

Energy Related Devices

Demonstration and Validation

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Objectives

Given that the goal from the previous assistance was to proof the feasibility of the concept claimed by BugBlingBand (BBB). This round of tests will be measuring performance based on the latest prototype version of the device created by the company—not available last year, and through an iterative process to determine optimization of the compounds. Recommendations will be provided based on findings as a pre-commercial development of the product in order to significantly increase its marketability.

Approach

We tested the repellent efficacy of two BugBling Band prototypes on *Aedes aegypti* mosquitoes.

The active ingredients in prototype 1 were DEET and Citronella (1: 0.9). The active ingredients in prototype 2 were DEET and Oil of Lemon Eucalyptus (1: 0.9). The prototypes were constructed by the inventor and provided to the experimenter.

In order to test the prototypes, we placed the BugBling band around the fingers of a volunteer then placed the fingers near one port on the Y-tube olfactometer. The Y-tube is an established device to measure attraction and repellency towards mosquitoes (<http://www.ncbi.nlm.nih.gov/pubmed/26443777>).

Materials and Methods

Band Prototypes- These prototypes were constructed by the inventor. The prototype with citronella and DEET is from here on referred to as prototype 1. The other prototype contained lemon eucalyptus oil and DEET, is referred to as prototype 2.

Prototype #	BugBling Bands
1	DEET and Citronella
2	DEET and Lemon Eucalyptus

Y-tube Assay- The Y-tube was used to further evaluate the efficacy of the new prototypes that were constructed by the inventor. The regions of the Y-tube include: the holding chamber, the Y, and the ports (Figure 1). The holding chamber is where the mosquitoes are initially placed to begin the experiment. The holding chamber is located at the bottom of the Y. There are 3 trap doors within the Y-tube.

Mosquitoes referred to as “wandering” indicate that they were within the Y of the tube, but not trapped within the holding chamber or the two ports at the top of the Y. We use the term “blank” for the port that contains no treatment. If a port has a treatment inside of it, such as a repellent or attractant, the port will be referred to as the “hand” port.

Air flow was achieved with a small fan at the bottom of the Y-tube. By placing an attractant or repellent at one port, we are able to evaluate the efficacy of either.

The mosquitoes were transferred and allowed 30 seconds to acclimate in the holding chamber. After 30 seconds, all trap doors were opened and the mosquitoes were given two minutes to relocate within the y-tube.

In this study, we performed four trials for each treatment. For each replicate, 10 mosquitoes were used. The four treatments evaluated in this study include: the positive control, the negative control, and the two BugBling band prototypes. The positive control in this study was a bare hand. The negative control in this study was two empty ports. The results of the replicates were averaged and the percentile of mosquitoes in the different parts of the olfactometer was graphed.



Figure 1. The olfactometer (Y-Tube).

Results

Positive Control- The first experiment tested the attractiveness of the bare hand to serve as a positive control. On average, 10% of the mosquitoes remained in the holding chamber. The port with the bare hand held approximately 70% of the mosquitoes. While the blank held about 10% of the mosquitoes. The number of mosquitoes left in the Y, also indicated as wandering, was 10%. There was a strong attraction to the hand as shown in Figure 2.

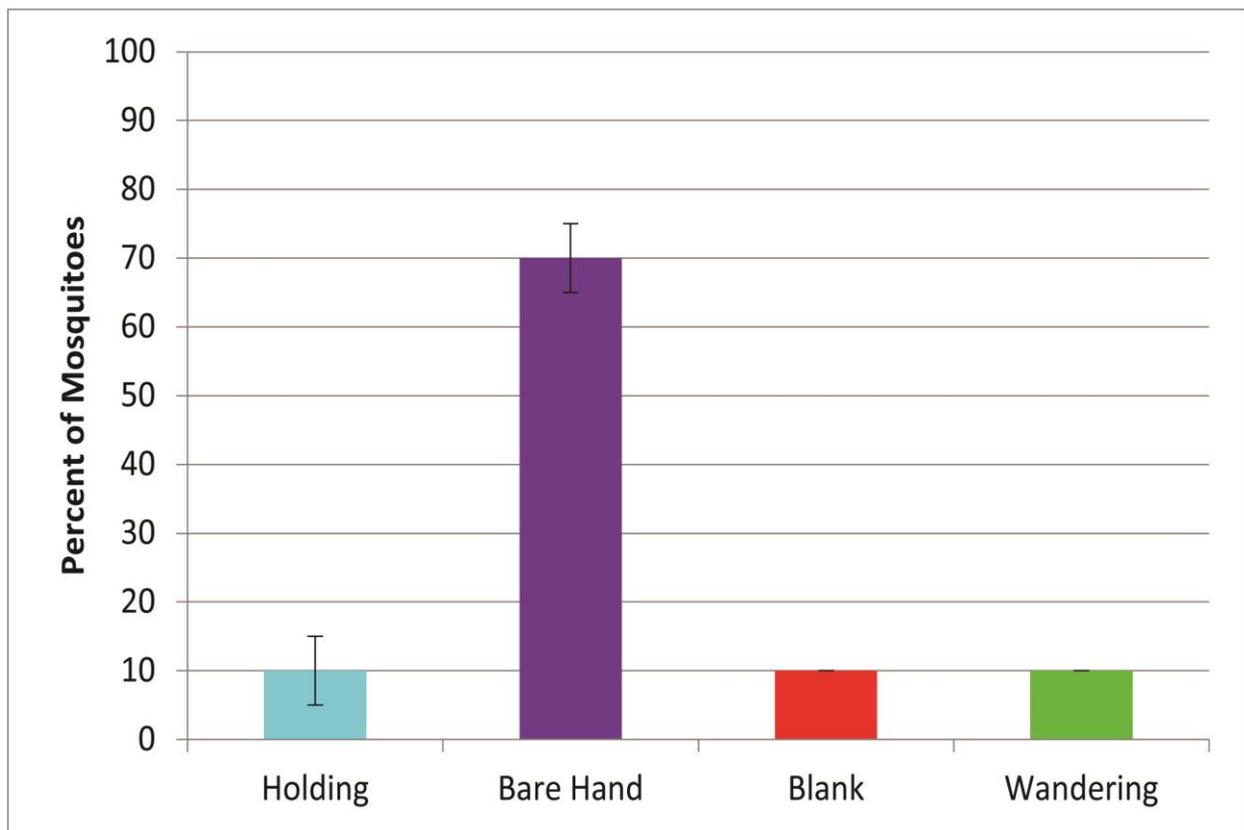


Figure 2. Positive Control. Percent of mosquitoes in each area of the y-tube.

Negative Control- A negative control was done in order to mosquito behavior without a stimulant. The percentage of mosquitoes that remained in the holding chamber was 73%. The average number of mosquitoes that were in either of the ports, labeled blanks, ranged between 0 to 10%. The percentage of mosquitoes that were wandering within the Y was 17%. The holding chamber contained most of the mosquitoes when there was no attractant or repellent present at either port.

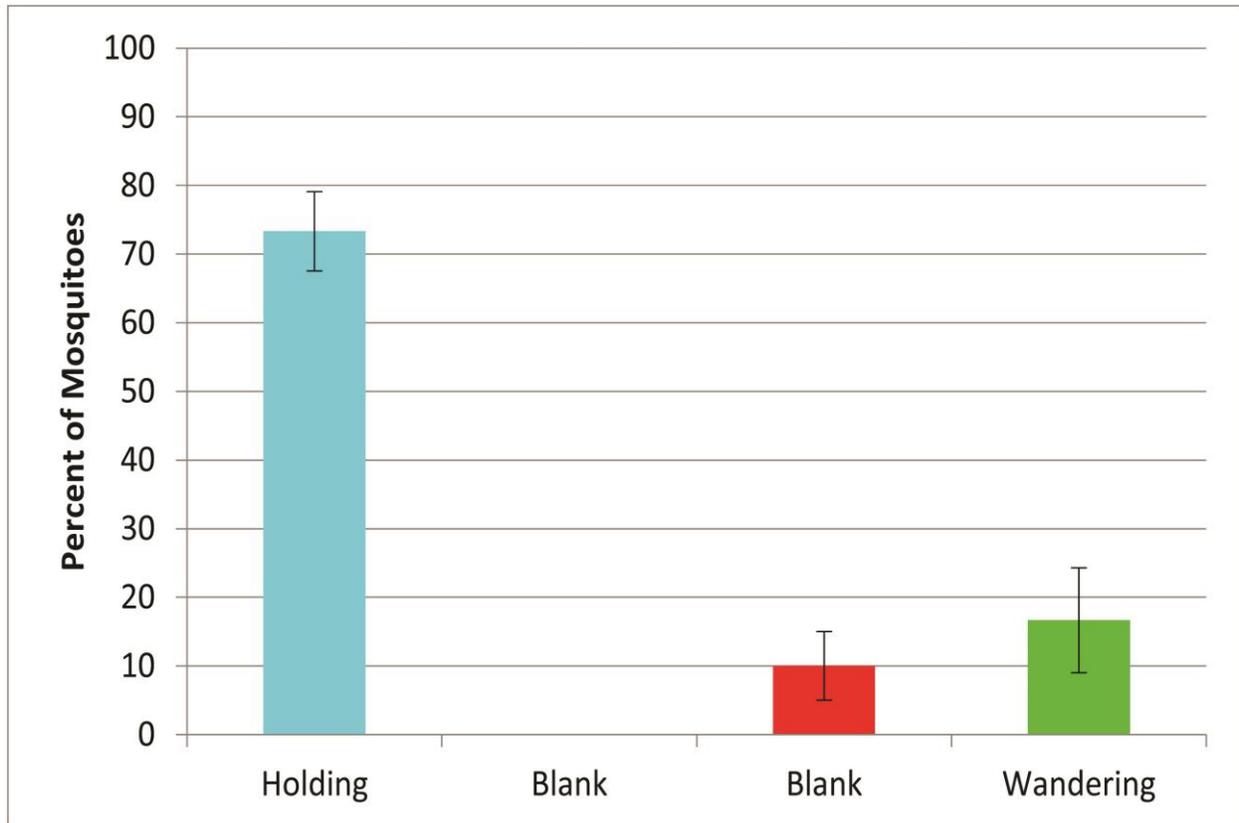


Figure 3. Negative Control. Percent of mosquitoes in each area of the y-tube.

Prototype 1- The efficacy of the Citronella/DEET BugBling band prototype was tested. The percentage of mosquitoes in the holding chamber was 23%. The port with the BugBling Band contained 17% of the mosquitoes. The empty port, reported as the blank, contained 20% of the mosquitoes. 40% of the mosquitoes remained in the Y, which were recorded as wandering.

We noticed that the Citronella/DEET BugBling band seemed to lose its pungency faster than the Lemon Eucalyptus/DEET BugBling band with repetitive use even when product was repacked.

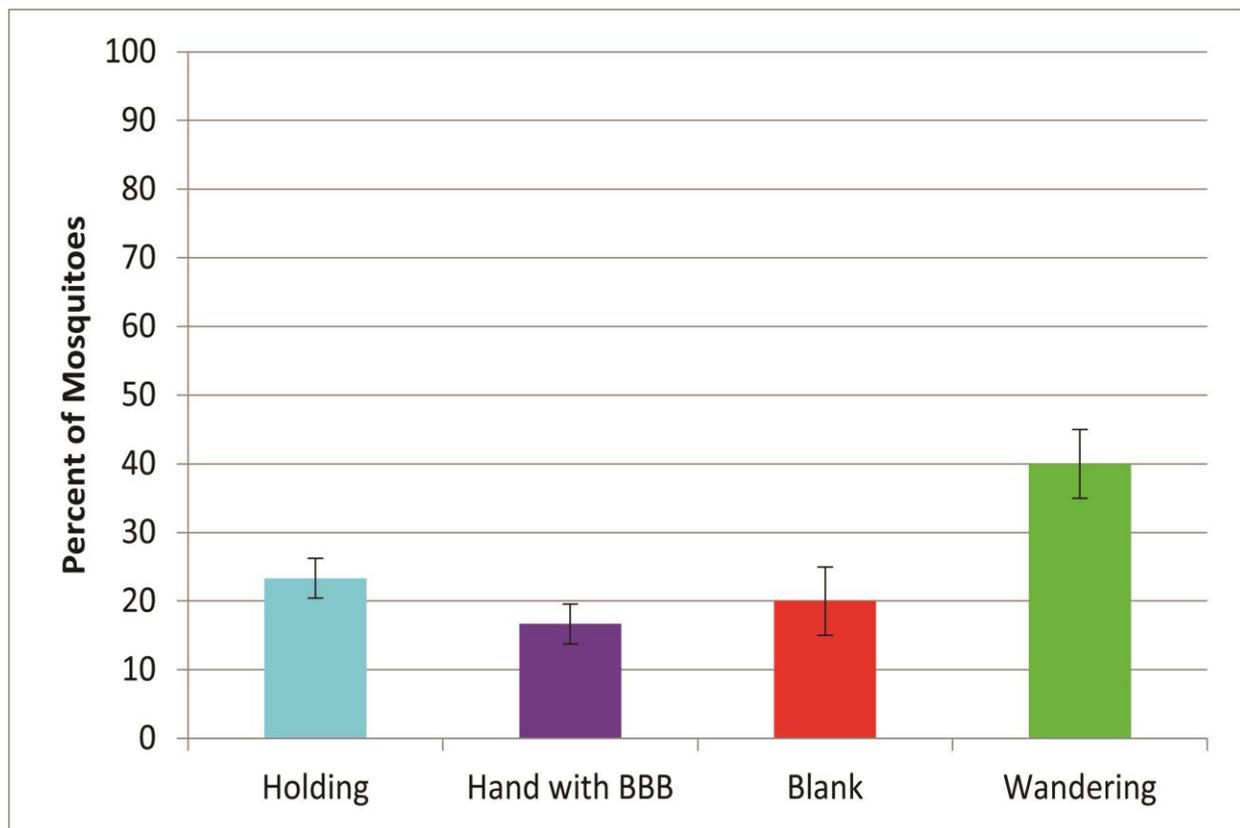


Figure 4. Citronella/DEET BugBling Band. Percent of mosquitoes in each area of the y-tube.

Prototype 2- Lemon Eucalyptus/DEET BugBling band was tested. The holding chamber contained 30% of the mosquitoes. The port that contained the hand wearing the BugBling Band contained 7% of the mosquitoes. The blank port contained 20% of the mosquitoes. 43% of the mosquitoes were wandering.

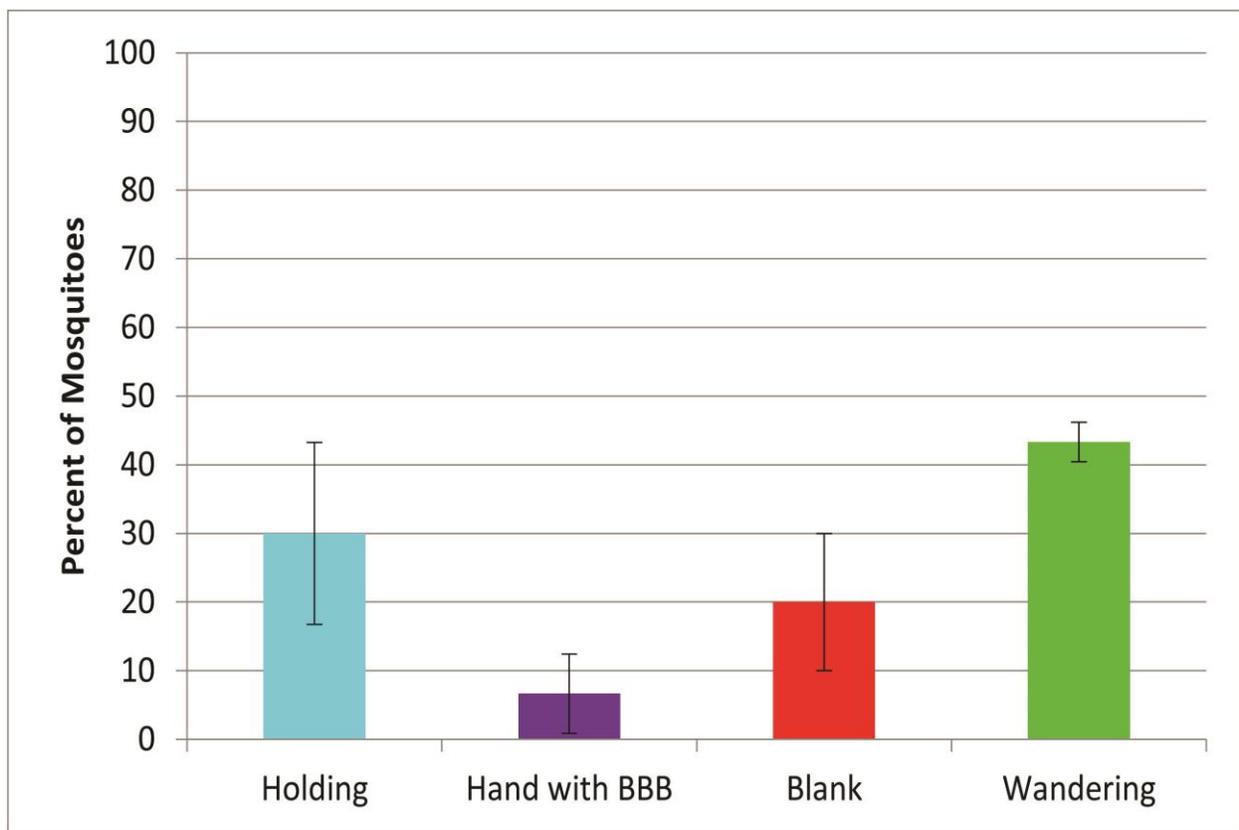


Figure 5. Lemon Eucalyptus/DEET BugBling Band. Percent of mosquitoes in each area of the y-tube.

Attraction analysis- In comparing the treatments, there was a significant difference between the positive control and the other treatments. The positive control had a 70% attraction rate. The negative control had a 7.5% attraction rate. The Citronella BugBling band had a 16.7% attraction rate. The Lemon Eucalyptus BugBling Band had a 6.7% attraction rate. The negative control, Citronella BugBling Band, and Lemon Eucalyptus BugBling Band were significantly different than the control with a P-value less than .001.

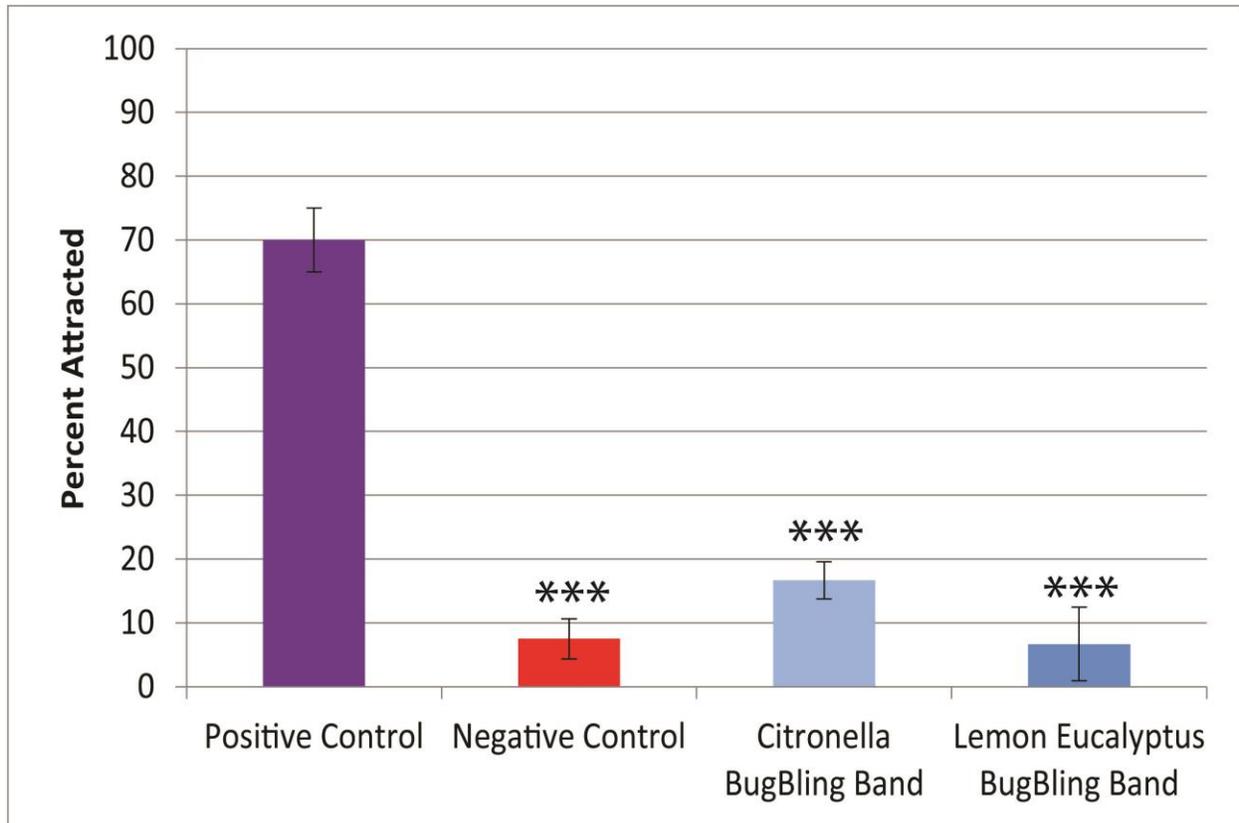


Figure 6. Efficacy of the BugBling bands.

Conclusions

Both of the prototype bands are highly effective at reducing mosquito attraction to the hand.

There was no significant difference in efficacy between the two prototypes. The Citronella/DEET BugBling band and the Lemon Eucalyptus/DEET BugBling band have similar repellency effects.

Based on this data, these BugBling Band prototypes provided by the inventor are effective mosquito repellent delivery systems.

Recommendations

- We suggest testing other active ingredient combinations with DEET in order to expand the product family, such as: geraniol, peppermint oil, metofluthrin.
- We suggest considering using a higher concentration of Citronella due to the loss of pungency with time and repetitive use.

Marketing strategies

Based on the results of this study, the inventor can claim that both BugBling bands are scientifically proven to reduce mosquito attraction.