

Final Report

Dr. Homola's Repellent Evaluation Study - II

Submitted to:

**Dr. Andrew Homola
Citrolux Corporation
P. O. Box 875
Morgan Hill, CA 95038-0875**

Prepared by:

Dr. John P. Smith, Professor of Entomology & Director
John A. Mulrennan, Sr., Public Health Entomology
Research & Education Center (PHEREC)
4000 Frankford Avenue
Panama City, Florida 32405-1933
(850) 872-4184 X23 (phone)
(850) 872-4733 (fax)
smith_j@popmail.firn.edu

Study Participants:

Dr. John Smith
Mr. Jimmy Walsh
Mr. Rob Williams

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Abstract

Homola E formulation provided 100% protection against *Culex quinquefasciatus* through 6 hrs. MosqiGuard, Repel Lemon Eucalyptus, and Off! DW were only slightly less in performance diminishing only slightly in hours 2-6. BugGuard diminished the quickest after application, but only by small amount through 4 hrs. Our findings do not represent an endorsement of these products by Florida A&M University.

Project Objective:

To compare repellency of the following treatments:

1. *Homola E*: A proprietary, microencapsulated cream DEET (N,N-diethyl-3-mehtylbenzamide) formulation developed by CitroLux Corporation.
2. *Off! Deep Woods*: A commercial aerosol formulation manufactured by SC Johnson containing 23.8% DEET.
3. *Skin-So-Soft BugGuard plus IR3535 Insect Repellent and Moisturizing Lotion*: A commercial cream formulation sold by Avon containing 7.5% ethyl butylacetyl-amino-propionate/butylacetyl-aminopropionic acid.
4. *Repel Lemon Eucalyptus*: A commercial cream formulation distributed by WPC Brands, Inc. containing 30% oil of lemon eucalyptus (approx. 65% p-methane-3,8-diol).
5. *Mosi-guard Natural*: A commercial pump spray formulation manufactured in England containing the active ingredient, citriodiol.
6. Non-treated control.

Study Protocol:

Bioasssay organisms:

The repellency of the above treatments was evaluated against a bovine blood-fed strain of southern house mosquitoes, *Culex quinquefasciatus* Say. The original source for the colony maintained at PHEREC was Benzon Research, Inc., Carlisle, PA. Food and water were removed from the mosquitoes 12 hours prior to testing to insure adequate biting pressure. Three male volunteers served as test subjects.

Study site and methods:

Experimentation was conducted at PHEREC in a laboratory using a modification of the K&D module technique (Klun & Debboun 2000). In brief, six-chambered plexiglass modules (three per evaluator) were stocked no more than one hour prior to testing with 10, 5-6-day-old colony-reared female mosquitoes per chamber. The chambers were equipped with sliding doors to expose the mosquitoes to the legs of the evaluators. Clear packing tape was applied to the bottom of each module and cut open beneath the doors with an Exacto® knife.

Tape was removed and the bottom swabbed with isopropyl alcohol, dried and replaced with fresh tape between tests to minimize accumulation of repellent residues. Treatments were applied at 28.6 ul to 12 cm² rectangles traced on the skin with a plastic template and ballpoint pen matching the door openings. Treatments were randomly assigned and spaced one chamber width apart to minimize repellent interactions so that three treatments were tested per leg surface. The upper surface and both sides of each leg were utilized for testing. Chambers were placed directly over three treatment rectangles, biting counts were conducted and then the module was rotated 180° to the same surface on the opposite leg so that all six chambers were utilized. Each volunteer conducted simultaneous 2-minute biting counts per treatment at five time intervals: 0, 1, 2, 4 & 6 hrs post-treatment. Each treatment and time interval combination were replicated three times and the entire experiment was repeated six times over six separate days. New mosquitoes were stocked into the modules for each time interval and day of testing. As such, each treatment was tested 54 times per time interval or 270 total tests per treatment. Ambient temperature and humidity were recorded with a HOBO data logger positioned in the lab where tests were performed.

Data Analysis:

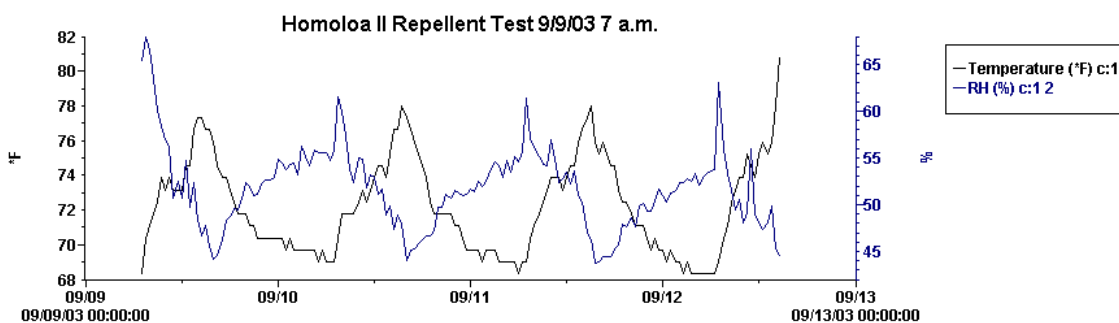
Data from this study was normalized by square root x + 1 transformation and statistically analyzed and combined so that the mean biting count for each treatment was based on 54 observations (i.e., tests) per time interval. Results were charted with 95% confidence limits as average biting count per exposure interval and as percent repellency using the following formula: (Control – Treatment) / Control X 100.

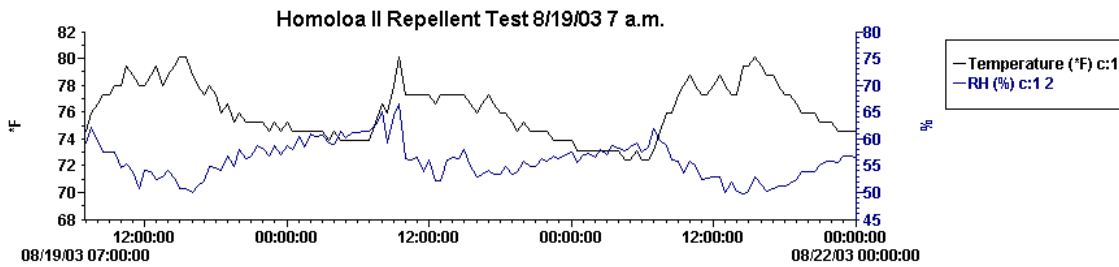
Results:

Environmental Data:

Ambient temperature and humidity during the six days of testing are presented graphically in Fig. 1. Two testing trials were conducted. The first was during August 19, 21, and 22 and the second on September 9, 11 and 12, 2003 between 8:30 a.m. and 3:00 p.m. (CT) each day. Temperatures averaged in the lower 70° F and mid-50% RH ranges during the first trial. The averages were in the upper 70° F and mid-50% RH ranges during the second trial.

Figure 1. Temperature and humidity during tests.





Biting Counts:

Significantly fewer bites occurred in all test repellents compared to the control at all time intervals (Fig. 2). There was no significant difference in biting counts among repellents. When converted to percent repellency in relationship to the control, MosiGuard, Repel, and Off! DW provided >90% repellency throughout 6 hrs. Homolola E was provided 100% protection throughout 6 hrs. BugGuard yielded >90% repellency through 4 hrs. and dropped to 88% at 6 hrs. (Fig. 3).

Figure 2. Mean biting counts and 95% confidence intervals by treatment and time interval.

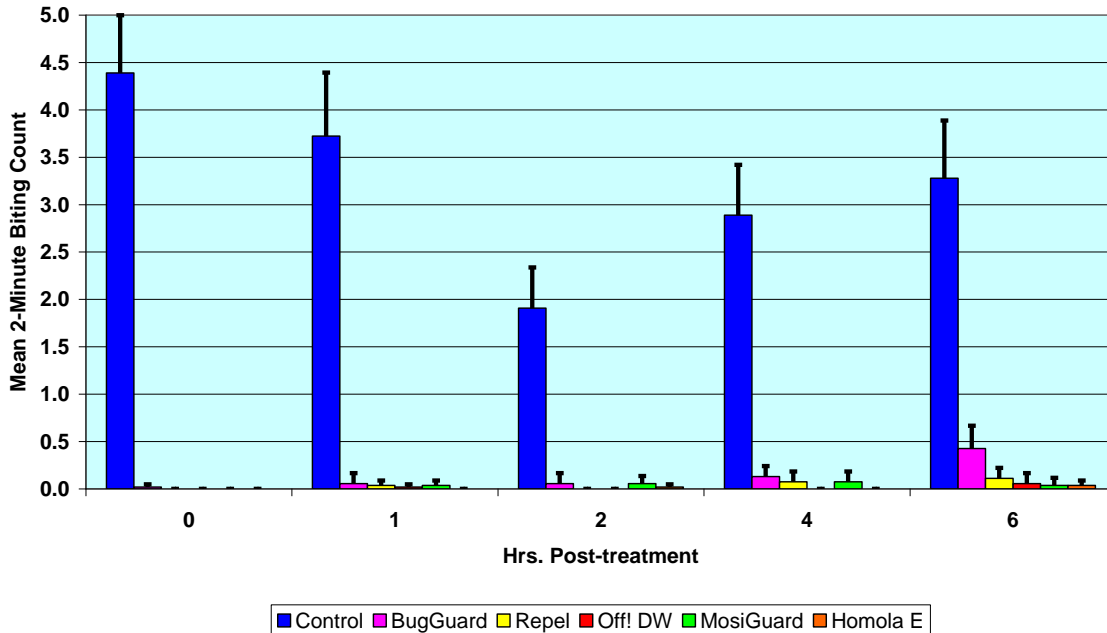
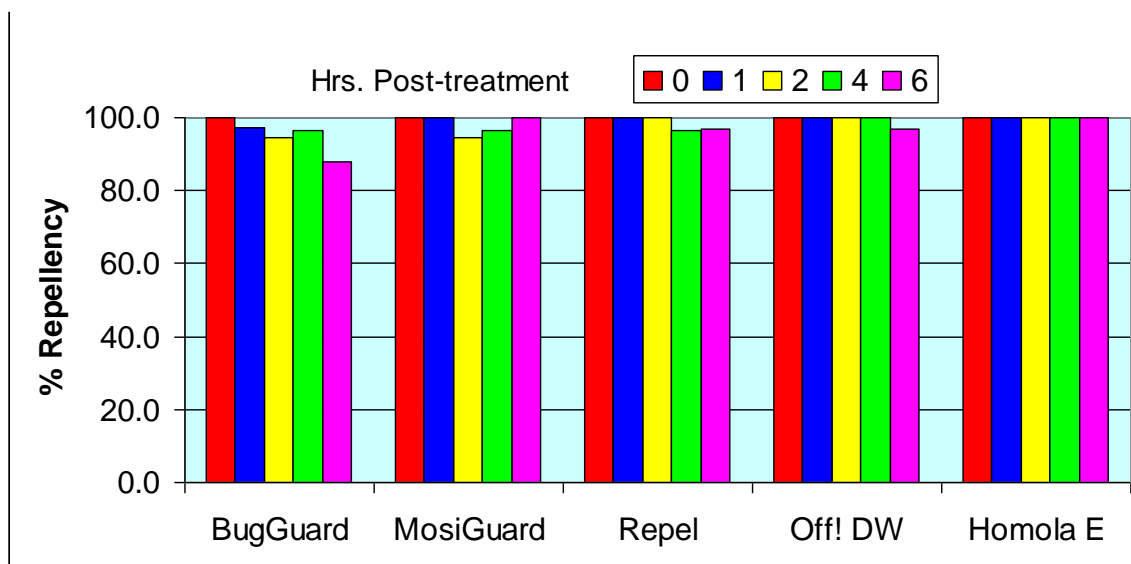


Figure 3. Percent Repellency by time interval for each test product.



Conclusions and Discussion:

All candidate repellents provided good protection against *Culex quinquefasciatus*. Homola E was the only formulation that provided complete 100% protection throughout 6 hrs. Off! DW, Repel, and MosiGuard were only slightly lower in repellent performance. BugGuard repellency diminished the most, but still provided 88% repellency at 6 hrs. All test formulations were relatively good performers providing on average well over 90% repellency.

Results may not be the same under field conditions and/or against other non-tested species. Additional testing is warranted. Our findings do not represent an endorsement of these products by Florida A&M University.

Literature Cited:

Klun, J. A. and M. Debboun. 2000. A new module for quantitative evaluation of repellent efficacy using human subjects. *J. Med. Entomol.* 37: 177-181