Attractiveness of *Solenopsis* Ants (Hymenoptera: Formicidae) to Assorted Sugars and Oils

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Abstract: Fire ants (Solenopsis spp.) are bothersome insects to both humans and the environment alike. Due to their prevalence in areas near human habitation, we sought to determine a substance that the ants find attractive that could be used in future control methods. To answer our question, we designed a simple experiment in which Solenopsis sp. specimens were each given the opportunity to choose from a variety of sugars and oils that were presented on a piece of paper in front of them. It was determined that fire ants have a stronger attraction to substances higher in fatty acids, such as cooking oils, than carbohydrates. These results have shown that when devising a home remedy for controlling these insects, individuals would have the most success if they were to use an oil-based product in their control method.

Keywords: *Solenopsis*, fire ants, fatty acids, attraction

Fire ants (*Solenopsis*)(Westwood) are insects most commonly recognized by their pervasiveness and irritating stings (Jardine and Taylor 1841). Most species of fire ants are simply considered nuisance pests by many, though some individuals may present with an allergic response or anaphylaxis in the event of exposure to the ant's venom (Havaldar and Phadnis 2011). In addition to the threat to human health that these insects pose, they are also capable of significant environmental disruption and widespread damage to infrastructure elements such as electrical wiring (Gutrich and Loope 2007). Unsurprisingly, there has been a targeted focus over the years on the deterrence and elimination of these ants' populations due to these deleterious effects.

Fire ants typically construct their nests below the ground in interconnecting tunnel systems, with mound sizes ranging up to 2 feet in diameter and 7 inches tall. Below the mound is a complex network of chambers and tunnels where most of the colony and the queen reside. A single colony contain around 100,000 to 500,000 worker ants and at least one queen. Queen ants live 2-6 years and may lay up to 1,500 eggs per day if well-fed. Worker ants live up to 180 days and are responsible for defending, foraging, building and housekeeping their colonies. Most worker ants are sterile, wingless females. Queen ants and males have wings, however after mating the male will die and the queen will shed her wings. After fertilization, a queen will lay a dozen eggs

which hatch within 7 days (Texas Imported Fire Ant Research and Management Project 2018). Once the eggs hatch it takes 20-25 days to mature into adults, meaning that successive generations of fire ants can be established quickly after a nest is in place. Fire ants are omnivorous and are known to eat meats and various nectars and sugars (Taber 2000). Their diets require an assortment of proteins, lipids and carbohydrates, much like other organisms. Common methods in the population control of fire ants often draw upon the ant's chemical association and attraction towards different types of sugars and oils as baits to increase the ant's exposure to the culling agent. Therefore, the purpose of the proposed experiment is to test the efficiency of assorted sugars and oils in the attraction of ants in the interest of such remedies.

Materials and Methods

Specimen collection was performed on the site of a previously identified location in College Station, Texas in the month of November. The site was situated near the entrance of the Woodlands apartment complex (~ 30.5918825, -96.3239257) whereby sight-identification was employed to further ensure the possible identity of the specimens.

Collection and Identification.

Following the further approval of the identified site, sample collections proceeded from a single nest series in which sixteen-ounce glass mason jars (Ball Corporation, Bloomfield, Colorado) were used to scoop from the surface layer of the colony and subsequently sealed with an aluminum lid and band. The two jars were filled approximately halfway (~8 ounces) with mound samples from the same colony. This qualitative collection of ant samples ensured for an excess (50+) of ant specimens in either jar, which proved to be more than enough for testing. A thin layer of coconut oil was then applied to the interior rim of each of the collection jars to prevent the fire ants from escaping this enclosure during experimental testing and observation. Following collection, specimens were then taxonomically identified down to the genus level following the morphological characteristics entailed in Pacheco and Mackay's descriptive key (2013).

Experimentation.

A stack of lineless printer paper was arranged upon a countertop and marked at the center with a graphite pencil. Further markings indicating the intended placement of sugar and oil samples were made three inches out from the center mark and space evenly apart from one another to promote trial clarity. Samples of brown sugar, light corn syrup, powdered sugar, high fructose corn syrup, sucralose, dextrose/stevia, white sugar, and canola oil were arranged on the aforementioned markings. Approximately 1 gram of each sample was crudely measured out from individual packets or by eye to prevent dramatic variation in sample proportions. A single ant was then isolated from the collection jar by allowing it to crawl onto a pair of tweezers then separating it onto the center mark. A small lid was then placed over the ant for 15-30 seconds to allow it to acclimate and then released. Observations on the ant's choice in its selected sample were then recorded and organized among 20 trial repetitions. Trials in which the ant made no selection or wandered off the test area and onto the bare countertop were discounted and a new trial was performed. Attractiveness was measured by instances in which the ant had lingered at a sample location for

approximately three seconds or longer, or if the ant had physically relocated the sample any distance from the sample pile.

Results

Results for each trial were collected as each one concluded. Among the 20 trials conducted, the single fire ant was attracted to dextrose/stevia and light corn syrup once for each sample. It was attracted to powdered sugar and white sugar twice for each sample. The fire ant selected the brown sugar sample three times during the experiment. High fructose corn syrup was selected four times by the fire ant and canola oil was selected seven times. However, sucralose was never selected by the fire ant. A bar graph (Figure 1) was constructed based on the table recording the results of the experiment that was conducted.

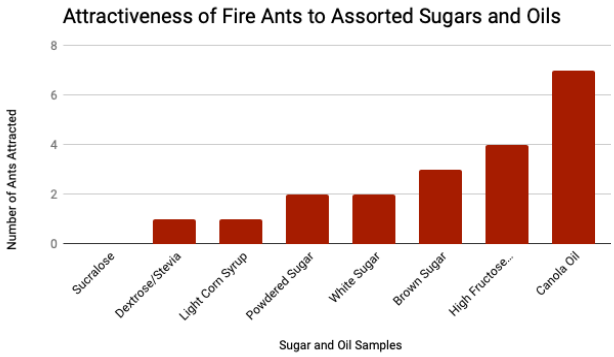

Fig. 1. Attractiveness of fire ants to assorted sugars and oils.

The graphical representation above illustrates the relationship between fire ants the chosen sugar and oil samples in terms of attraction. The bar graph shows that the canola oil was the sample that was most commonly selected by the fire ant (7) while the sucralose was the least commonly selected sample (0).

Discussion

Upon further investigation, most ants are opportunistic feeders. In natural environments and settings, fire ants have been commonly observed scavenging on food left out by humans occasionally on decaying matter of other dead insects or animals. Certain ants, in this case the *Solenopis* ant, have specific food preferences aligned to the need of the colony (Glunn and Tschinkel 1981). The *Solenopis* ants are considered grease ants, meaning they seek out protein-based meals that contain high amounts of fatty acids (Stringer and Lester 2011). Ants need to fuel their bodies for work just like humans do, and in doing so they require a diet of proteins, carbs, and lipids in various quantities. Just like humans need certain amounts of different food groups, so do ants. For example, sugar ants are generally known for their carbohydrate-based diets, where fire ants are after food groups high in proteins and fats. In fact, once one ant finds a good source of food they leave a trail of pheromones for other ants to follow (Suckling and Meer 2010). One possible proposed explanation for the experimental results was that once one ant found the delectable fatty acid meal, it left a trail for the others to follow. This leaves room for further investigation into other fatty acid derivatives that could be used for *Solenopis* ant population control. In all, this experiment was conducted to potentially determine a cheap, effective, and environmentally safe way to control *Solenopis* ant populations in the future in a limited setting or utilizing only home remedies (Meer and Lofgren 1999). Canola oil can be set out to trap the worker ants, who usually go out to bring back food for the queens and fertile females who lay the eggs. Therefore, over a period of time the colony could potentially starve and die off. Another method of control could be including a small dose of insecticide in the fatty acid substituent, so when the worker ants bring back the food, they poison the whole colony, though further

experimentation in this area is required. The experiment was successful in determining that sugar ants are most attracted to oils rather than sugars and syrups tested.

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