

Efficacy of Salt Water, Lemon Juice and Vinegar, and Orange Oil as *Isoptera Rhinotermitidae* Insecticide

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Abstract

Species of the order, Isoptera (termites), have always been a nuisance to humans, costing them tremendous amounts of damage. Because of this, exterminating termites is a common goal, but finding natural pesticides is quite a difficult task. For this reason, we have conducted an experiment using three organic materials: 50% lemon juice/50% vinegar, orange oil, and salt water to test their efficiency at killing termites, along with recording any behavior changes observed. The orange oil worked the best, exterminating every termite it came into contact with. The other two organic materials did not kill the termites at all, only causing hindrance to their movements. Due to the success of the orange oil as a pesticide for termites, we now have an interest to investigate deeper and test how well other concentrated oils would do as pesticides.

It is commonly known that termites are a pest. This is true not only in households, but in agriculture as well. In fact, 83 of the 2300 termite species bring about significant damage (Su 1998). To suppress some of the damage, more than \$1.5 billion is spent on liquid termiticides (Su 1998). Not only is this a costly endeavor, but these harsh chemicals have had a notable effect on crops and humans. As time has passed, there has been more pressure to eliminate the use of such chemicals, as they may be responsible for 75% of most cancers (Stewart 2004). In addition, methyl bromide, one of the main chemicals until recently in the pesticide Terminix, has been reported for its toxic nature as it recently poisoned a family of four after exposure from fumigation (Abassi 2016). Additionally, 32% of domestic sample

studies have shown to have leftover residues from pesticides (Akiyama et al 2002). It is critical to find a safer pesticide in case of human ingestion or medical consequences, especially because termites infest food crops like corn (Nyagumbo 2015). In light of cutting costs and producing safer alternatives, oil orange extract, along with a few other natural techniques, have been used and shown some efficacy in killing termites (Ashok 2007).

Materials and Methods

The experiment was conducted on campus at Texas A&M University, in the Entomology lab. The intentions for this study were to use natural alternatives to observe termite death, with time and effectiveness being the variables of interest. The following

materials were used: 100 termites provided by the Texas A&M Entomology department, two plastic containers lined with Tanglefoot, one spray bottle, and the testing variables: orange oil, 50% vinegar/ 50% lemon juice, and salt water. For the purpose of replicating results to determine any differences, two trials for each variable were performed. Exactly 15 termites were placed in each plastic container, lined with tanglefoot on the upper perimeter to keep termites from escaping. For each experiment, a container was given five sprays of its assigned mixture and observed for 20 minutes. Any changes in the behavior of the termites or termite deaths were recorded with the corresponding time it occurred. The 50:50 lemon vinegar mixture was made by filling a spray bottle with 100 ml of lemon juice and 100 ml of vinegar. The orange oil was simply that; no other substances were added. The salt water mixture was created by mixing one-fourth of a dixie cup with salt and 150 ml of tap water. The results from these trials were used to determine the effectiveness of each mixture toward exterminating termites.

Results

To begin our experiment, we tested the lemon vinegar 50:50 mixture. For both trials, we waited the full allotted 20 minutes, but resulted with zero termite deaths. When observing our sample termites under the microscope, they could be seen attempting to rid themselves of the liquid as their antennas were stuck together. The main result from this experiment was an impairment of the termite's movement, caused by the presence of the liquid. The orange oil was tested next. When sprayed with the orange oil, all

termites from trial one died within 1 minute and 30 seconds, while the termites from trial two all died by 1 minute and 15 seconds. Deterioration began at around 47 seconds for each trial. From this, we determined that orange oil had 100% effectiveness toward killing the termites. Lastly, we tested our saltwater mixture. In both trials, no termites were effectively killed. As observed with the Lemon Vinegar mixture, movement was hindered due to the presence of liquid. However, the termites seemed to have a harder time with the lemon vinegar mixture. This was determined by comparing the termite's previous behavior with their behavior after being sprayed.

Discussion

Although the lemon juice/vinegar and salt water methods had no effect on the morality of the termites within the 20-minute time frame, the orange oil showed significant termination of termites within a very short time period. The findings of this experiment indicate that there are safer, alternative methods of termite control than what are typically used in the pest control industry. Since orange oil is not only an effective pesticide, but also edible for humans, it is a healthier alternative to other pest control - like methyl bromide - in food preparation environments (Abassi 2016). These findings provide a safer, more "natural" pesticide that could be helpful in environments with children, the elderly, and generally immunocompromised patients. Orange oil has also been shown to have antibacterial qualities, making it especially fitting for environments like hospitals, schools, and nursing homes.

This successful discovery of a potential replacement for the common pesticides used today, could possibly lead to an agricultural revolution that could save a large sum of crops that would typically be lost.

There is a chance that a reduction in diagnosis of cancer may occur due to the avoidance of dangerous insecticides. With this article, it is shown that simpler, but still effective methods can be used to rid away unwanted

pests, however more research should be done in order to understand the maximum potential of orange oil and to determine adequate dosage to sufficiently replace other insecticides. Another important area of research that should be thoroughly evaluated are the negative health effects or environmental impact of unusually high exposure to this compound.

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