Comparison of Attractant Type, Trap Size and Trap Color based on Diptera Captured at a Livestock Facility

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Abstract: Biting and filth flies are typically present in large numbers at livestock facilities. Using surveillance tools to monitor the species composition and abundance is a critical part of integrated pest management. A commercial funnel trap with different sugar bait attractants was used to evaluate the effectiveness at capturing these flies. The Texas A&M University Sheep Center was used as the location to perform the study. Two different sugar baits, mango and honey, were compared to determine which one was more effective at attracting flies. Another variable that was tested was whether trap size and color affected the number of flies that were captured. The specimens were collected, preserved, and counted, and the data was recorded. Upon analyzing the data, it was established that the two sugar baits were not all that different in their ability to attract flies. There was however, a noticeable difference in the number of flies captured in the large versus small traps and the small dark versus small light traps.

Keywords: Diptera, livestock,funnel-trap, sugar

It is important for livestock producers to understand the impact that biting and filth flies can have on their operation. These flies are considered synanthropic, because they benefit from living in close association with humans and the environments that humans create around them (Chaiwong et al. 2014). Biting and filth flies are considered pests but they are also of medical and veterinary importance. Their larvae commonly develop in or near the feces of animals or humans, in garbage dumps, and other areas with decomposing matter where they can feed on the microbes that thrive at these sites (Ahmad et al. 2009). Due to the location that the larvae develop, these flies are vectors for many diseases, including typhoid fever, dysentery, and anthrax (Black et al. 2015), and are capable of transmitting pathogens and parasites directly to animals because of their attraction to the animals themselves and the food sources they utilize (Ahmad et al. 2009, Chaiwong et al. 2014). Due to the variety of vectoring capabilities it is important to integrate control of these pests in livestock facilities.

To implement an effective pest management program in the livestock operation, surveillance is an important step that provides the producer with information about the pests. Data generated should include identification of the pest species, seasonal changes in pest behavior, and the degree of infestation in different areas of the operation.. If deemed necessary, the data can assist in the development of an intervention effort to control the pest population.

This study was designed to test the effectiveness of a plastic funnel trap and whether attractant type, trap size, and trap

color influenced the number of biting and filth flies captured at a local livestock facility. Previous experiments have used funnel traps and were successful in catching flies and other research showed that flies were more attracted to objects darker in color (Ngoen-klan et al. 2011, Kilpatrick 2016). Based on the information collected in this investigation, the manager of the livestock center where the traps were deployed can decide if a pest management program is necessary for the operation.

Materials and Methods

Collection Site.

Traps (Flystop, Whitefish, Montana) were placed at the Texas A&M Sheep Center located at the O.B. Butler, Jr. Animal Science Complex. The Sheep Center houses sheep and goats and is approximately 6 miles south from the main campus.

For the first collection, a total of 4 traps were placed at the Sheep Center. Based on data obtained during the first collection, it was decided that more traps were needed so 8 traps were placed at the Sheep Center for the second collection in hopes of capturing more specimens.

Attractant Type.

Two different baits were used to determine which flavor/scent the flies were more attracted. The first bait was a mixture of mango, guava, and brown sugar and was chosen based on previous research completed on mosquitoes (Fikrig et al. 2017). The bait was diluted in a 1:1 ratio with water before being placed in the traps. The second bait was also chosen from former studies involving mosquitoes and consisted of honey, sugar, and floral chemical (Lothrop et al. 2012). This bait was also diluted in a 1:1 ratio with water before being added to the traps. For ease of reference, here after the baits will be referred to as "mango" for the mango/guava/brown sugar mixture and "honey" for the honey/sugar/floral chemical mixture.

Trap Design.

A plastic cone trap (Flystop, Whitefish, Montana) was used to capture flies for this experiment. The cone snaps into household containers that have a common opening size. . The plastic funnels have small holes to facilitate the entry of flies. Upon entry the flies go to the attractant and either drown or become contained until they die because the cone limits opportunity of escape.

Containers that were used for this experiment were of two different sizes one gallon (3.785 liters) and 200 milliliters in volume. The two large containers were painted black in color for uniformity by the trap producer. The small containers were either a light plastic or a dark brown/amber plastic.

Fig. 1. Traps used for this experiment from left to right: large trap, small light colored trap, small dark colored trap, and plastic funnel trap inserted in all containers.

Experimental Design and Collection.
Traps set at Sheep Center were placed in pairs depending on their size, color, and attractant type. The two traps that were paired together were placed approximately one meter apart and were placed at least 10 meters from the next pair. The first collection period was for five days from April 5 – 10, 2017. The pairings at the location are summarized in Table 1.

Table 1. Pairings of traps and descriptions for Collection 1

Pairing Code	Trap Number	Size	Color	Bait	Amount of Bait (mL)
A	1	Large	Dark	Mango	75
B	2	Large	Dark	Honey	50
A	3	Small	Light	Mango	25
B	4	Small	Dark	Honey	25

Traps set at the Sheep Center were placed in pairs depending on their size, color, and attractant type. However, for the second collection, twice as many traps were set. The two traps that were paired together were placed approximatelyone meter apart and were placed at least 10 meters from the next pair. The second collection period was also for five days from April 20 – 25, 2017. The pairings at the Sheep Center for the second collection areprovided in Table 2..

Table 2. Pairings of traps and descriptions for Collection 2

Pairing Code	Trap Number	Size	Color	Bait	Amount of Bait (mL)
A	1	Large	Dark	Honey	100
B	2	Large	Dark	Honey	100
C	3	Small	Light	Honey	25
A	5	Small	Light	Mango	25
C	6	Large	Dark	Mango	100
D	7	Large	Dark	Mango	100
D	8	Small	Dark	Honey	25
B	10	Small	Dark	Mango	25

Preservation and Data Analysis. Flies were collected, rinsed in water, and preserved in vials in 70% ethanol. A different vial was used for each trap at each collection date so that the specimens could be kept separate. Later, flies were counted and numbers of flies per trap were recorded for analysis. All data are presented as the mean number of flies captured per funnel trap per day.

Results

Collection Site.
A total of 1,228 flies and two cockroaches were captured during the first collection using four traps of various sizes. Twice as many traps were set for the second collection and approximately 3.7 times more flies were caught. A total of 4,535 flies and no other insects were caught in the second collection. All flies where morphologically identified as house fly, *Musca domestica*. (Diptera: Muscidae) (Linnaeus 1758).

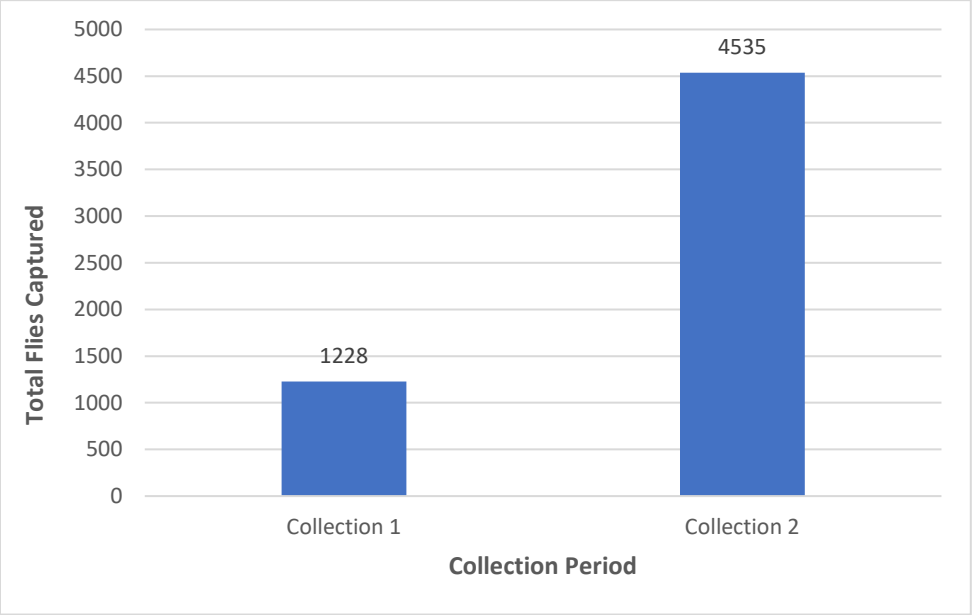

Fig. 2. Total number of flies captured during each collection

Large Trap Data.
The mean number of flies caught per day by the large mango and large honey traps in the first collection were 7.4 and 17.8 flies respectively.

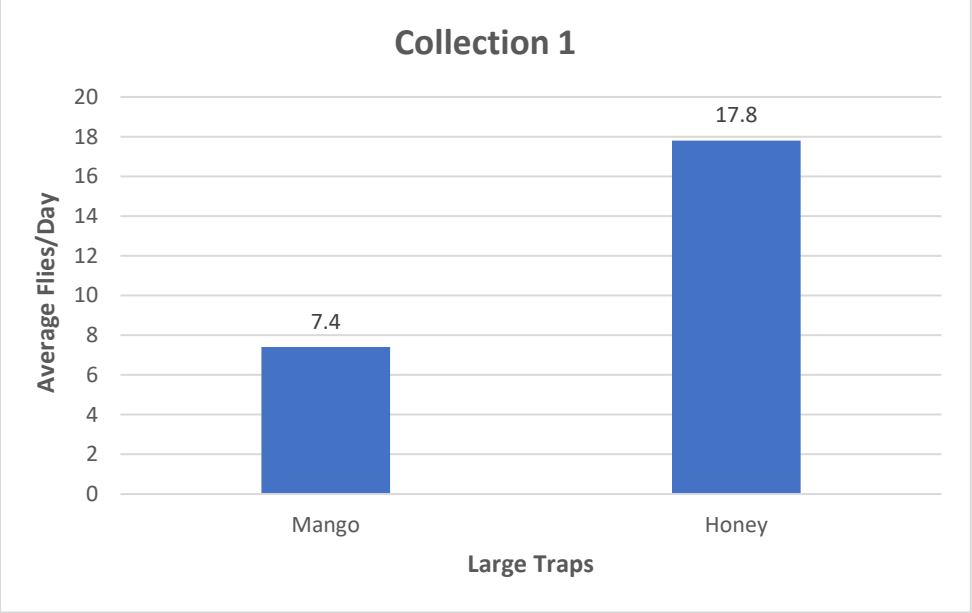

Fig. 3. Average number of flies captured per day in large traps for Collection 1

For the large traps in the second collection, the average number of flies caught per day by the mango traps was 49.4 flies, and the honey traps caught 160.3 flies per day on average.

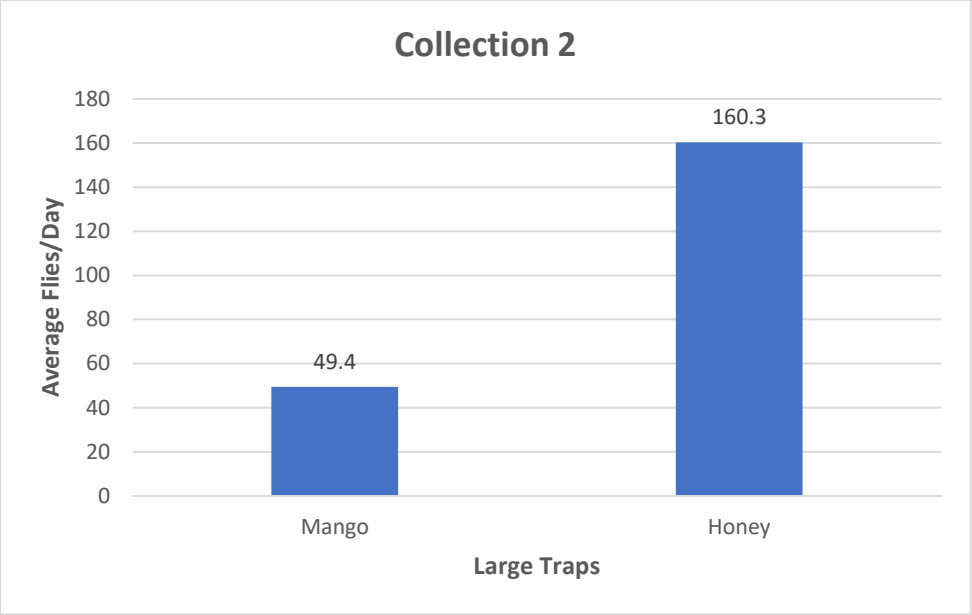

Fig. 4. Average number of flies captured per day in large traps for Collection two

Small Trap Data.

In the first collection, the small light honey trap caught an average of 12 flies per day, and the small dark mango trap caught an average of 174 flies per day. The small light mango and small dark honey traps were not successful in catching any flies over the first collection period.

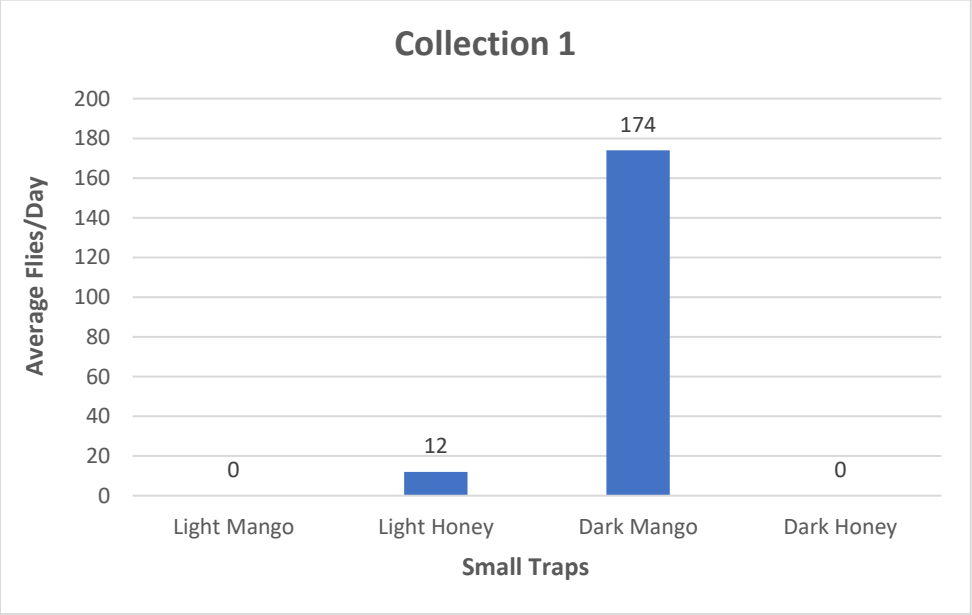

Fig. 5. Average number of flies captured per day in small traps for Collection one

The second collection period provided numbers that were more uniform. The average number of flies caught per day for the small light mango and light honey traps were 126.4 and 102.4 flies respectively. The small dark mango and dark honey traps caught an average of 148.2 and 110.6 flies per day.

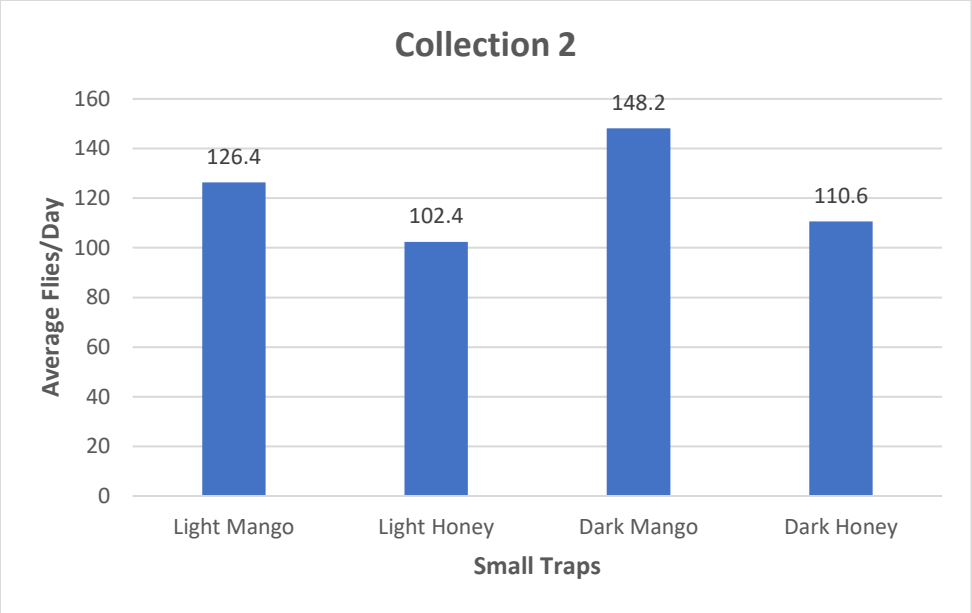

Fig. 6. Average number of flies captured per day in small traps for Collection 2

Data Collection Totals.

The mean values for the two collections were averaged to yield the mean number of flies per day per type of trap. The large mango traps averaged 35.4 flies per day, and the large honey traps averaged 112.8 flies per day. The small light mango and small light honey caught 126.4 and 57.2 flies per day on average respectively. The small dark mango averaged 161.1 flies per day, and small dark honey caught 110.6 flies per day. Based on this data, the small dark mango trap was the most successful at capturing flies while the large mango trap was the least successful.

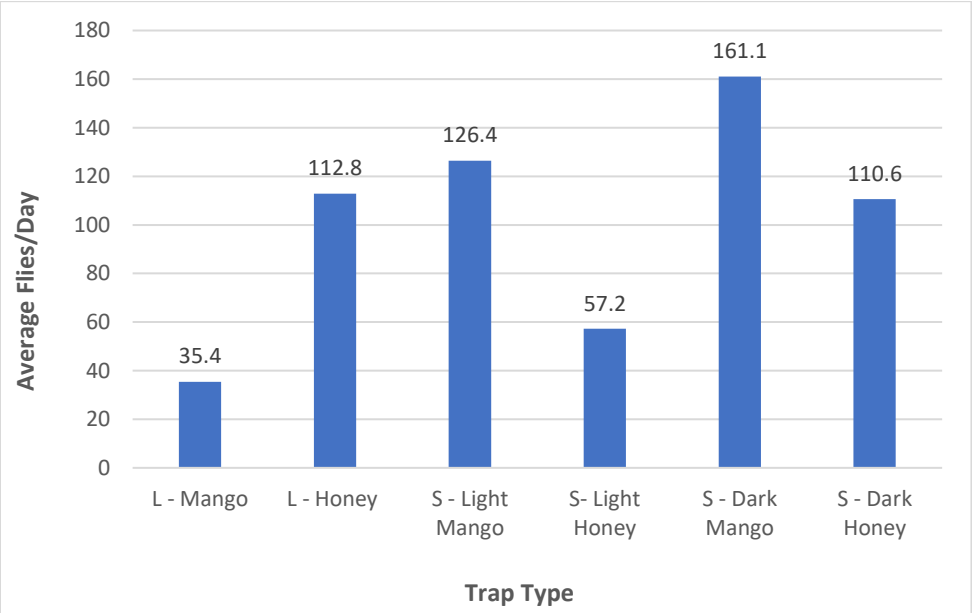

Fig. 7. Average number of flies captured per day in all traps for both collections

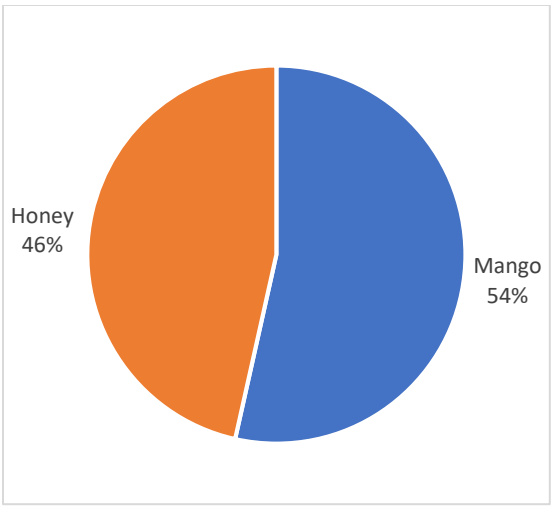

Fig. 8. Percentage of flies captured based on attractant used

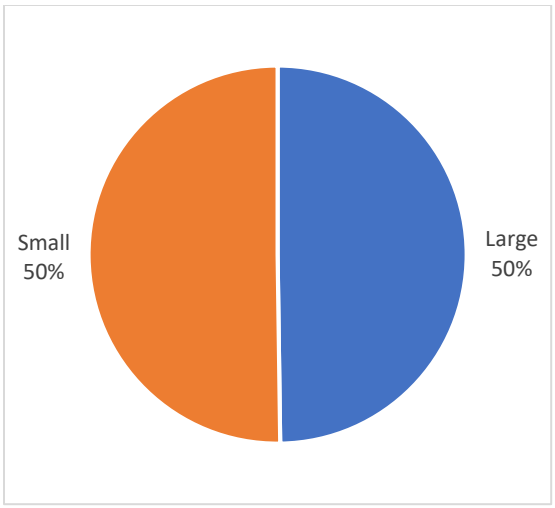

Fig. 9. Percentage of flies captured based on trap size

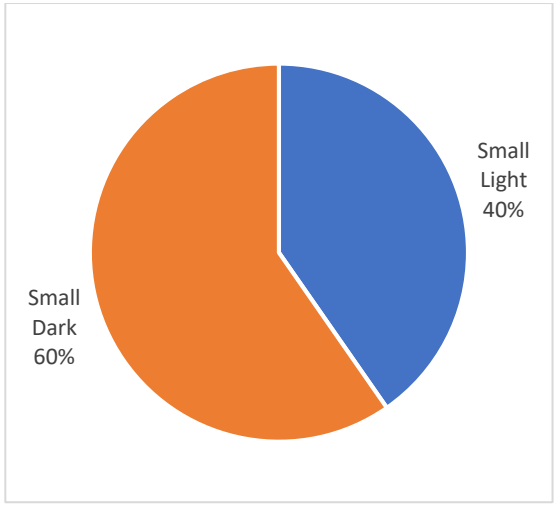

Fig. 10. Percentage of flies captured based on color of small traps

Discussion

Based on the total number of flies captured during both collections, more flies were caught duringthe second collection event. Becausethe attractants, location, and size of containers remained unchanged, the increase in number of flies captured was due to the doubling in number of traps used

Based on the average numbers of flies captured per day per attractant type, it appears that the mango mixture was slightly more effective at attracting flies than the honey. To validate these assumptions, more studies need to be conducted in a variety of locations. It is reasonable that the two baits were similar in their ability to attract the flies because they are both sugar-based baits.

It was determined that the two sizes of traps, large and small, were equally as effective at capturing flies based on the average numbers of flies captured per day per size of trap. It is logical that the two different sized traps averaged the same number of flies per day because although the large containers had more volume, the same plastic funnel trap was used in each container and the bait

mixtures were diluted the same amount. A study completed on fruit flies reported that size and shape of trap were not as important to capturing the flies as the attractant used (Iglesias et al. 2014).

The data revealed that the flies favored the small dark colored traps over the small light colored traps. When looking at the average amounts of flies captured in the small traps only, 40% of the flies were caught in the small light traps and 60% were caught in the small dark traps. Although a study completed on fruit flies determined that clear traps can be as effective as darker colored traps (Lee et al. 2012), other research has shown that mosquitoes tend to be more attracted to items darker in color (Chambers et al. 2013). Mosquitoes and house flies are closely related so it is hypothesized that flies exercise the same habits. It is likely that this attraction is due to their oviposition patterns which makes them want to lay their eggs on a darker surface. This research coincides with the data that were generated in this experiment.

Limitations and Future Recommendations.

Potential limitations in this study include location, weather/temperature, and sturdiness of traps. The fact that only one location was utilized for collection of specimens could have influenced the results. Also, the weather over the two sampling periods was relatively stable with no significant precipitation and no drastic changes in temperature. This was not indicative of the year-round weather/temperatures and did not allow determination of whether those variables influence the number of flies trapped. Some of the traps were not very sturdy and a gust of wind could blow them over. The researchers are not certain as to whether the traps were blown over at any time and another person at the Sheep Center placed them upright or whether the cone trap popped out, freeing live specimens, and was replaced. Perhaps for future studies, the researcher should consider placing a weight in the bottom of the trap to make them sturdier.

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