Survey of Effectiveness in Catching Pest Insects in Southeast Texas Using Various Homemade Traps

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Abstract: The presence of pests in Southeast Texas is not uncommon given the primarily marsh biome it encompasses. A result of this is the nuisance that is having many insects present near human habitations. A good portion of these insects tends to become pests and interrupt everyday life and potentially cause disease. This study has the intent of searching for a reliable trap to exterminate these pests in the convenience of a residential space and its materials. Three different types of traps were used in this experiment: a bowl filled with vinegar, plastic wrap, and side-door bottle trap. Each trap was studied for three trials, with a total of nine traps set across three locations in Southeast Texas. Traps were set for 24 hours each trial in a period from November 26 to November 29, 2021. There was a total of 111 insects caught, all in the order Diptera. Among this order, there were three families present: 109 in Drosophilidae, one in Calliphoridae, and one in Culicidae. Insects higher in quantity and diversity found a significantly stronger attraction to and mortality rate with the vinegar bowl trap most likely due to its ability to drown the pests.

Keywords: Nuisance, insects, residential, Diptera, attraction, pest

For the sake of this project, it is important to identify the definition of a pest insect. A pest insect will be any arthropod that lives near, interacts with, or can harm humans.

Pest insects have been around for as long as humans have been roaming and cultivating foods. The first pests followed the very first farmers when there was not yet a form of control. Dating back to 2500 B.C., some ancient civilizations began to use sulfur compounds to kill insects or some used herbs and oils for control. Agriculturally, around 300 B.C., China acknowledged phenology as a method to apply towards the timing at which crops will be planted. A little over one thousand years later, the Chinese began using soap as a pesticide. Tobacco, herbs, and arsenic saw an increase in appearance as the leading materials for insect pest control around the 1600s. In the late 1800s and early 1900s, there was a growth in popularity for the application of insecticide equipment. From the 1930s and beyond there has only been an exponential increase in the discovery of pesticides (Frazier 1997).

Phenology is an important facet of insect pest control. By accurately timing a method of control during the most vulnerable stages of their lives people can better avoid or eliminate pest problems. (Rettke 2015). This weakened stage is known as overwintering. There are multiple forms of overwintering for insects, depending on the stage of life they are in at that time. The egg

production rate for insects will decrease, leaving for there to be fewer eggs that already have a lower chance of survival. Larvae will usually survive the winter due to the protection provided to them by their environments. For example, heavy covers of leaf litter can protect caterpillars. Some insects will produce compounds such as glycerol, other polyols, proteins, or sugars in the hemolymph to passively overwinter. (Vanin, Bubacco, and Beltramini 2008). Holometabolous insects can cause more issues as pupae can simply overwinter and emerge as adults once the temperature increases. In the case of hemimetabolous or paurometabolous insects, some nymphs will live in waters or ice and feed all winter to emerge as adults similarly to larvae. As adults, they do their best to hibernate in compact micro-habitats such as under the soil, inside wood crevices, and inside of plant galls (Smithsonian Institution n.d.). These insects that are inactive during the colder months will go into a state of dormancy with a metabolic rate high enough to keep them alive. They will focus on their development and growth in this state, which is known as diapause.

Insects use an olfactory system that is used to locate the most important necessities of an arthropod's life. These are mates, oviposition sites, and finally food (Carey and Carlson 2011). Adult insects use olfactory receptor neurons that can be contained inside the sensilla. The sensilla are sensory organs that stick out of the exoskeleton of an insect. Some neurons seek out pheromones, others will specifically pick out food odors. Regardless, insects rely on olfactory senses the most of all senses to find their nutrients.

This brings another important connection to the cold temperatures. When the climate is cooler, scent molecules are unable to travel long distances because the air molecules in the air will freeze and restrict the movement of scent molecules (Code Blue 2018).

Materials and Methods

There were three locations for this study, all in Southeast Texas. The sites for Trial 1 and Trial 2 were in Houston, TX. Trial 1 took place in the Greenway District. Trial 2 was conducted in the Texas Medical Center. The site for Trial 3 was in College Station, TX near the campus of Texas A&M University. Traps were set in varying locations from near trashcans to elevated surfaces, but all were in residential areas to reinforce the concept of using homemade pest traps.

Three different traps for each trial were placed in close proximity to each other at each location to ensure that the pests will have the opportunity to acknowledge each trap. These trials each lasted 24 hours, so each trap was placed and collected at the same time one day apart. Thus, the proximity and time allotment will allow the pest population to make the choice of favoring specific traps over other ones. Each trap consisted of different substances and entrances. The vinegar bowl trap was made of apple cider vinegar and dish soap. The proportions were one cup of apple cider

vinegar (H-E-B, LP., San Antonio, Texas) and roughly five tablespoons of dish soap (Radiance by Aldi, Essen, Germany), making the ratio close to 4:1 vinegar to soap. An example of the vinegar bowl in Trial 3 can be found in **Figure 1**. The trap has no covering and has been placed completely exposed in its bowl.

Fig 1. Vinegar bowl trap in Trial 3 location

Next, the plastic wrap trap consisted of 0.25 cups of honey (Trader Joe's, Monrovia, California), 0.5 cups of balsamic vinegar (Kirkland's, Brentwood, Tennessee), and 5 drops of olive oil (Kirkland's, Brentwood, Tennessee). Before placing this trap, it also had to be wrapped with a saran wrap tightly with ten holes, each roughly one-half centimeter wide, to ensure a pest insect can enter. An example of the plastic wrap trap can be found in **Figure 2** from Trial 1. The poked 0.5 cm holes can be seen in the plastic wrap that covers the mixture inside the bowl.

Fig 2. Plastic wrap trap in Trial 1 location

Finally, the bottle trap consisted of an empty 1-liter bottle and apple slices. A one square-inch door was cut into the side of the bottle as an entrance. An example of the bottle trap can be found in **Figure 3** from Trial 2.

Fig 3. Bottle side-door trap in Trial 2 location

Any brand of the materials used is acceptable since these are traps that are designed to be replicated inside one's residential space using objects that are common in households.

Results

A total of 111 specimens were caught throughout the three trials. The vinegar bowl collected a significantly larger pool than the other two as seen in **Figure 4**. The averages of the traps support this overwhelming difference in effectiveness between the vinegar trap and the other two, which is shown in **Figure 5**. There was also a location that collected significantly more than the other two. This was from Trial 3, in College Station, TX. Trials 1 and 2 had more similar yields in terms of Drosophilidae, but Trial 2 had a noticeable increase in the collection of them from the plastic wrap trap. This is also supported by **Figure 4**.

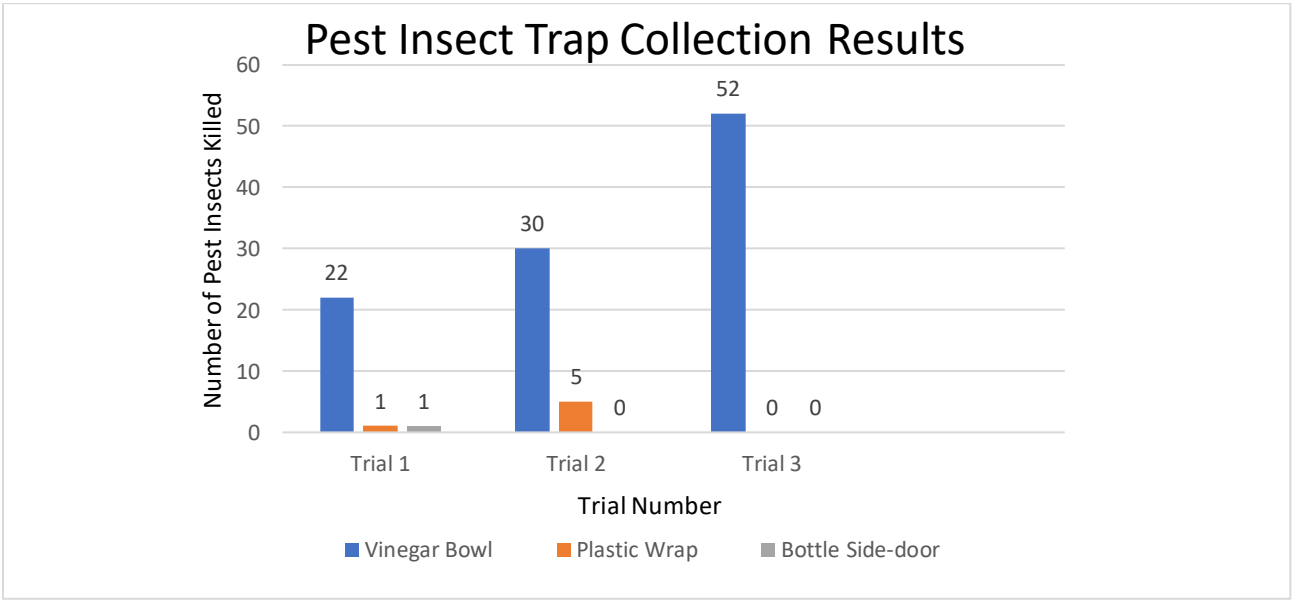

Fig 4. Bar graph of specimens collected per trial

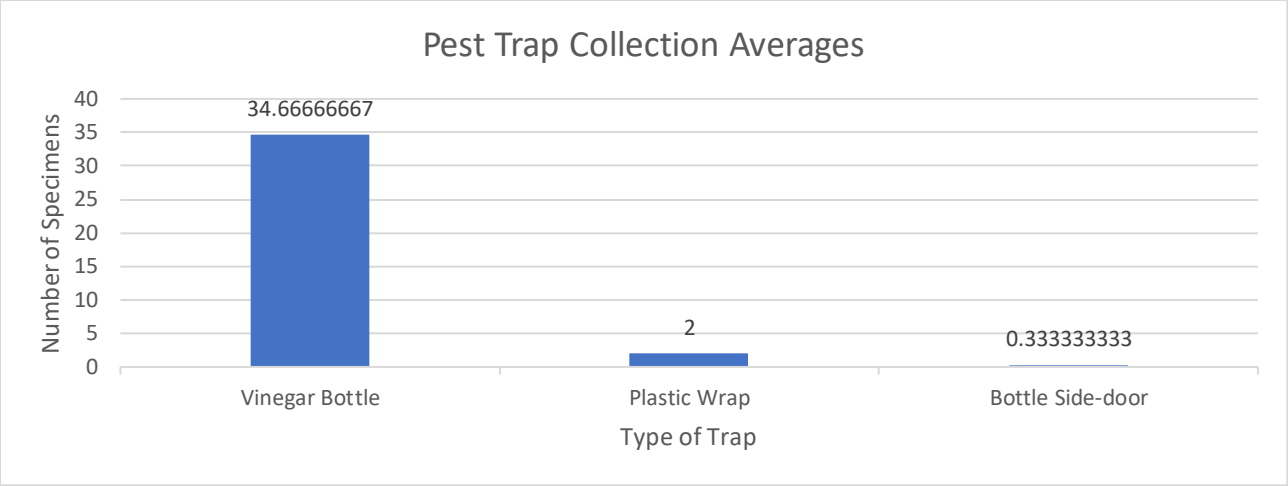

Figure 5 *Average number of specimens caught in each trap*

Regarding diversity, there was little to none with a total of three Insecta families all in the order Diptera. Among these pests, nearly all were family Drosophilidae, but there was one specimen from family Calliphoridae and one specimen from family Culicidae present in the vinegar traps from varying trials.

Fig 6. Calliphorid Specimen

Fig 7. Culicidae Specimen

Discussion

In accordance with the collected data, the effectiveness of all the traps displays that the vinegar bowl trap performed significantly better than the other two. As mentioned earlier, the College Station

trial collected more than double the average of Trial 1 and Trial 2.

The reason the vinegar trap is so effective is due to the ease of access and the way the apple cider vinegar and soap work well together as a trap. The sweet odor of the apple cider vinegar will attract the pest insect to the bowl. Once they reach the bowl, the soap causes the pest to sink upon contact with the mixture due to the soap reducing the surface tension (Palermo 2021).

The plastic wrap trap is intended to work by having the balsamic vinegar present as bait in the system. The honey in this mixture is not meant to attract, but rather it is intended to trap the flies in the liquid and hold them until death. The olive oil is also used as an attracting substance in the mixture.

The apple bottle trap has a very simple structure. Bait such as apples or peanut butter is placed inside the vessel. There is only one entrance to this, the function should be for the pest to enter, begin consuming the bait, and eventually be stuck inside the vessel with no exit. Though, the flap was unable to contain whatever pests may have entered almost entirely.

It is also important to consider the phenological aspects of this experiment. The climate at the time this study was performed was during the winter months in a marshy biome. This is a crucial detail because it will decrease the number of active arthropods as a whole. This is due to their tolerance to the cold, migration to warmer environments, and hibernation until the temperature increases. The hibernation is also referred to as overwintering. As a result of these tendencies, the specimen quantity and diversity could have presented themselves in a different manner if this experiment were to be done during the spring or summer months. Most likely, there would have been not only a higher specimen count, but a more diverse pool of specimens. Thus, the traps would technically be more effective in the summer months for getting rid of pest insects, in comparison to the winter.

What is interesting about the specimen pool diversity is that all the collected pests were from the order Diptera. Vinegar strongly attracts family Drosophilidae because it contains acetic acid, which is a product of the fermentation process of fruits. (Jouandet and Gallio 2015). The Calliphoridae and Culicidae specimens could have also been attracted to the vinegar trap from the apple cider vinegar's acetic acid component, which may have been mistaken for plant odors.

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