# Measuring the Efficacy of Common Household Products as Repellents for *Solenopsis invicta* (Buren) (Hymenoptera: Formicidae)

Brianna Basinger, Emily Janak, Kendra Mack, Rahil Patel, Seth Smitherman, and Stewart White

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**ABSTRACT:** Red imported fire ants, *Solenopsis invicta*, are known to be household pests and a potential danger to small children and animals. Fire ants are particularly a problem in the state of Texas because of the $1.2 billion cost in damages associated with fire ant activity. Wildlife, agricultural, and urban areas are prone to fire ant infestation, and the fire ants can cause several problems to plants and animals in that area. The purpose of our study was to find effective, common household products that can function as a repellent of the insect. Using baby powder, cinnamon, and petroleum jelly as individual barriers between the fire ants and honeydew melon, it was found that petroleum jelly and baby powder were the best repellents. Lastly, the cinnamon powder, while effective, was the worst of the three repellents tested. In the future, other common household items should be tested for their efficacy at repelling *Solenopsis invicta*, but based on our results, it has been found that both petroleum jelly and baby powder are effective repellents of red imported fire ants.

*Keywords*: fire ants, repel, household, *Solenopsis invicta*

The red imported fire ant, *Solenopsis invicta*, is a fire ant species common to South America and areas of the southern United States. *Solenopsis invicta* has economic importance and is a model organism for superorganism research that includes development, function, ecology, and organization (Vinson 2013, Tschinkel and Wilson 2014). The red imported fire ant is of public importance because it causes billions of dollars in damages to buildings, crops, and livestock (Texas A&M Agrilife Extension). The species is known for its aggressive behavior, large colony formation, and painful bite (Tschinkel and King 2013).

Redness, itchiness, and swelling accompany any fire ant bite. Several resulting effects include pus-filled blisters that last from three to eight days on average (Haddad and Larsson 2015). Scabs will form at the site of the bit and these scabs can remain on skin for up to 10 days, usually (Heller 2015). Throat swelling, difficulty breathing, and rapid heart rate are just a few symptoms that result from a bite on a person that is allergic to fire ant venom. Some people, if not treated properly, can have an anaphylactic reaction that can result in death (Heller 2015). With these qualities in mind, efforts to control these insects are in constant demand, and the search for common household repellents for this species is ongoing. Cultural and biological control methods are utilized in many cases of fire ant infestation, and site-specific insecticide products are particularly effective (Wang and Henderson 2016, Drees et al. 2012). The use of integrated pest management includes having set goals, action levels, the existence and presence of non-target ant species, size of treatment area,

seasonality, environmental impact and implementation cost (Drees et al. 2012). Many control methods such as baiting and fumigation exist, but there is a need for cost-effective repellents that can be used by lower-income families.

## Materials and Methods

Eighty red imported fire ants, *Solenopsis invicta*, were taken from a single ant hill located in College Station, Texas. Ants were collected using tweezers with a slanted edge (Revlon, New York, New York). Next, the 80 ant sample was placed in a 62.46 L clear container for storage purposes, (Sterilite, Townsend, Massachusetts) and the container was covered with clear plastic cling wrap (Glad, Oakland, California). The plastic cling wrap on the top of the container was then punctured 20 times with a sewing needle (Spiral Eye Needle, Blaine, Minnesota) to allow airflow. In a second clear 62.46 L experimental container, a vertical cling wrap divider was created to separate the container's width in half to assure that the ants did not cross the container by crawling on the walls. A two-inch space was left underneath the divider. A 12.7 mm tall and 6.35 mm wide barrier of baby powder (Johnson and Johnson, New Brunswick, New Jersey) was created underneath the length of the divider. Four 25.4x25.4x25.4 mm cubes of honeydew melon (H.E.B., College Station, Texas) were subsequently placed on one end of the experimental container while 20 ants from the storage container were transferred to opposite end. Next, clear cling wrap was stretched on top of the experimental container, and 20 holes were punctured to allow airflow. For 20 minutes the ants were monitored to see their movements across the barrier towards the fruit. If an ant crossed the barrier and reached the melon, it was placed into a third clear 62.46 L container. The number of ants that reached the melon in 20 minutes (the number of ants that were placed in the third container) were counted and recorded. The baby powder from the experimental container was then removed, and the experiment was repeated with 20 new ants from the sample with a cinnamon powder (McCormick, Sparks, Maryland) barrier. This process was then repeated a third time with a petroleum jelly (Vaseline, Rotterdam, Netherlands) barrier. All barriers were created with the same dimensions, 6.35 mm width and 12.7 mm height. Lastly, a control experiment was run utilizing the same design without barrier to separate the ants from the melon.

After the four subsequent experiments were completed, the number of ants that reached the melon in each experiment were compared to the control using Chi-squared analysis to determine the whether the ants could have crossed the border simply by random chance; this tested the null hypothesis that the tested border did not affect the ability of the ants to cross over. Given that the null hypothesis was true, the expected number of ants to cross the border would be 20. The observed number of ants was the number of ants that successfully crossed the border. Once the Chi-squared number was calculated, the number was compared to a Chi-squared distribution table with the degree of freedom number of 2. The final number given was the chance given probability number. A chance probability number less than 0.05 rejected the null hypothesis.

## Results

During the control run of the experiment, 18 of the 20 fire ants crossed the border over a 20-minute time period. This data provided a negative control because there was no border preventing the ants from crossing over to the other side of the plastic tub. When faced with the baby powder border, four ants crossed over during the 20-minute time limit. Six of the ants made contact with the border, but

these ants turned around instead of crossing the border. The Chi-squared value was found to be 12.8, and this gives a probability of 0.0016 and indicated that these actions happened by mere chance. When faced with the cinnamon border, 11 ants crossed the border during the 20-minute time limit, and five ants made contact with the border before turning around. The Chi-squared value was found to be 4.05, meaning that the probability of this happening by chance is 0.1319. The Vaseline border only allowed three ants to cross during the allotted time while 17 ants made contact with the border before turning away (**Fig. 1)**. Analysis of the ants crossing the Vaseline border gave a Chi-square value of 14.45 and a subsequent chance probability of 0.0007.

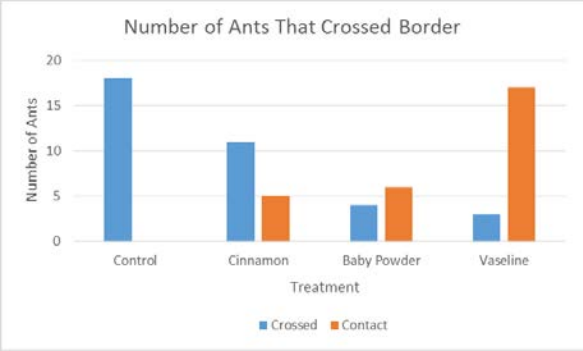


**Fig. 1.** Number of Ants that crossed or made contact with the border of each treatment.

## Discussion

Over half of the ants crossed the cinnamon border during the given 20 minutes. The random chance probability of the cinnamon border does not reject the null hypothesis that cinnamon does not stop ants from crossing over it. Therefore, this experiment does not provide definitive evidence that cinnamon is an effective method for stopping fire ants from crossing. However, both the baby powder and Vaseline borders could reject their null hypotheses. Though neither was perfect, baby powder and Vaseline were fairly successful at keeping ants from crossing over and getting to the melon. These three household products were not compared to common fire ant controlling chemicals such as Ortho and Andro because these fire ant controlling methods kill fire ants rather than repel. Such products are a common method of preventing fire ant infestations in households because they either effectively neutralize ant mounds or provide chemical bait traps capable of poisoning all ants that walk into the premises. Although these methods are proven to be effective, many people are now turning to “natural” or “chemical free” lifestyles. Families wary of formicidal chemicals or unable to afford them need methods of repelling fire ants from their house without the use of chemicals. Vaseline, baby powder, and even cinnamon provide answers to both of these issues. For example, Vaseline and baby powder can both be found in organic forms. Our data suggest that creating a border around household openings such as cracks around doors, near window sills, or on walls could limit the number of fire ants invading the home. In terms of cost, fire ant killers can cost up to $10 for 354.882 mL, while Vaseline and baby powder cost around $4 and $6 for 354.82 mL, respectively. In addition, because Vaseline and baby powder already serve other cosmetic and household purposes, they can both most likely be found in a majority of households. Using the method described above, baby powder and Vaseline both show the potential to keep ants from coming into households, even if they do not control ant populations by directly killing them. More replications of this experiment should be conducted to better confirm the results. Future experiments could compare the home methods of fire ant repellant to chemical products could be conducted. These experiments could involve testing the efficacy of different treatments for keeping live ants from getting into a specified area.

Fire ants are a common pest to households in most areas where the species is found. Numerous individuals have deadly or serious allergies to fire ant bites (Vinson 2013). Further, animals and infants are also at risk of being injured or killed by the stings of fire ant swarms (Haddad and Larsson 2015). Although fire ant killing chemicals are effective, many treat the mounds directly and do not protect the home. At home, fire ant killers contaminate the area around a home with potentially hazardous chemicals, which could be a serious concern to certain families pushing to live a more natural lifestyle (Suckling et al. 2010). In addition, these chemicals can be very expensive. Filling cracks or openings with lines of baby powder or Vaseline by doors, windows, or other points of access for fire ants can potentially repel fire ants from entering households, spoiling food, and pestering the humans and pets that live there (Wilder et al. 2013).

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