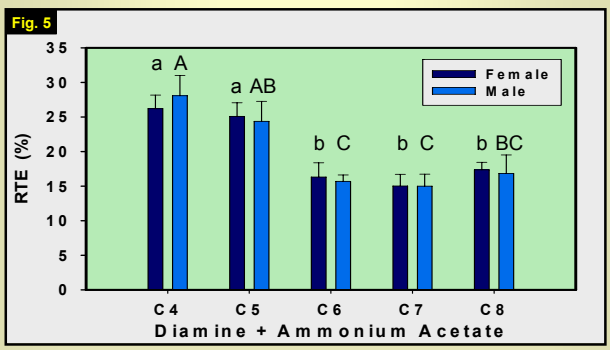
Electroantennography. In EAG recordings from mature females (Fig. 4), significant differences were observed in antennal responses to the five diamines (F = 16.98; df = 4,20; P < 0.001). EAG responses to C4 and C5 were significantly higher than responses to the longer chain diamines, C6-C8.

Fig. 4



Field Tests. Numbers of flies/trap/day per treatment were summed for each sample date, and converted to relative trapping efficiencies (RTE). Mean RTE for females and males (Fig. 5) was affected significantly by treatment (Females: F = 6.50; df = 4, 25; P < 0.001. Males: F = 4.25; df = 4, 25; P = 0.009). Traps baited with AA plus either C4 or C5 captured more females than traps baited with AA plus any of the other diamines.

Fig. 5



Summary. Putrescine (C4) is a known attractant used in commercial fruit fly lures. Of the homologous diamines evaluated, cadaverine (C5) gave EAG and behavioral responses comparable to that of C4. Future research will evaluate C5 as a potential supplement to improve trapping efficacy for pest *Anastrepha.*

Kendra, P. E., A Vázquez, N. D. Epsky, and R. R. Heath. 2005a. Ammonia and carbon dioxide: Quantification and electroantennogram responses of Caribbean fruit fly, *Anastrepha suspensa* (Diptera: Tephritidae). Environ. Entomol. 34: 569-575.

Kendra, P. E., W. S. Montgomery, D. M. Mateo, H. Puche, N. D. Epsky, and R. R. Heath. 2005b. Effect of age on EAG response and attraction of female *Anastrepha suspensa* (Diptera: Tephritidae) to ammonia and carbon dioxide. Environ. Entomol. 34: 584-590.

The authors gratefully acknowledge technical assistance from Wayne Montgomery, Jorge Sanchez, Carina Allen, Elena Schnell, Micah Gill, Ingris Filpo, and Luis Mazuera.