Project Proposal

Project Title: Maximizing the effectiveness of mosquito chemical attractants using Drosophila as a model.

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Project Definition:
The overall aim of this project is to analyze the effectiveness of utilizing a chemical that targets a mosquito's olfactory senses. The chemicals utilized by the experiment in the project are researched, and have been proven to significantly attract mosquitoes. However, this project will use *Drosophila* as a model organism to test the different chemical attractants. The hypothesis of this project is that a higher number of *Drosophila* will be lured towards an odor than a light source.

Background:
Does utilizing a chemical attractant, like 1-octen-3-ol, of mosquitoes make mosquito-killing devices more or less effective at attracting and killing mosquitoes?

The goal of this project is to examine if chemical attractants most effectively lure mosquitoes, thereby reducing the chances of mosquito bites in certain areas. Because a mosquito's olfactory sensory system goes into effect at the farthest range, it is expected odor stimuli will most effectively attract mosquitoes.

Importance

Mosquitoes are vectors of deadly diseases that cause millions of fatalities each year and leave people with health complications for the rest of their lives (Mathew et al., 2013). Furthermore, mosquito bites are unpleasant, leading to inflammation, swelling, and itching (the body's response to an unknown invader). Currently, many attempts at producing a mosquito-controlling method have been based on sight or taste, which often leads to at least one flaw. For example, DEET has been proven harmful to the environment (Aronson et al., 2011). Since DEET is hard to remove as a waste product, it eventually seeps back into the ecosystem, disrupting the growth of smaller insects and microorganisms (Aronson et al., 2011). Many household attempts at lowering mosquito populations in or around the home also are ineffective. Although most methods are safe for human use, this safety indicates a lesser effectiveness at preventing mosquito bites. Certain natural odors are not as effective as chemical ones (Mathew et al., 2013). Utilizing sight as a lure is also not 100% effective, as experienced by many users of a "typical" bug zapper. Maintaining a low mosquito population in an area reduces the probability of a vector transmitting a disease into a host (Barrera et al., 2018). Therefore, a more safe but effective method to attract and remove mosquitoes in an area is needed.

Concepts

Scientists have found three major steps that are based upon the distance from a host in a mosquito's host seeking process (Raji & Degennaro, 2017). The first stimulus that draws the attention of a mosquito is odor, which occurs at around 10 to 50 meters (Caltech 2015). Next, a combination of CO2, as well as the odor and sight, continues to lure the mosquito to its host, occurring at around 5 to 15 meters (Caltech 2015). Finally, the third phase occurs when the mosquito is within a meter of the host, it is able to sense the host's body heat (Caltech 2015). A part of the last phase is also when physical contact between the mosquito and the host occurs, where CO2, odor, visual signals, and the host's body's heat, moisture, and taste cues the mosquito whether the host is a viable blood meal (Mathew et al., 2013). By targeting a mosquito's olfactory senses, the first and farthest occuring phase, a hypothetical trap should be the most effective, as the attractant functions at the farthest range during the mosquito's host-seeking process. For example, DEET primarily serves at minimal distance, the last phase of the host-seeking process, because DEET tastes bad for mosquitoes.

A research paper done by Vosshall in 2000 indicated *Drosophila* are great model organisms to use for odor experiments. *Drosophila* are able to recognize hundreds of different odorants (Vosshall 2000). In addition, *Drosophila* has been proven to adapt to simple olfactory-based tests (Vosshall 2000).

Context

The independent variables of the project are: different chemicals that have been proven to significantly attract mosquitoes.

The dependent variable of the project is: number of *Drosophila* attracted to the chemical attractant.

The control variables of the project are: length of exposure, *Drosophila*, test container size, choice chamber.

Control group: previous data on effectiveness of current devices used to control mosquitoes

Materials List

The materials of the project include: chemical attractants (1-octen-3-ol, lactic acid, and myristic acid), CO2, and a choice chamber.

Procedure

The building process of the system includes assembling an experiment already conducted by previous scientists relating to olfaction and *Drosophila* (Versace et al., 2016). A choice chamber will be used. *Drosophila* will be released into a box where two different chemical attractants will be present at two different ends of a tube. There will be a small opening in the middle of the tube *Drosophila* will be able to fly into, where they then will be attracted to one of the two chemicals. Once enough data, the attractivity of each chemical determined by the number of *Drosophila* entering either end of the tune, is obtained from the odor test, it will be compared to

data retrieved from studies performed by scientists in the past as well as data from each chemical used in the experiment. This will determine whether the hypothesis is correct or not.

Goals

Choice chamber provides accurate data on the chemical attractant of the experiment.
The data will lean towards a most effective chemical attractant, and this data will be able to be effectively analyzed and compared with existing data completed by previous studies.

Potential Safety Concerns

The safety concern is the use of dangerous chemicals. 1-octen-3-ol, myristic acid, and lactic acid will be used in combination with CO2.
I will be mentored by a teacher at all times when conducting the experiment.

Data Analysis

The data obtained from the conducted experiment will be compared with existing olfaction data using a chi-squared model to test whether chemical attractants are effective in terms of luring mosquitoes. The data will be achieved by documenting occurrences of *Drosophila* navigating to the attractant independently

Potential Roadblocks

One potential roadblock is handling living *Drosophila* and dangerous chemicals. Having a mentor and research will be able to help me overcome this roadblock.

References:

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Timeline:

August-Mid October: Brainstorming, researching, narrowing down the topic
October-November: researching, start designing experiment. Begin testing
December: testing, analyze data
January: Finish testing if needed. Interpret data. Start and finish presentation materials, such as final paper