

## **Attractiveness and Impact of Terminix® All Clear® brand Attractive Targeted Sugar Bait (ATSB) to Honey Bees during nectar dearth.**

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### **Abstract**

Increases in consideration and potential use of Attractive Targeted Sugar Bait (ATSB) for mosquito abatement has raised concerns of any possible impacts on non-targeted insect foragers such as honey bees. Honey bees (*Aphis mellifera*) engage in sharing food, communicate the location of food sources located at great distances from the colony, and store food for later use. Toxic impacts can not only occur to food foraging bees but to an entire colony with access to contaminated honey stores.

Nectar is primarily composed of sugars. During times of nectar shortage honey bees search a broad area for any sugar source to use as food. They have been observed foraging for molasses on treated animal grain foods and searching around discarded soda pop containers for sugary residues. Beekeepers will feed liquid sugar solutions as a nectar replacement during times of limited food availability. This study was to gauge attractiveness and subsequent impact of ATSB (Terminix® ALL Clear® brand) in relation to natural nectars. The active ingredient is listed as 0.40 % garlic oil. The baits were put out during the period of high nectar flow and then continued through a period of (artificially) low nectar or other sugary foods availability. Bees were not attracted to the ATSB when nectar or replacement sugar solution was available. In times of nectar dearth scout bees showed some interest in ATSB placements but were not observed at repeated feedings. No toxic or other impact was noted in the hive beyond the conditions brought about by controlled food shortages.

### **Introduction**

In the search for new tools to use in an integrated Pest management approach to mosquito control, Attractive Toxic Sugar Baits (ATSB) has had several successful field trials for mosquito control (Muller2010).

Using sugar to deliver a toxin has the potential to have an impact on honeybees as they will actively forage for sugar solutions or residue when a better nectar source is not available. A recent example of this occurred in France. Honey bees foraging sugary waste from a factory processing M&M waste located 2.5 miles from their hives produced blue honey. Honey bees communicate within the hive as to how attractive a food source is in quantity and quality. Sugar concentration plays a role in determining if a nectar source is attractive or not. In a study conducted by Terminix (Terminix 2013) of nontargets feeding on ATSB with no active, all insects were collected after a 24 hour period. In that trial Honey bees made up a small percentage of the total catch that was feeding on the ATSB. It was not clear however if that low number of bees was influenced by more attractive competing flower blooms. Secondly It is possible that the collected bees were captured scout bees (bees who report findings of new food sources back to the colony) were removed before they had a chance to report back to the hive and recruit additional foragers to harvest the sugar.

The question remained, is ATSB attractiveness to bees dependent on the other sugar sources (nectar) available to them. If so what would be the impact to the bees.

If consumed what would be the impact to the hive. ATSB is defined as a gut toxin that kills feeding mosquitoes. Honey bees share food. Toxins that kill the forager before arriving back at the hive pose less

of a risk than those that work slowly allowing for the sharing of the toxin within the colony or possibly storing it within the hive to be consumed in times of dearth.

With the exception of the Queen, bees don't live a long time and the hive survives through continual replacement from the queen laying up to 1,000 eggs a day in the summer. Bees have a division of labor in the colony. Younger bees serve as nurse bees and caretakers of the young. Older bees are the foragers and guard bees. If a bee becomes sick, they move to more hazardous jobs where they are less likely to survive and where the likelihood of them sickening other bees is reduced. Changes happening to bee behavior can indicate to what level a toxin impacts a hive and its likelihood of recovering.

## **Methods**

Time line for study was as follows; divided into observation periods.

1. Move observation hive to study location allowing older foragers to leave.
2. Provide 50% sugar solution, observe active feeding by bees and acclimation to cage.
3. Apply ATSB to half vegetation in study cage and observe
4. Remove food and observe.
5. Allow bees to forage naturally (open cage to outside) and observe response with ATSB still present.

1. A small nucleus hive was created in June (basically a small colony). This colony was then used to stock the observation hive. After 30 days in the observation hive, one frame containing the queen, capped brood and larva as well as capped honey was placed between two sheets of glass for easy viewing and located above the rest of the frames. A queen excluder was placed below this frame so that the queen had to remain on this frame. Worker bees could travel below to the other frames as well as out the entrance. The hive showed good brood pattern, larva at all stages and adequate nectar, pollen and capped honey stores. The observation hive was then moved approximately 1 mile to the test location.

Bees know the location of their hive, by moving the hive during the day; many older foragers were lost as they were away when the hive was moved as well as many that left the hive at the new location and returned "Home" to the old location. Older bees do not do well in cages, so it was important to remove these from the hive. (Young bee's first jobs are in the hive as they get older they move on to the more hazardous jobs outside the hive such as foraging.) Young forager's bees tend to work close to home and accept the limited space of a cage much easier than older bees used to foraging a long distance.

2. The observation hive was connected at the entrance by a clear water bottle that had both ends removed (making a tube in which it was easy to observe bees traveling in and out.) to a enclosed cage. (39 by 45 by 41 inches high) dirt covered the floor with plants placed on both sides. In the center was located two Boardman entrance feeders one with water and the other containing a 50 % sugar salutation. A second feeder containing just water was left in place during the study.

Seven days were spent allowing Bees to adjust to the cage. Initially some of the older bees would cling to the outside wall of the cage( Many of these died or were released and returned to the old hive location.) Once bees were adjusted to limited flight area, they also found the water and sugar solutions provided. Bees would leave the observation hive fly directly to the sugar water and then back to the hive. At this point the hive was ready to move on to step 3.

3. All work done inside the cage was done after dark so that bees didn't escape. Half the vegetation was removed and treated with Terminix® ALL Clear® ATSB at label rates and then returned to the cage when it was dry. Vegetation included a potted Arborvitae, Colorado blue spruce and tall ornamental grass. None of this vegetation was flowering or is generally attractive to honey bees. These plants represent similar harborages where we find adult mosquitoes resting during the day in Twin Falls county Idaho.

4. Following seven days of exposure to ATSB with sugar solution available as a food source, the sugar solution was removed creating a artificial dearth of nectar.

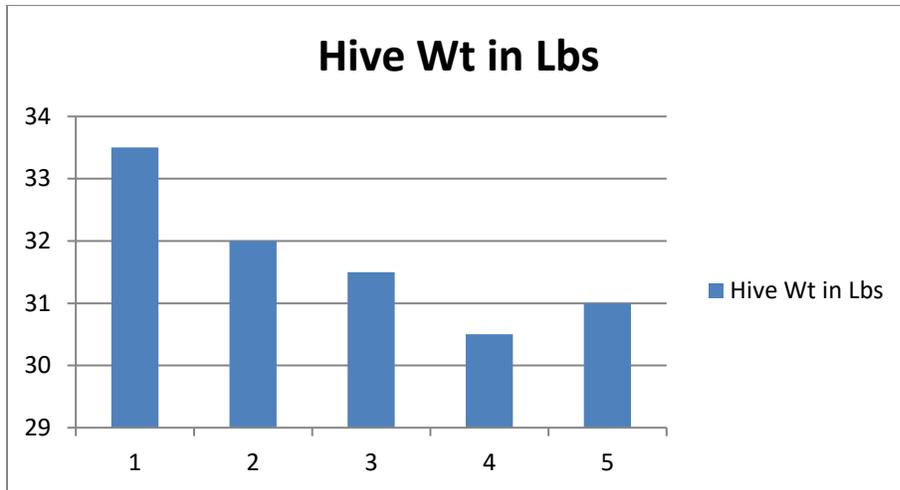
5. Following seven days of no food, the bee cage was opened allowing bees to fly past the ATSB vegetation to forage naturally on the abundant food available.

During all stages, observations were made of bee activity, temperament, and hive food stores in the form of capped honey, larval development and general behavior and hive weight.

An easy to track variable in how a hive is doing is to look at its daily weight. When food is abundant it goes up, if food ends or there is a sudden loss of bees it goes down. Also capped honey is considered an emergency food, when bees are consuming this it is because there is not enough nectar available. Bees with no visible capped honey are on the verge of starvation.

## **Results**

Weight: An easy to track variable is hive weight. It helps understand what is going on in the hive, but can also be quite variable depending on weather (temperature, rain, wind impact bee foraging behavior) bees leaving the hive, death or conditions that cause bees to eat into stored food. In our small observation hive, weight swings weren't as dramatic as hives with a large population. The drop in hive weight initially shown was a result of loss of foragers followed by bees consuming in hive stores of nectar and honey. The initial loss of foragers required younger bees to start foraging. With fewer bees to provide for the hive, the bees would have been looking hard for food.



**Food Stores:** Bees store excess food for use during nectar dearth and winter. Capped honey is bee enzyme processed nectar that has been evaporated to the proper moisture content and stored in cells sealed with capping of wax. At this stage it doesn't go bad and is a long term storage food. In the summer bees eat nectar first and honey last. Sugar water will be stored in open cells same as nectar. In the winter bees eat honey. Observing the amount of capped honey and nectar present on the frame gives a indication as to the amount of food available to the bees. Hives without capped honey are general on the verge of starvation. The amount of uncapped honey or nectar can change rapidly in response to blooms or feeding. Starvation conditions were created in the hive in period 4.

#### CHART

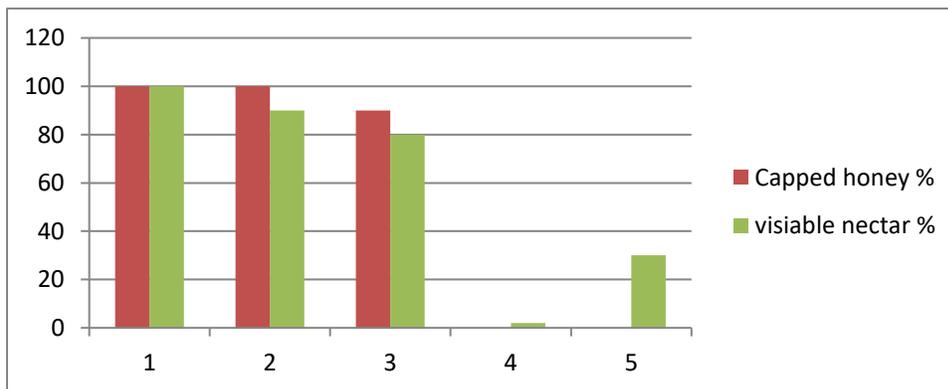


Chart shows capped honey and nectar using the initial inspection as 100% and records following observations as % compared to the starting point.

**Bee observations :** By the end of period 2, the bees had settled into their new home well and were observed making trip after trip directly to the feed jar and back to the hive. Every few days a scout bee would climb on vegetation or fly around the cage, the bees were calm. The hive looked good. When ATSB was applied to half the vegetation, It had a really strong smell. That day the bees were very noisy and irritable. They flew around the cage, hung on the outside of the screen and tried to avoid the ATSB. It took about two days before hive behavior was back to normal. Once the sugar water was removed, a

total of two scout bees were observed climbing on the ATSB and appeared to be tasting the vegetation for a few seconds. Once they left they did not return to it. With the starvation condition in the hive and no other nectar sources I fully expected more bees to return and forage for sugar on the ATSB. No bees returned to the ATSB and no dead bees were noted. Instead the hive focused on eating stored honey and really shut down its foraging activity. In the final period, the lid to the screened enclosure was removed permitting bees to forage naturally. Once the first scout bee ventured out and returned, the hive came back alive with activity. Bees continued to ignore the ATSB and traveled past it to haul in both pollen and nectar. The hive quickly began to rebound.

## Conclusion

The creation of controlled food shortages both in and out of the hive created a perfect environment for bees to forage on ATSB. With all this pressure, bees showed little to no interest in the ATSB baits. The hive was shutting down and slowly starving to death rather than forage on ATSB. No negative effects other than those brought about by the controlled food shortages were noted. I had planned to look at the impact to bees consuming ATSB, but could not find any feeding or effect on the bees from the ATSB.

One potential source for bee consumption that was not studied is; if the product was applied to blooming plants or to plants that bloom during the 4 week period ATSB is active. Bees gather pollen as the protein source for the larva. (Many contaminants make their way into hives with pollen that the bees gather.) It is possible that while bees seem to have no desire to feed directly on ATSB, it could be gathered along with pollen and fed to larvae.

In conclusion ATSB applied as directed by the label to non flowering plants poses little to no risk to Honey Bees.