BioOne COMPLETE

Mixing Male Lures Results in an Effective Multispecies Bait for Trapping Bactrocera (Diptera: Tephritidae) Fruit Flies

Authors: Shelly, Todd E., and Kurashima, Rick S.

Source: Florida Entomologist, 99(2) : 318-320

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.099.0229

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Mixing male lures results in an effective multispecies bait for trapping *Bactrocera* (Diptera: Tephritidae) fruit flies

Todd E. Shelly and Rick S. Kurashima*

The genus *Bactrocera* Macquart (Diptera: Tephritidae) contains invasive, polyphagous species that threaten fruit and vegetable production worldwide, and many countries maintain continuous surveillance programs to detect and monitor these pests (e.g., Jessup et al. 2007). These programs rely heavily on traps baited with male-specific lures, namely, methyl eugenol (ME, a natural plant product) and cue lure (CL, a synthetic compound), which attract several species within the genus (Jang & Light 1996). These lures are presented in separate traps, and it has long been recognized that traps baited with a blend of these liquid lures would greatly reduce costs of trap materials and servicing. Unfortunately, ME-CL mixtures generally show reduced performance relative to single-lure treatments. For example, Vargas et al. (2000) reported that traps baited with an ME-CL mixture captured similar numbers of the CL-responding species *Bactrocera cucurbitae* (Coquillett) as traps baited with CL alone but significantly fewer individuals of the ME-responding species *Bactrocera dorsalis* (Hendel) than traps baited with ME alone.

Recently, a solid dispenser or wafer (Farma Tech International, North Bend, Washington) containing ME and raspberry ketone (RK, a natural analogue of CL) has been found to perform as well as standard, single-lure presentations (Shelly 2010; Vargas et al. 2010). Given this result, the present study was undertaken to compare captures of *B. cucurbitae* and *B. dorsalis* male flies in traps baited with ME-RK mixtures versus traps baited with the single lures.

We assessed the attractiveness of 3 ME-RK mixtures that varied in the relative amounts of ME (a liquid) and RK (a powder). By weight, the 3 mixtures contained ME and RK in proportions of 85:15, 90:10, and 95:5. A toxicant (naled, a liquid) was then added to each mixture (5% by volume). Solutions were stirred thoroughly, and aliquots of 5 mL were applied to cotton wicks placed individually in perforated baskets and then placed inside Jackson traps (IAEA/FAO 2013). For the single-lure treatments, we placed 5 mL of ME or CL on cotton wicks. This basic protocol follows that of *Bactrocera* detection programs in California and Florida (IPRFFSP 2006).

All trapping was conducted in a coffee (*Coffea arabica* L.; Gentialnales: Rubiaceae) field about 10 km southeast of Haleiwa, Oahu, Hawaii. Coffee is a host of *B. dorsalis*, and hosts of *B. cucurbitae* were abundant along the field's perimeter. The 3 ME-RK mixtures were tested individually against ME and CL treatments in separate sampling intervals following the same protocol. Thirty trapping stations, separated by a minimum of 50 m, were established. At 15 stations, we placed 2 Jackson traps (2–3 m apart), one baited with ME and the other with CL. At the remaining 15 stations, we placed a single Jackson trap baited with an ME-RK mixture. All traps were hung directly on coffee plants in shaded locations 1.5 to 2.0 m above ground. Trapping was conducted every 2 wk over an 8 wk interval. During a sampling interval, traps operated for 24 h and were then returned to the laboratory, where the sticky inserts were removed and the flies identified by species and sex under a dissecting microscope. Traps, with lures still inside, were suspended in a covered, outdoor area near the laboratory for weathering until the next sampling period. The lure treatment used at a particular station was alternated between successive sampling events.

Raw data were $\log_{10}$ transformed, which yielded normal distributions in most cases (4 of 6; 2 species, 3 ME-RK mixtures), and analyzed using a 2-way ANOVA (with week and lure type as main effects). ANOVA using ranked data (Conover & Iman 1981) generated results identical to those obtained using raw data, indicating that the parametric analyses of raw data were sufficiently robust to accommodate the degree of non-normality present in a few cases.

For *B. dorsalis* (Fig. 1), lure type had a significant effect only for the comparison involving the 90:10 mixture ($F_{1,140} = 20.1$; $P < 0.001$), where traps containing the ME-RK blend captured more male flies than traps containing ME alone. Lure type had no detectable effect in tests with the 85:15 ($F_{1,140} = 0.1$; $P = 0.73$) or 95:5 ($F_{1,140} = 3.3$; $P = 0.07$) ME-RK mixture. Week had a significant effect in comparisons involving 90:10 ($F_{4,140} = 20.1$; $P < 0.001$) and 95:5 ($F_{4,140} = 22.5$; $P < 0.001$) ME-RK blends but not the 85:15 mixture ($F_{4,140} = 1.6$; $P = 0.17$). Where significant, temporal variation in male fly captures appeared to reflect not monotonic decreases in trap catch (resulting, for example, from a decrease of lure attractiveness), but natural fluctuations in population size. The lure type ´ week interaction term was not significant in any of the tests ($P > 0.05$ in all 3 cases).

For *B. cucurbitae* (Fig. 2), lure type did not have a significant effect in any of the comparisons (85:15 blend: $F_{1,140} = 0.7$; $P = 0.42$; 90:10 blend: $F_{1,140} = 0.1$; $P = 0.99$; 95:5 blend: $F_{1,140} = 2.5$; $P = 0.12$). Week had a significant effect only in the comparison involving the 95:5 mixture ($F_{4,140} = 21.1$; $P < 0.001$) but not the 85:15 ($F_{4,140} = 0.2$; $P = 0.95$) or 90:10 blend ($F_{4,140} = 1.9$; $P = 0.11$). In the test involving the 95:5 ME-RK mixture, male fly captures showed a consistent decrease over time, but whether this trend reflected decreased lure attractiveness or natural population dynamics is unknown. The lure type ´ week interaction term was not significant in any of the tests ($P > 0.05$ in all cases).

Whereas previous studies (Vargas et al. 2000; Shelly et al. 2004) showed that liquid ME-CL mixtures attracted fewer *B. dorsalis* male flies than liquid ME alone, the present data revealed no inhibitory effect of liquid ME–granular RK solutions on *B. dorsalis* male fly captures, a result consistent with field trials involving solid dispensers (wafers) containing ME and RK in a single matrix (Shelly 2010; Vargas et al. 2010). Why ME mixtures containing RK, but not CL, effectively attract *B. dorsalis* male flies is unknown, but the present results suggest the ME-RK solution is an effective multispecies lure that could greatly reduce costs of tephritid trapping programs.

United States Department of Agriculture, Animal and Plant Health Inspection Service, 41-650 Ahiki Street, Waimanalo, Hawaii 96795, USA
*Corresponding author; E-mail: todd.e.shelly@aphis.usda.gov

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

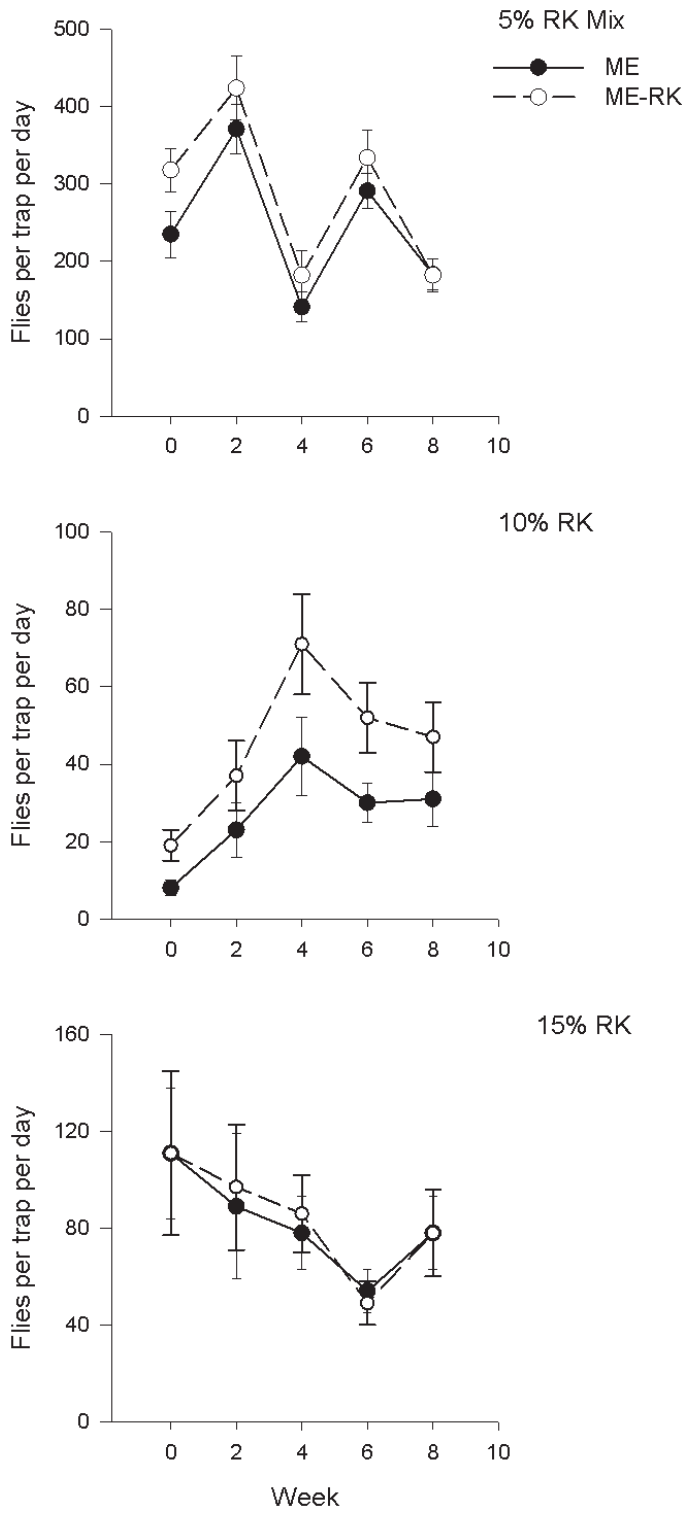


Fig. 1. Numbers of *Bactrocera dorsalis* male flies captured in traps baited with methyl eugenol (ME) alone or a mixture of ME and raspberry ketone (RK, a natural analogue of cue lure). Comparisons involved 3 mixtures in ME:RK ratios (wt:wt) of 95:5, 90:10, and 85:15. Symbols represent means (± SE) of 15 traps per lure type at 2 wk intervals over an 8 wk sampling period.

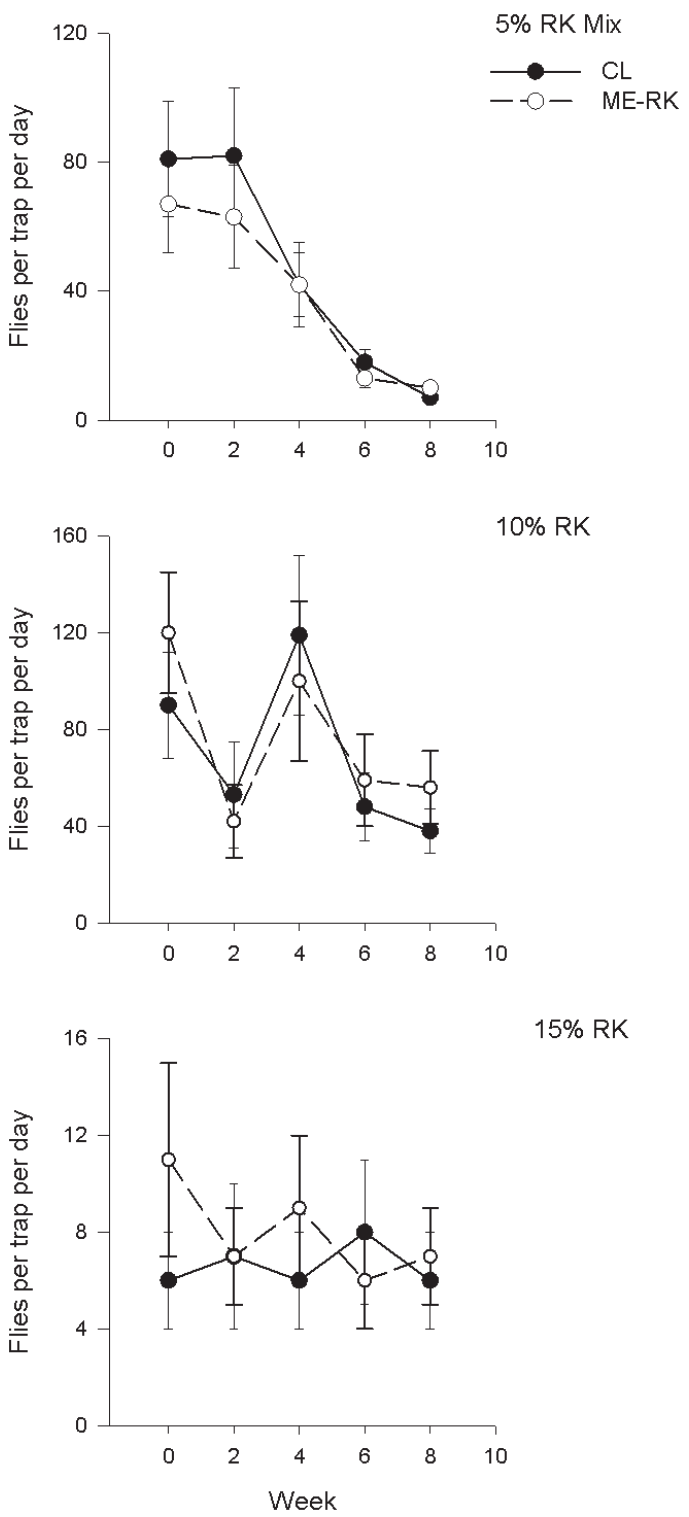


Fig. 2. Numbers of *Bactrocera cucurbitae* male flies captured in traps baited with cue lure (CL) alone or a mixture of methyl eugenol (ME) and raspberry ketone (RK, a natural analogue of cue lure). Comparisons involved 3 mixtures in ME:RK ratios (wt:wt) of 95:5, 90:10, and 85:15. Symbols represent means (± SE) of 15 traps per lure type at 2 wk intervals over an 8 wk sampling period.

Summary

Detection of *Bactrocera* Macquart (Diptera: Tephritidae) fruit flies relies on male-specific lures, methyl eugenol and cue lure, which are presented singly in traps. We compared the efficacy of the standard single-lure treatments against mixtures of methyl eugenol and raspberry ketone (a natural analogue of cue lure) deployed in the same

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

trap. No significant differences were found in captures of *Bactrocera cucurbitae* (Coquillett) or *B. dorsalis* (Hendel) male flies over 8 wk intervals between traps baited with a single lure and traps baited with any of the 3 mixtures tested.

Key Words: trapping; detection; semiochemical; invasive species

Sumario

La detection de moscas de la fruta *Bactrocera* (Diptera: Tephritidae) depende de los señuelos específicos para los machos, metil eugenol y el señuelo de referencia, que se presenta indivualmente en las trampas. Se comparó la eficacia de los tratamientos estándar de un solo señuelo contra mezclas de metil eugenol y la cetona de frambuesa (un análogo natural del señuelo señuelo de referencia) puesto en la misma trampa. No se encontraron diferencias significativas en las capturas de machos de *Bactrocera cucurbitae* (Coquillett) o *B. dorsalis* (Hendel) por los intervalos de 8 semanas entre las trampas cebadas con un único señuelo y trampas cebadas con cualquiera de las 3 mezclas probadas.

Palabras Clave: atrapando; detección; semioquímicos; especies invasivas

References Cited

Conover WJ, Iman RL. 1981. Rank transformations as a bridge between parametric and nonparametric statistics. The American Statistician 35: 124–129.

IAEA/FAO (International Atomic Energy Agency and Food and Agriculture Organization). 2013. Trapping manual for area-wide fruit fly programmes. International Atomic Energy Agency, Vienna, Austria.

IPRFFSP (International Panel for Review of Fruit Fly Surveillance Programs). 2006. Review of fruit fly surveillance programs in the United States. United States Department of Agriculture/Animal and Plant Health Inspection Service/Plant Protection and Quarantine/ Fruit Fly Program, Riverdale, Maryland.

Jang EB, Light DM. 1996. Olfactory semiochemicals of tephritids, pp. 73–90 *In* McPheron BA, Steck GJ [eds.], Fruit Fly Pests: A World Assessment of their Biology and Management. St. Lucie Press, Delray Beach, Florida.

Jessup AJ, Dominiak B, Woods B, De Lima CPF, Tomkins A, Smallridge CJ. 2007. Area-wide management of fruit flies in Australia, pp. 685–697 *In* Vreysen MJB, Robinson AS, Hendrichs J [eds.], Area-Wide Control of Insect Pests: From Research to Field Implementation. Springer, Dordrecht, the Netherlands.

Shelly TE. 2010. Capture of *Bactrocera* males (Diptera: Tephritidae) in parapheromone-baited traps: a comparison of liquid versus solid formulations. Proceedings of the Hawaiian Entomological Society 42: 1–8.

Shelly TE, Pahio E, Edu J. 2004. Synergistic and inhibitory interactions between methyl eugenol and cue lure influence trap catch of male fruit flies, *Bactrocera dorsalis* (Hendel) and *B. cucurbitae* (Diptera: Tephritidae). Florida Entomologist 87: 481–486.

Vargas RI, Stark JD, Kido MH, Ketter HM, Whitehand LC. 2000. Methyl eugenol and cue-lure traps for suppression of male oriental fruit flies and melon flies (Diptera: Tephritidae) in Hawaii: effects of lure mixtures and weathering. Journal of Economic Entomology 93: 81–87.

Vargas RI, Mau RFL, Stark JD, Piñero JC, Leblanc L, Souder SK. 2010. Evaluation of methyl eugenol and cue-lure traps with solid lure and insecticide dispensers for fruit fly monitoring and male annihilation in the Hawaii areawide pest management program. Journal of Economic Entomology 103: 409–415.

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use