

An Analysis of Household Products as Ant Repellents

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Abstract: In the summer, harvester ants are responsible for all the ant mounds found across the front and back yard of every household across the country. *Pogonomyrmex barbatus* are extremely active ants and bites when they feel threatened. The sting from the bite spreads poison along our lymph channels causing irritation and can lead to serious medical complications. However, this does not compare to what danger the chemicals in current ant repellents present to our health. Therefore, we tested the effectiveness of household products as an alternative method as ant repellents. A quarter size of honey was deposited into the center of 7 separate plastic containers. Next, for each container we placed one of the following household products: baking soda, black pepper, vinegar, mustard, coffee grounds, bleach, and crushed up bay leaves completely around the honey as a barrier. Then 10 harvester ants are placed on the outside of the barrier to examine which household product kept the most ants away from the honey after 5 hours. The results presented that coffee grounds was the best repellent, because it successfully kept all the ants away from the honey. However, the bleach, vinegar, and mustard were better ant pesticides killing most to all. Therefore, common household substances can be used as an alternative to effectively repel insects or as pesticides. This would reduce the use of harmful chemicals that are found in ant repellent products.

Keywords: Harvester ants, *Pogonomyrmex spp.*, pests, household, repellent

Harvester ants, or *Pogonomyrmex spp.*, are one of the most common household pests in Texas. They are most commonly found in South America and Mexico and tend to prefer desert conditions. (MacMahon et al. 2000) They are also commonly found in cities and suburbs, from the front yard to the kitchen pantry, though they typically do not invade homes. With a keen sense of smell, they travel towards any spills, stains, or other traces of food. While a trip to the grocery store will provide aisles of products to get rid of these pests, these products often contain harmful chemicals that will not only kill the ants, but may have a negative effect on human and environmental health as well.

In hopes of finding a safer and cheaper alternative, we tested some common household items to determine if they could be used as “DIY” ant repellents.

A common pesticide used to repel and kill household pests, such as the harvester ant, is fipronil. Fipronil is used worldwide, and studies have been conducted to determine its effect on human and environmental health. Fipronil can pose a risk to endangered species, and may also be a human carcinogen (Tingle et al. 2003). Fipronil has been seen to “exert sub-lethal effects ranging from genotoxic and cytotoxic effects, and impaired immune function, to reduce growth and reproductive

success, often at concentrations well below those associated with mortality” (Gibbons et al. 2015). Researchers found thyroid tumors in both male and female rats when exposed to high doses of fipronil. While these findings are considered to apply only to rats for now, fipronil is classified as a "possible human carcinogen" by the United States Environmental Protection Agency (Jackson et al. 2009). For these reasons, we are aiming to find common household solutions to ant infestations, to avoid exposing humans and pets to the potentially harmful chemicals contained in fipronil and many other common pesticides.

Material and Methods

In our experiment, we used several common household products such as baking soda, black pepper, rice vinegar, mustard, coffee grounds (Summer Moon coffee beans, freshly ground), bleach, and crushed up bay leaves. In addition to these household products, we also needed 100 harvester ants (*Pogonomyrmex spp*) with at least seven different plastic containers (Tupperware. Orlando, FL.) including a covering top for each plastic container. Lastly, we also needed seven bug carriers to transport our test subjects from one location to another.

To begin the experiment, we first obtained 100 harvester ants (*Pogonomyrmex spp*). Using seven plastic Tupperware containers, (Tupperware. Orlando, FL.), we then placed organic honey in the center of each container in order to attract the ants. Using the household items listed above, we put a different item into each container making a barrier that encircled the honey at a distance of 3-5 cm. Next, we took 70 of

the 100 ants and put 10 ants into each of the seven different containers with the extra ants as a fallback. We then placed the ants near the wall of the container so that they were in the section of the plastic container that does not have the honey. We set a timer for 5 hours in order to give the ants time to seek out and attempt to reach the honey. After the 5 hours were up, we checked each container to see if any of the ants crossed the household item barrier and reached the honey. We then recorded the results from each individual container. If none of the ants successfully crossed the household item barrier, the household item was an effective repellent; however, if the ants manage to cross the barrier, the household item was an inefficient repellent.

Results

The ants were left in their containers for approximately 5 hours. Immediately after placing the ants in their respective containers, some observations were made. Ants in the containers containing the coffee grounds and mustard were reluctant to cross the border to the honey. Ants in the rest of the containers crossed the border to the honey freely, and seemed to have no difficulties in doing so. Following the 5 hour time period, all ants in the bleach and rice vinegar containers had died. In containers containing pepper, coffee, bay leaves, and baking soda, nearly all ants survived, with the exception of one ant in the coffee container. Of the ants left in the mustard container, three survived, and six died, with one ant which could not be located.

	<i>Pepper</i>	<i>Coffee</i>	<i>Bay Leaves</i>	<i>Baking Soda</i>	<i>Mustard</i>	<i>Bleach</i>	<i>Rice Vinegar</i>
<i>Survived</i>	10	9	10	11	2	0	0
<i>Died</i>	0	1	0	0	6	10	10
<i>Total</i>	10	10	10	11	8	10	10
<i>% Deaths</i>	0.0%	10.0%	0.0%	0.0%	75.0%	100%	100%

Table 1: Number of ants that survived, died and the total number of ants that were in each container. Including the percent that died in each container.



Figure 1. Image, from left to right, of the coffee grounds (classic roast), crushed up bay leaves, bleach, rice vinegar, mustard, black pepper, baking soda, organic honey and the cling wrap .

	Beginning 11:40AM		End 4:45PM
Pepper		Pepper	
	Beginning 11:46AM		End 4:45PM
Coffee		Coffee	
	Beginning 11:48AM		End 4:45PM
Bay Leaves		Bay Leaves	
	Beginning 11:50AM		End 4:45PM
Baking Soda		Baking Soda	
	Beginning 11:51AM		End 4:45PM
Mustard		Mustard	
	Beginning 11:54AM		End 4:45PM
Bleach		Bleach	
	Beginning 11:57AM		End 4:45PM
Vinagar		Vinagar	

Figure 2. Image of each container with the household item and ants. Includes the times the ants were placed in the container and the time that the ants were counted for each household item.

Discussion

Each household product affected the harvester ants in a different way. Some of the household products repelled the ants completely, so that they tried to avoid it altogether. Other household products killed the ants. In addition, some had no effect on the ants at all. For some containers, once the ants reached the honey, they drowned within it and were no longer able to escape.

Coffee grounds were the most effective at repelling the harvester ants. When the 10 ants were first placed in the container, they avoided the coffee at all costs. The containers were not very large, and the ring of coffee grounds was slightly wider than it should have been, meaning the ants were constantly trying to climb up the sides of the container in order to get away from the coffee grounds. One ant in the coffee container made it into the honey, but was unable to get out. This ant was the only one which died in this container. After a 5-hour period, the ants in the container were still unable to reach the honey and were more concerned with getting away from the coffee grounds. This indicates that something in the coffee was repelling them. This is an area which could benefit from further research. Information on the chemical structure of coffee and its effect on ants is something that could be used in the future when developing insect repellents, as coffee was demonstrated to be effective at repelling harvester ants based on this experiment (Mora et al. 2015).

Mustard seems to be an effective repellent most likely due to the fact that it has a very strong odor. The viscosity of mustard was very high, so the ants were actually getting stuck in the household product and suffocating them. For some reason the mustard became very liquidy and most of the product actually ended up going

all over the container, probably had to do with the fact that water and vinegar are two ingredients of the food item. The Ants were not only exposed to the ring of mustard set around the honey, but throughout the entire tupperware because of the runoff. Mustard was an expected household item in our eyes that would be efficient on keeping the ants away from the honey because of its acidity and strong smell brought by the vinegar ingredient. (Fernandez-Escobar et al. 1988) The results of the mustard reflected what we believed would be the outcome of how many ants would get across the barrier of food created around the honey. All the following attributes including strong smell, viscosity, or the acidity of the mustard, had pretty high success at keeping *Pogonomyrmex* spp away from the honey in the middle of the tupperware.

The baking soda had almost no effect on the ants. They just seemed to run right over it and weren't bothered by the household item at all. Baking soda is found in most homes and is used in cooking as well as in odor relief; however, it had very little effect on the ants. It didn't repel them in any way, and it didn't cause any disturbances or deaths within the ants. Any of the ants that made it to the honey got stuck, but their death wasn't caused by the baking soda. There is very little use and very little effect by using baking soda on *Pogonomyrmex* spp. This isn't to say that baking soda could be effective on a different species of ant or maybe an entirely different arthropod. This would need to be researched in a different study to show the effects of baking soda on various insects.

The black pepper is a common household item used to flavor different meals. The black pepper did not work as a deterrent of *Pogonomyrmex* spp in the slightest. As soon as the ants were placed into the container they went straight to the

honey with no hesitation. After the five hours the pepper was scattered within the container and some was in the honey. None of the ants died and the ants never seemed to be deterred by the black pepper even after they were in the container for the five hours. This is highly contrasted by a study done on the effect of pepper on pests of garden plants. In this study spraying black pepper on plants would make Lepidopteran immediately drop and not come back to the plant for a while (Scott et al. 2004). Even though black pepper is common and has effects on Lepidopteran it has no effect on *Pogonomyrmex* spp. Further testing of black pepper as a deterrent could be tried on different ant species to see if they are affected by the pepper or not.

The crushed bay leaves were the least effective ant repellent and pesticide out of all the household products. Bay leaves are commonly found in most kitchens as a spice to flavor soups, vegetables, and meats. The leaves give off a strong fragrance which was thought to repel the ants. A study found that the components: benzaldehyde, piperidine, and geraniol were the repellent components in bay leaves (Saim and Meloan 1986). However, when the 10 harvester ants were placed into the container, they immediately crashed through the crushed bay leaf barrier. Therefore, the bay leaves seemed ineffective since the aroma had no impact on their foraging activity and it failed as a repellent and pesticide. After 5 hours, all 10 harvest were still alive and they were transporting parts of the crushed bay leaves into one corner. This was interesting to watch, because they worked together quickly to move the bay leaves out of the way. Sometimes the ant mounds seem to appear in front and backyards overnight because countless numbers of ants work together continuously to build the nest. Overall, bay leaves would not be an effective alternative, so further studies should be made to observe

other household products effectiveness as repellent to avoid the use of chemicals.

On using rice vinegar to deter the ants, we discovered that it was actually stronger as a pesticide than a repellent. After 5 hours, we saw that the ants were dead after they stepped foot in the vinegar, and all the ants seemed to have died in the pool of vinegar inside of the container I assume as they smelled the vinegar, wandered in and were all eventually killed. As rice vinegar is mainly composed of acetic acid (CH_3COOH) along with other organic acids and water causing it to have a low pH level (Liu et al. 2008). A low pH level, a PH below 7, represents an acid, which was enough to kill all the ants in a relatively short amount of time. However, as a pesticide, this would not necessarily keep the ants away, just simply kill them. Overall, vinegar is definitely a viable organic pesticide for ants, but there are drawbacks as in the odor is quite overpowering and unpleasant so when using vinegar as a pesticide in your home, be wary of the smell. Our research indicates that using a different kind of vinegar, apple cider vinegar, as both a fungicide and pesticide has a less pungent odor, so this might in fact be more practical to keep as a organic pesticide in your home.

We found two products that were very effective in killing ants. Both vinegar and bleach had a 100% mortality rate. The bleach killed all of the ants within 15 minutes of exposure. Though the vinegar had the same 100% mortality rate, it took significantly longer to obtain that same result. The advantage of these products is that they are effective in killing ants. A disadvantage of using these products is that they have a very strong unappealing odor. The bleach contains a 5.25% sodium hypochlorite (NaOCl) solution (Dohlen et al. 2017). This solution within bleach causes the pH of the overall solution of bleach be

very high. Additionally, the solution also causes the very strong unappealing odor for bleach. This indicates the bleach is a very basic solution causing strong harm to kill the ants in very little time.

In conclusion, the data presented shows that common household substances can be used to repel insects or as pesticides. The coffee was a great insect repellent; however, it did not actually kill any of the *Pogonomyrmex spp.* If one were wanting to use a common household product as a pesticide, it has been shown that bleach, rice vinegar, and mustard are effective pesticides

for *Pogonomyrmex spp.* In addition, further research presents itself in the reason behind why coffee deters *Pogonomyrmex spp.* and why exactly the mustard, bleach, and rice vinegar exterminates these insects. One possible suggestion is the pH of these causes harm to the insect, but we did not conduct any research on this subject. By using these various household materials, one could properly prevent any harm that may come to someone or their animal companions while also not using any of the possibly dangerous pesticides already out there.

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