**International Journal of Entomology Research**
**ISSN: 2455-4758; Impact Factor: RJIF 5.24**
**Received: 20-09-2020; Accepted: 10-10-2020; Published: 21-11-2020**
**www.entomologyjournals.com**
**Volume 5; Issue 6; 2020; Page No. 45-47**

# Mosquito control: A simple optical method

**Phi Tran**
B.A. Alumni, Liberal Art, University of St. Thomas of Houston, Cypress, Texas, USA

**Abstract**
Mosquitoes are extremely harmful to humans, spreading diseases to millions of people each year, many of whom die as a result of these infections. Mosquitoes have evolved to live in low light conditions, to identify active, moving predators to avoid, and to recognize passive objects around which to navigate. The experiments in this paper introduce a method that involves the use of LED light to flood areas with the simulated presence of actively persisting objects. In a related paper[1], a highly regarded mosquito laboratory at a U.S. university used a dual-color pulsing light bulb to encourage mosquitoes to prefer one place to another. Although this was shown to be a potentially life-saving technology, further study under more carefully controlled conditions is required to ascertain whether the mosquitoes' behavior was not influenced by extraneous factors. The experiments conducted for this study capture the movement of Mosquitoes away[2] from even a faintly treated area of simulated night towards an unfavorably well-lit area of simulated yellow daylight.

**Keywords:** mosquitoes, control, catch, repel, malaria, dengue

## Introduction

Usually discoveries of new phenomena involve those phenomena first being theorized then created, observed, and analyzed in the laboratory, which leads to the development of new products and applications. By contrast, the technology detailed in this paper was produced on the basis of inspired guesswork, using existing off-the-shelf products with simple modifications or changes to source code. Although the resultant 'products' were widely distributed for humanitarian purposes, critics surfaced claiming that their distribution was the result of some kind of scheme of exploitation at the expense of the disadvantaged. Feedback, opinions, and testimonies were the only evidence available to prove the efficacy of the technology as a mean of repelling mosquitoes, whereas the academic community demands published, objective, and reproducible proofs to go further. Demonstrating such proofs in the controlled environment is the purpose of this paper.

The experiments focus on a very narrow use of the technology-addressing mosquito bite problems. However, the doors are wide open for future innovations that use this technology to repel insects, whether to reduce the transmission of diseases or simply for environmentally friendly insect control. For example, one potential application of the technology could be to repel other harmful insects on the fields.

## Background

The LED technology used in this study came about in response to the simple desire to address immediate mosquito bite problems. The inventors conceived of a light pulse system with asserted periods long enough to broadcast to flying mosquitoes the sudden arrival of new objects in their vicinity, but short enough that the light would disappear before the mosquitoes were able to calculate the distances to said objects to determine that it was safe to ignore them due to their remoteness. Under the combined action of alternately pulsing units, before a mosquito could formulate an action to address the sudden flash, another pulse would appear in a different location. The designers of this system reasoned that as a result of such instances repeatedly and continuously popping up, calling for reactions upon reactions, the mosquitoes, finding themselves in a situation where fleeing from one flash would only point them in the direction of another, would become confused. The design was a once-and-for-all attempt conceived with the hope that its failure would provide sufficient reason to shelve these ideas for good, as the inventors suspected that if such a simple approach could work it would already have been presented elsewhere. The design, consisting of two cool white LED light bulbs spaced 10 meters apart and modified to pulse at 120 events per second in correspondence with changes in the 60 Hz AC, happened to work on the first try. The system kept the mosquitoes from entering the common area.

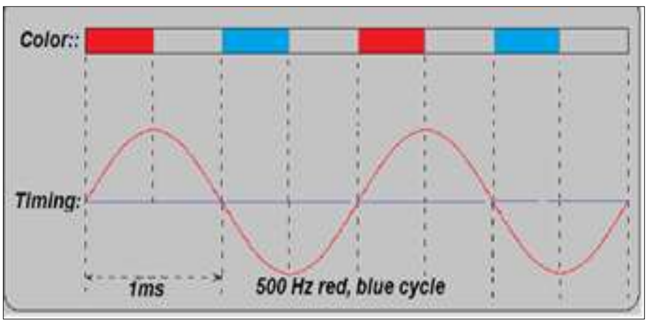


**Fig 1**

The technology further evolved to use multiple colors instead of multiple light sources. Through trial and error, a 500 Hz frequency, and the colors red and blue emerged as the best combination. The system alternately emits one color in its first quadrant and the other in its third as illustrated in figure 1.

With positive feedback from users as the background, the lights repelled the insects; numerous 16 hours experiments were conducted in the laboratory[1] using experimental and control protocols, with experimental and normal control yellow light bulbs in transparent taxis cages. Contrary to expectations, the devices were classified as mosquito-attracting units[1], as the insects consistently distributed themselves 80% vs 20% for the experiment as opposed to the control[1]. On the other hand, the results confirm the effectiveness of this technology as a mean to control the movement of mosquitoes.

Subsequent experiments produced similar results. However, the protocols largely resulted in the deaths of the mosquitoes, thus requiring a new batch for each session. Slow-motion video[3] showed behavioral differences in the way the mosquitoes approached a white obstruction upon light-on and light-off. With the lights in the off state, they either landed with their feet or made a turn from approximately 1 cm away, while with the lights in the on state, the mosquitoes approached as if the obstruction were invisible and needed to make physical contact with the surface before reacting.

Close-up pictures [4] corroborate this observation; the antennas and/or feeding tubes of the mosquitoes became crooked after a few minutes of the stress tests; upon each impact, it was the bending of these appendages that forced the insects to change direction.

Evidence and observations point to the idea that the light causes confusion that leads to disorientation, as a result of which the mosquitoes injure themselves on the surfaces of the box. However, there are other conceivable reasons that might cause these phenomena to occur, such as heat, hunger, or dehydration. The injuries incurred meant that keeping the mosquitoes alive eventually became a daunting task; unfortunately, only if the same groups of mosquitoes were kept alive and put through both the control and experimental protocols could the results objectively be said to reflect their true behavioral choices.

**Experimental Developments**

It is clear that mosquitoes lack the capability to see the other side of a transparent plate as being physically obstructed, either considering it to be a reachable destination or possibly another approaching mosquito. Circumstances could drive them to move toward that place if it appears safer or more favorable, resulting in their trajectories being blocked by the plate. The experiments constructed for this study employ dark-room arrangements, opaque chambers, enclosures, shades, and reflective liners to minimize these adverse effects.

To take further advantage of the dark-loving nature of these insects, the control part of the chamber is more brightly illuminated. Consequently, it eventually becomes warmer. As a result of the greenhouse effect under long exposure, the temperature increases, driving the insects to seek shelter in cooler places. The experiments neutralize this phenomenon by circulating the air in the test environment.

Use of a ready-made, publicly available product in the experiments would seem more logical. These products are designed for large areas and regions; thus, having low-output, specially built units is more practical for this purpose than making great efforts to lower their intensity to the desired level.

**Materials and Methods**

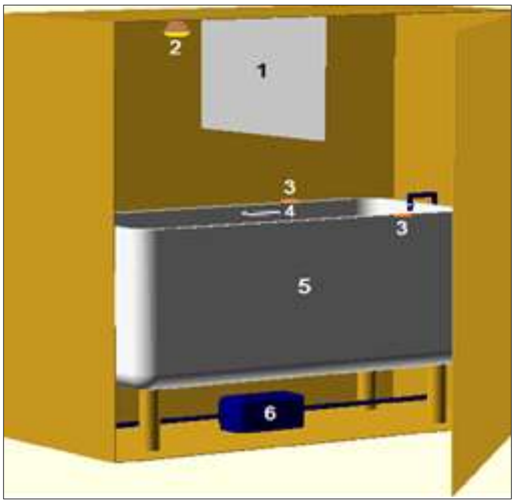


**Fig 2**

**Material Summary [5]**

**Samples**

The samples were mosquitoes that emerged from vendor-supplied aedes aegypti or yellow fever eggs; there were approximately 350 mosquitoes per batch.

**Procedures**

Following a resting and feeding period of at least three hours, the session in which the experimental lights were on lasted six hours. During the first period, the experiments took advantage of the mosquitoes' preference for dark environments to lure the creatures to abandon the well-lit control side and move to the other side, which the majority of the mosquitoes did. The compiled data are based on before and after pictures. The mosquitoes can be divided into three categories based on their chosen location in the experimental or control areas, or the neutral intersection of the two, which was the nearest location where some would choose to land either prior to entering or upon leaving the line-of-sight of the LED lights.

**Result Summary [6]**

The samples remained alive and well. Six marathon experiments were conducted. With a few exceptions; samples consistently cleared out of and stayed out of the experimental area of the chamber.

**Conclusion**

The experiments conducted for this study demonstrate that a timing artificial light emitting device has capability to tamper with the perceptual abilities of mosquitoes to influence their instinctive reactions. Beside its capability to provide some comforts, such technology has the potential to save lives in areas plagued by mosquito-borne diseases, while also presenting the possibility of other commercial applications.

**References**

1. Polaris Mosquito Repellent Light Bulb Experimental Efficacy Evaluation Report from Hansen Laboratory of

New Mexico State University, 2016.

2. Ceres Maciel, André Fujita, Daniele I Gueroni, Anderson D Ramos, Margareth L Capurro. Anderson Sá-Nunes. Evans Blue as a Simple Method to Discriminate Mosquitoes' Feeding Choice on Small Laboratory Animals. PLoS One. 2014; 9(10):e110551.
3. Douglas A Burkett, Jerry F Butler, Daniel L. Kline. Field Evaluation of colored Light: Emitting Diodes as Attractants for Woodland Mosquitoes and other Diptera in North Central Florida. Journal of the American Mosquito Control Association. l4 (2):lg6-195.
4. Liu Y, Liu Y, Chen Y. Enhancement of mosquito trapping efficiency by using pulse width modulated light emitting diodes. Sci Rep. 2017; 7:40074. https://doi.org/10.1038/srep40074
5. Mar Sobral, María Losada, Tania Veiga, Javier Guitián, José Guitián, Pablo Guitián. Flower Color Preferences of Insects and Livestock: Effects on Gentiana Lutea Reproductive Success. PeerJ. 2016; 4:e1685.
6. Shimoda M, Honda K. Insect reactions to light and its applications to pest management. Appl Entomol Zool 2013; 48:413-421. https://doi.org/10.1007/s13355-013-0219-x
7. Yang-Hong Zhou, Zhong-Wei Zhang, Yu-Fan Fu, Gong-Chang Zhang, Shu Yuan. Carbon Dioxide, Odorants, Heat and Visible Cues Affect Wild Mosquito Landing in Open Spaces.Front Behav Neurosci. 2018; 12:86.