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Source: Florida Entomologist, 89(2) : 286-287

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/0015-4040(2006)89[286:EOPGAO]2.0.CO;2

EFFECT OF PROPYLENE GLYCOL ANTIFREEZE ON CAPTURES OF MEXICAN FRUIT FLIES (DIPTERA: TEPHRITIDAE) IN TRAPS BAITED WITH BIOLURES AND AFF LURES

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Multilure traps (Better World Manufacturing, Inc., Miami, FL) baited with BioLure MFF lures (Suterra LLC, Inc., Bend, OR) and containing water with propylene glycol antifreeze as the drowning agent were about 2× more attractive than similar traps baited with AFF lures (Advanced Pheromone Technologies, Marylhurst, OR) in orchard tests with irradiated Mexican fruit flies (*Anastrepha ludens* Loew) (Robacker & Czokajlo 2005). Although antifreeze originally was used in traps only to preserve the captured flies, Thomas et al. (2001) found that attraction of feral Mexican and Caribbean (*A. suspensa* (Loew)) fruit flies to McPhail-type traps baited with BioLure MFF lures doubled when antifreeze was added to the water. Thomas et al. (2001) did not establish whether or not antifreeze was attractive by itself. Hall et al. (2005) found that water with 10% propylene glycol was not more attractive than water but the two drowning agents were not tested in the same trap type so conclusive data about the attractiveness of antifreeze has not been published. The objectives of this work were 1) to determine if antifreeze is attractive to Mexican fruit flies, 2) to investigate whether antifreeze enhances attractiveness of the AFF lure; and 3) to compare efficacy of BioLures and AFF lures in traps containing water without antifreeze as the drowning agent.

Multilure traps were used to test the following treatments: 300 ml of water with 0.01% Triton X-100R (Fisher Scientific, Pittsburgh, PA) (hereafter referred to as water); 300 ml of water with 10% propylene glycol-based antifreeze (LowTox Antifreeze, Prestone Products Corp., Danbury, CT) (hereafter antifreeze); BioLure 2-component (ammonium acetate and putrescine) MFF lure (hereafter BioLure) with water; BioLure with antifreeze; AFF lure with water; and AFF lure with antifreeze. BioLures were deployed in traps by adhering the ammonium acetate patch and the putrescine patch separately on the inside wall of the plastic top. Two versions of the AFF lure, the standard lure and a smaller version made specifically for multilure traps, were used in separate experiments. For the standard lure, the plastic bags containing the AFF lure components were removed from the mesh bag provided by the manufacturer. The larger plastic bag was taped onto the inside wall of the trap top and the smaller one was put into the lure basket on the ceiling of the trap top. For the smaller version, both plastic bags were put into the lure basket of the trap top.

Tests were conducted with irradiated Mexican fruit flies from a laboratory culture started in 2000 from pupae collected from yellow chapote (*Casimiroa greggii*), a native host, from the Montemorelos area of Nuevo Leon in northeastern Mexico. Larvae were reared on artificial medium and pupae were irradiated with 70-92 Gy (Cobalt 60) 1-2 d before adult eclosion. Mixed-sex groups of 200 flies were kept in 473-ml cardboard cartons with sugar and water until released in test plots 3 to 8 d after eclosion.

Testing was conducted in a grapefruit (*Citrus paradisi*) (variety Rio Red) orchard near Weslaco, Texas. Three blocks of 6 consecutive trees were used in each of two rows for a total of 6 blocks. Traps were hung one to a tree, north of center, at 1-2 m height. Approximately 4000 flies were distributed equally onto trees in rows adjacent to the test rows during each week of the experiments. Each week, flies were removed and counted, water and antifreeze were changed, and the traps were rotated sequentially within blocks. Synthetic lures were not changed.

Two experiments were conducted that were identical except for the AFF lure type. Experiment 1 used the standard AFF lure and Experiment 2 used the smaller version of the AFF lure. Experiment 1 was conducted for 10 weeks (10 weeks × 6 blocks = 60 tests of each treatment) and Experiment 2 for 8 weeks. Replications over time (weeks) were treated like replications over space (blocks of trees) for statistical analyses. Counts of captured flies were transformed by square root to stabilize variance (Snedecor & Cochran 1967). Transformed data were subjected to analysis of variance by SuperANOVA (Abacus Concepts 1989).

The results of Experiment 1 with standard AFF lures are shown in Table 1. BioLure traps with antifreeze captured more than 2× as many males and females as BioLure traps with water. AFF lure traps with antifreeze also were significantly more attractive than AFF lure traps with water, but the difference was not as great as for the BioLure traps. Generally, BioLures and AFF lures performed comparably in traps with water. The results of Experiment 2 with smaller AFF lures (Table 2) were similar to those of Experiment 1.

TABLE 1. CAPTURE OF MEXICAN FRUIT FLIES IN MULTILURE TRAPS BAITED WITH BIOLURES OR STANDARD AFF LURES AND CONTAINING WATER WITH TRITON OR WITH ANTIFREEZE IN THE TRAP RESERVOIR.[1]

Lure/drowning agent	Males	Females	Total
none/water-Triton	0.2 ± 0.1 a	0.2 ± 0.1 a	0.3 ± 0.1 a
none/water-antifreeze	0.2 ± 0.1 a	0.3 ± 0.1 a	0.6 ± 0.1 a
BioLure/water-Triton	8.3 ± 0.8 b	9.2 ± 0.9 b	17.5 ± 1.7 b
BioLure/water-antifreeze	17.7 ± 2.3 d	20.6 ± 2.0 d	38.2 ± 4.2 d
AFF lure/water-Triton	9.2 ± 0.9 b	8.8 ± 0.8 b	18.1 ± 1.6 b
AFF lure/water-antifreeze	11.8 ± 1.2 c	12.6 ± 1.4 c	24.4 ± 2.4 c

[1]Means (± SE) in the same column followed by the same letter are not significantly different by Fishers protected LSD test ($P < 0.05$) (males: $F = 154$; $df = 5{,}345$; $P < 0.0001$, females: $F = 166$; $df = 5{,}345$; $P < 0.0001$).

TABLE 2. CAPTURE OF MEXICAN FRUIT FLIES IN MULTILURE TRAPS BAITED WITH BIOLURES OR SMALL-VERSION AFF LURES AND CONTAINING WATER WITH TRITON OR WITH ANTIFREEZE IN THE TRAP RESERVOIR.[1]

Lure/drowning agent	Males	Females	Total
none/water-Triton	0.7 ± 0.1 a	0.8 ± 0.2 a	1.5 ± 0.2 a
none/water-antifreeze	0.7 ± 0.1 a	0.6 ± 0.2 a	1.3 ± 0.2 a
BioLure/water-Triton	7.0 ± 1.0 bc	10.0 ± 1.3 c	17.0 ± 2.1 bc
BioLure/water-antifreeze	17.8 ± 2.8 d	22.6 ± 3.4 d	40.4 ± 6.0 d
AFF lure/water-Triton	5.9 ± 0.8 b	7.3 ± 1.2 b	13.2 ± 1.9 b
AFF lure/water-antifreeze	9.4 ± 1.2 c	9.0 ± 1.3 bc	18.4 ± 2.4 c

[1]Means (± SE) in the same column followed by the same letter are not significantly different by Fishers protected LSD test ($P < 0.05$) (males: $F = 61.6$; $df = 5{,}263$; $P < 0.0001$, females: $F = 67.3$; $df = 5{,}263$; $P < 0.0001$).

The results of these experiments indicate that antifreeze enhances the efficacy of AFF lures only slightly compared with the large enhancement effect with BioLure-baited traps. Differences in the effects of antifreeze in traps baited with BioLures and AFF lures may be related to differences in emissions from the two lures. Whereas both lures emit ammonia, putrescine, and 1-pyrroline, the lures differ in that BioLures also emit acetic acid and AFF lures emit methylamine (Robacker & Czokajlo 2005). In addition, AFF lures emit much more ammonia and 1-pyrroline than BioLures (Robacker & Czokajlo 2005).

I thank Maura Rodriguez and Israel Arroyo (both USDA ARS, Weslaco) for technical assistance. Mention of a proprietary product does not constitute an endorsement or recommendation for its use by the USDA.

SUMMARY

Multilure traps baited with AFF lures captured equal numbers of sterile Mexican fruit flies in a citrus orchard compared with traps baited with BioLure MFF 2-component lures, when water with Triton X-100R was used as the drowning agent. Use of 10% antifreeze as the drowning agent enhanced attractiveness of BioLure-baited traps by more than twofold over traps containing water with Triton. Antifreeze increased attractiveness of traps baited with AFF lures by less than 50%. Because antifreeze had no attractiveness by itself, the effects reveal synergism. Reasons for the different interactions of antifreeze with BioLures and AFF lures were not determined.

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