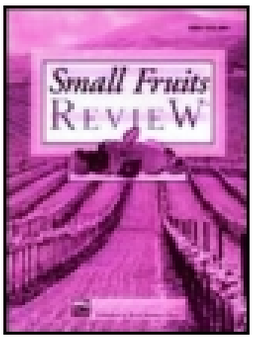

Small Fruits Review

ISSN: 1522-8851 (Print) (Online) Journal homepage: www.tandfonline.com/journals/wzsf20

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To cite this article: Oscar E. Liburd (2004) Identification of Host Volatile Compounds for Monitoring Blueberry Maggot Fly, Small Fruits Review, 3:3-4, 307-312, DOI: 10.1300/J301v03n03_07

To link to this article: https://doi.org/10.1300/J301v03n03_07

Published online: 15 Oct 2008.

Identification of Host Volatile Compounds for Monitoring Blueberry Maggot Fly

Oscar E. Liburd

SUMMARY. In choice tests, blueberry maggot *Rhagoletis mendax* Curran flies were exposed to blueberries or marbles (surrogate berries) in a highbush blueberry *Vaccinium corymbosum* L. planting. Significantly more *R. mendax* flies were attracted to cages baited with blueberries compared with marbles. In additional experiments, five volatile compounds consisting of butyl butanoate, cis-3-hexen-1-ol, alpha-terpiniol, geraniol, and trans-2-hexenal were extracted and identified from ripening blueberries using gas chromatography and mass spectroscopy (GC-MS) techniques. Late in the season, butyl butanoate and cis-3-hexen-1-ol were as attractive to *R. mendax* as ammonium acetate (1BEEM® capsule). Increasing the load-rates of butyl butanoate and cis-3-hexen-1-ol did not significantly increase trap captures

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The author would like to thank his technician Gisette Seferina and graduate students Erin Finn and Lukasz Stelinski for their help in preparing the figures and text for this manuscript. John Hamill and Dr. Steven Alm also contributed significantly to the data presented in this paper.

[Haworth co-indexing entry note]: "Identification of Host Volatile Compounds for Monitoring Blueberry Maggot Fly." Liburd, Oscar E. Co-published simultaneously in *Small Fruits Review* (Food Products Press, an imprint of The Haworth Press, Inc.) Vol. 3, No. 3/4, 2004, pp. 307-312; and: *Proceedings of the Ninth North American Blueberry Research and Extension Workers Conference* (ed: Charles F. Forney, and Leonard J. Eaton) Food Products Press, an imprint of The Haworth Press, Inc., 2004, pp. 307-312. Single or multiple copies of this article are available for a fee from The Haworth Document Delivery Service [1-800-HAWORTH, 9:00 a.m. - 5:00 p.m. (EST). E-mail address: docdelivery@haworthpress.com].

http://www.haworthpress.com/web/SFR

Digital Object Identifer: 10.1300/J301v03n03_07

KEYWORDS. Blueberry maggot, *Vaccinium corymbosum*, blueberries, volatile

INTRODUCTION

Blueberry maggot, *Rhagoletis mendax* Curran, is a key pest of blueberries, *Vaccinium* spp., from Nova Scotia southward into Georgia and northern Florida. Current monitoring practices for *R. mendax* rely on both visual and olfactory stimuli and include the use of ammonium-baited Pherocon AM yellow sticky panels (Prokopy and Coli, 1978) and green sticky spheres (Liburd et al., 1998). A principal problem with ammonium baits is that they attract non-target insects including beneficials (Liburd et al., 2000). Furthermore, ammonium acetate appears to lose its attractiveness to *R. mendax* as flies reach sexual maturity. Our objective was to increase selectivity and late-season captures of blueberry maggot fly (BMF) using a two-phase study involving both field and laboratory experiments. Phase I will determine if *R. mendax* is responsive to volatiles emitted from ripening blueberries and phase II would identify and screen synthetic host-volatile compounds for their attractiveness to *R. mendax* in the field as well as to evaluate release rates of potential volatile compounds for monitoring *R. mendax*.

MATERIALS AND METHODS

Phase I. In order to determine if blueberry maggot flies were responsive to host volatiles emitted from ripening blueberries, two treatments consisting of (1) blueberries and (2) marbles (control) were placed in collapsible cages and hung ~ 2 m from stripped (blueberries removed) highbush blueberry bushes. Collapsible cages containing blueberries or marbles were fitted with four green sticky spheres for monitoring *R. mendax* flies. The experimental design was a completely randomized block with five replicates. Flies were counted and sexed twice per week and treatments within blocks were rotated twice per week.

Phase II. Volatile compounds were collected from ripening blueberries using Solid Phase Micro-extraction techniques (SPME) then identified using Gas Chromatography (HP-6980, Hewlett-Packard Co.) and Mass Spectrometry (Pegasus II, LECO Corp., St. Jos) techniques. Based on previous research (Liburd, 1997) and the compounds identified from our laboratory blueberry volatile profile, five synthetic compounds con-

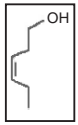
sisting of butyl butanoate, cis-3-hexen-1-ol, geraniol, alpha-terpiniol, and trans-2-hexenal were purchased from Aldrich Chemical Co., Milwaukee, WI. Volatile compounds were loaded (0.3 ml) into polyethylene slow-release BEEM® capsules (Ted Pella, Inc., Redding, CA). BEEM® capsules containing synthetic compounds were attached to green sticky sphere traps during field evaluations. Volatile compounds were compared with the standard ammonium acetate for their attractiveness to *R. mendax* throughout a typical blueberry growing season.

In experiments to compare the various load-rates, the two most active volatile compounds (based on attraction to *R. mendax*) that included; butyl butanoate and cis-3-hexen-1-ol were compared against the standard ammonium acetate (Figure 1). Each sticky green sphere had either one or five BEEM® capsules containing the respective volatile treatment. Fly attraction to baited spheres was recorded throughout the season.

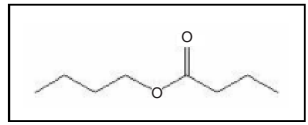
RESULTS AND DISCUSSION

Significantly more *R. mendax* flies were caught on green sticky spheres placed on collapsible cages and baited with blueberries compared with cages baited with marbles (surrogate blueberries) (Figure 2). Early in the season (6-17 July), ammonium acetate was significantly more attractive to *R. mendax* compared with other compounds evaluated (Figure 3). More than 150 *R. mendax* were captured on spheres baited with ammonium acetate (Figure 3). During the screening of volatile compounds, none of the five host volatile compounds evaluated were significantly more attractive to *R. mendax* early in the season compared with the control (Figure 3). Butyl butanoate was significantly more attractive than geraniol and alpha-terpiniol late in the season [2-16

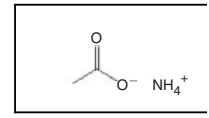
FIGURE 1. Chemical structures of the three most attractive volatile compounds to *R. mendax* adults based on field studies conducted in Rhode Island and Michigan (1999-2001).



cis-3-hexen-1-ol

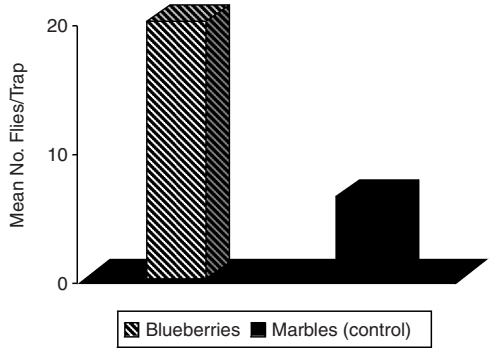


n-butyl butyrate



ammonium acetate

FIGURE 2. Response of *R. medax* files to collapsible cages baited with blueberries and marbles. Means followed by the same letter are not significantly different ($P \leq 0.05$, LSD test).



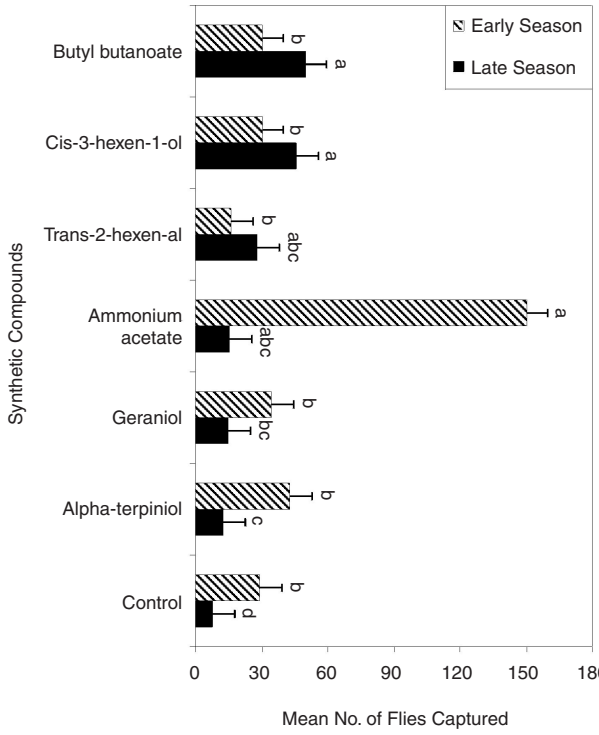
August] (Figure 3). Butyl butanoate and cis-3-hexen-1-ol were as attractive as ammonium acetate (1 BEEM® capsule) late in the production season when the majority of *R. mendax* were sexually mature (Figure 4). Increasing the load-rates of butyl butanoate and cis-3-hexen-1-ol did not significantly increase trap captures (Figure 4).

Five major host volatile compounds, including butyl butanoate, cis-3-hexen-1-ol, alpha-terpiniol, geraniol, and trans-2-hexenal were identified from ripening blueberries. Of these compounds, butyl butanoate and cis-3-hexen-1-ol were the most attractive compounds to *R. mendax* in the field. The attractiveness of these two compounds was more apparent later in the season when these two compounds were equally attractive to *R. mendax* compared with ammonium acetate.

CONCLUSION

Ammonium acetate was the most attractive compound to *R. mendax* flies early in the season, although its attractiveness decreased as flies reached sexual maturity. Butyl butanoate, cis-3-hexen-1-ol, appear to be good candidates to be used in a mixed volatile blend or individually for monitoring mature *R. mendax* flies. However, appropriate devices for releasing volatile compounds and proper release rates must be identified before these compounds can be used effectively in any monitoring program. Future research should examine devices for releasing volatile compounds and optimum trapping distances.

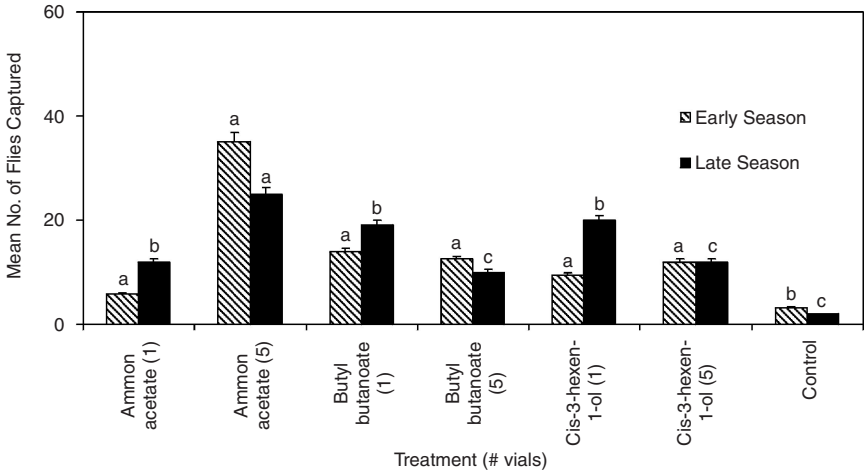
FIGURE 3. Screening synthetic volatile compounds for attraction to *R. medax* adults. Mean number of flies captured on 9-cm diameter green spheres baited wtih volatile treatments. Means followed by the same letter are not significantly different ($P \leq 0.05$, LSD test).



GROWER BENEFITS

The identification of host volatile compounds will improve monitoring efficiency for growers. Currently, ammonium acetate is used for baiting monitoring traps for *R. mendax*. The problem with ammonium acetate is that it attracts beneficial insects, which can help to regulate populations of *R. mendax*. In addition, ammonium acetate does not work well late in the season because sexually mature flies are not highly attracted to this compound. Growers will be able to better time their insecticide applications, and subsequently use less insecticides if monitoring protocol for *R. mendax* is improved.

FIGURE 4. Attraction of *R. mendax* to synthetic volatile compounds at different load-rates. Mean number of flies captured on 9-cm diameter green spheres baited with volatile treatments. Means followed by the same letter are not significantly different ($P \leq 0.05$, LSD test).



LITERATURE CITED

Liburd, O. E., S. R. Alm, R. A. Casagrande and S. Polavarapu. 1998. Effect of trap color, bait, shape and orientation in attraction of blueberry maggot flies. J. Econ. Entomol. 91: 243-249.

Liburd, O. E., S. Polavarapu, S. A. Alm, and R. A. Casagrande. 2000. Effect of trap size, placement, and age on captures of blueberry maggot flies (Diptera: Tephritidae). J. Econ. Entomol. 93: 1452-1458.

Liburd, O. E. 1997. Behavioral management techniques for broccoli and blueberry pests. PhD Diss. Univ. Rhode Island, Kingston, R.I. Diss. Abstract No. 9831111.

Prokopy, R. J., and W. M. Coli. 1978. Selective traps for monitoring *Rhagoletis mendax* flies. Protection. Ecol. 1:45-53.