A Comparison of Different Sugar Baits for the Capture of Diptera in Texas

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Abstract: Identifying the most effective baits to attract Diptera flies is critical for surveillance and control activities. Four different baits consisting of sugar-water, molasses and water, a vinegar-syrup mixture, and a mango mosquito lure were used inside funnel kill traps and placed in various locations in the city of College Station, Tx and left out for five days at a time. *Lucilia sericata* (Meigen) was the most prevalent species collected, but others included *Musca domestica* (Linnaeus) and *Drosophila melanogaster* (Morgan). The molasses bait was the most effective trap, with sugar-water in a close second. The syrup-vinegar mixture did not effectively attract anything.

Key Words: Diptera, *Lucilia sericata,* fly traps, funnel traps

Not only have flies always been renown as a nuisance, but they can also vector serious diseases. Areas abundant in death and decay, often in close proximity to living quarters and streams of water used for drinking, saw an unparalleled magnitude of flies (Miller 1997). As of now, flies have been found to vector at least 65 diseases transmissible to humans, such as dysentery, cholera, leprosy, and tuberculosis (Honavar et al. 2018). At rest, flies regurgitate and defecate on the substance landed upon, which ranges to anything from garbage cans and fecal and decaying matter to open wounds. Oftentimes, disease agents are picked up from these sites and transported with the fly to places where humans can easily contract them, such as when a fly lands on a person's plate (Albano et al. 2013). Continual efforts to control flies must be made because of their large capacity to transmit diseases to humans.

Although efforts to control flies have increased with the use of pesticides, these control methods often contain harsh chemicals that may pose a threat to humans or other unintended animals (Lee and Sarwar 2015). A prime example of this is the effect of the common neonicotinoid pesticide, thiamethoxam, that was discovered to hinder the honeybee's ability to fly (Burgio et al. 2017). In addition, flies have shown resistance to common pesticides throughout the United States, making the need for other control methods much more pressing (Aberegg et al. 2014).

The purpose of this experiment was to test the effectiveness of four different baits on their ability to attract different types of true Dipteran flies. This study utilizes blue funnel traps because a separate study found that blue-colored traps were more attractive to Diptera than the other available glow traps (Ali et al. 2018). Species of Diptera, usually from the sub-family Brachycera, are

known to feed on dead and decaying matter, and are especially attracted to sweeter substances, such as fruit or sugar (Gerry et al. 2015). It has been suspected that one species of fruit fly, *Anastrepha obliqua* (Macquart) is attracted to mangoes in particular because of the foliage they offer for feeding and reproduction (Jirón and Hedström 1991). After taking in the consideration of these findings, the four different baits used in this experiment were chosen.

Methods and Materials

Making the traps: Three different sites in College Station, Texas were used as collection areas in this experiment: a porch at The London apartments, a balcony at Sterling Northgate apartments, and a spot behind the dumpsters at The London. For each site, four Stingstop clear bottle funnel traps (McFly, Helena, Montana) were fitted with blue funnel cones and filled with bait up to the first ridge of the bottle.

Baits: There were four different baits used in this experiment. The first was a sugar and water mixture, in which one cup of water and two tablespoons of sugar were mixed together. The second was made by adding one tablespoon of molasses to one-half cup of water. The third included a quarter cup of vinegar mixed with a quarter cup of syrup. The fourth was a mixture of fresh mango. Extras of each bait were stored in a refrigerator until they could be used to fill another container.

Procedure: Four traps, each containing a different bait as outlined above, were set out in their respective locations for five days before being pulled for samples. The samples on the balconies were run twice before the traps behind the dumpsters were used for a more effective collection and representation on the effectiveness of the baits. The samples behind the dumpsters were tied to wooden stakes hammered into the ground to prevent them from being disturbed by natural elements. After being left out for five days, each set was collected and the contents inspected. Each insect found in the traps were placed in vials of ethanol for preservation.

Results

There was a total 97 collected specimen, 62 of which were caught in the molasses trap, 33 within the sugar-water, 2 in the mango, and none in the syrup mixture.

Within the order of Diptera specifically, *Lucilia sericata* (Meigen) was the most common species collected, but *Musca domestica* (Linnaeus), male *Culex spp.,* and *Drosophila melanogaster* (Morgan) were identified as well. Over half of the specimens gathered were in the order Hymenoptera, mostly bees, including a large amount of *Apis mellifera* (Linnaeus) in both the sugar-water and molasses traps.

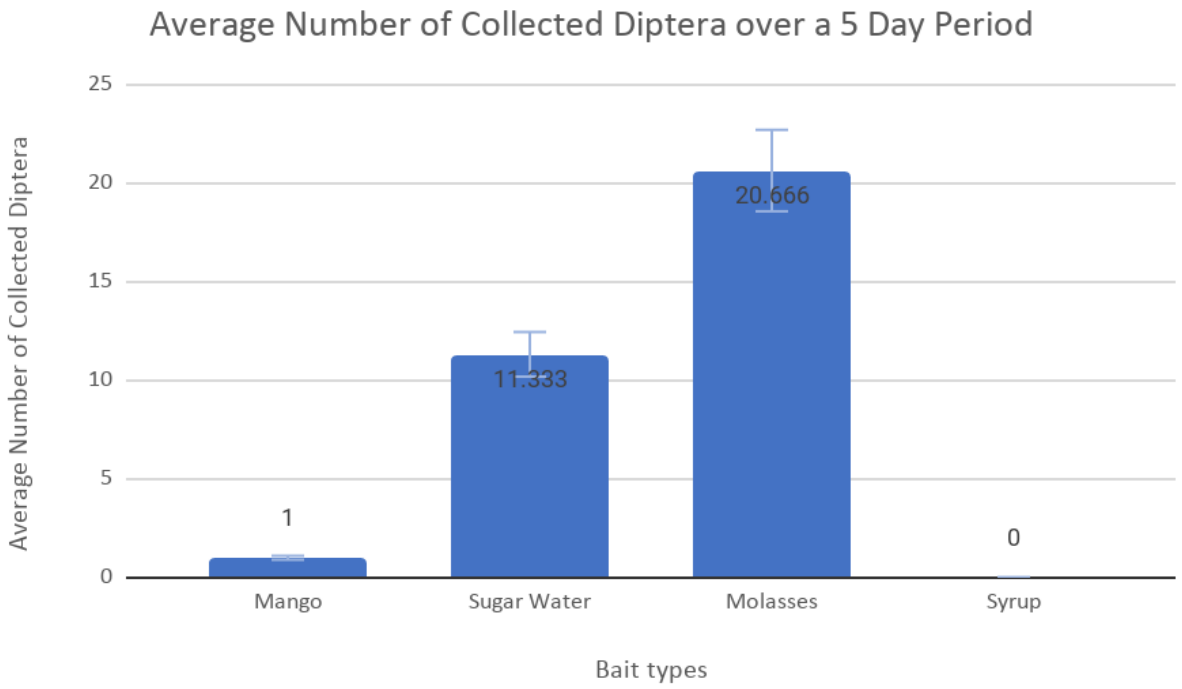

Fig. 1. Average Number of Collected Diptera per 5-Day Period

Discussion

Figure 1 exhibits the average number of Diptera caught per five-day period. The numbers reflect a much higher number of collection from the dumpsters compared to the balcony traps. The totals were added up and divided by the three total trials that were performed, resulting in the above averages.

The molasses bait captured the most Diptera, averaging a total of 20.6 collected specimen. Sugar-water attracted slightly more than half of what molasses was able to collect, averaging to a total of 11.3 Dipterans collected in each trial. The mango bait averaged only 1 Diptera during every trial, thus making it the third most attractive trap. Syrup and vinegar collected nothing in each experimental trial.

The dumpster location and the balcony locations had very different results. The balconies were largely unsuccessful in collection when compared to the results yielded from the garbage bins. This is likely due to the fact that the balconies were elevated several feet above ground level; therefore, Dipterans were less likely to fly up to these heights. These trials could have been more successful had they been placed on the ground or near grass. A heavy fly infestation in the surrounding balcony areas could have also resulted in more captured specimen. Because the balcony location yielded low numbers, the dumpster locations were utilized to collect a respectable amount of data that would accurately demonstrate the effectiveness of the different baits. This location was likely more successful due to

the rancid, decaying smell that the dumpsters emitted, automatically attracting significantly more Dipterans than the balcony locations. The odors from the dumpsters could have influenced the species of Diptera attracted to the area, thus the data might not represent a typical fly community in an area absent of dumpsters. In addition, the data may only indicate that the Dipterans and other insects were attracted to the smell from the dumpsters, not independently attracted to the various baits.

Molasses, although largely considered sweet, does have a slightly bitter or strongly sour smell. This could mimic the smell of rotting garbage and be the factor that attracted the majority of the *L. sericata* species, although some did migrate towards the sugar-water, which may mimic decaying fruit. As mentioned in the introduction, flies are often attracted to sweet or decaying matter. The data collected from this experiment bolsters this theoretical attraction because of the results from the molasses trap (Ali 2018). Mixtures used in this experiment are both harmless and easily accessible; therefore, this molasses trap could be placed in any setting to collect and eliminate the annoyance or threat of flies.

The hypothesis for this experiment was incorrect, as sugar-water did not attract the majority of the Diptera species. However, it is noted that sugar-water collected a large amount of *A. mellifera,* which is likely due to the sweetness mimicking nectar and other sweet smells that honeybees naturally feed on. The one mosquito caught was attracted to the mango mixture, which was specifically designed for mosquito capture. Although the single collected mosquito is not enough to confirm or deny the success of the product, it may serve as a foundation of where to start future mosquito research in experiments that are focused purely on mosquitoes. Studies have shown that male mosquitoes feed more on sugar in nature than female mosquitoes, which supports this study, as the mosquito found was a male (Jones 1978). Many more trials and data would have to be run to definitively conclude this conjecture.

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