

The Effects of Increasing Temperature on *Solenopsis invicta* (Hymenoptera:Formicidae)

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Abstract: This experiment focuses on the *Solenopsis invicta*'s ability to withstand increasing temperatures in a dry, arid environment and determining the highest temperature that it would be possible for them to survive without the protection of an underground mound. Forty organisms were collected and separated in half, one being the control group and the other being the test group. The test organisms were then placed into a commercial food dehydrator and temperature was gradually increased. The behaviors of the organisms were noted as each increase in temperature took place. The lowest temperature that a change was observed was at 115°F and the highest temperature found that a fire ant could withstand was 125°F. The majority of change occurred at 120°F. At this temperature, 90% of the test ants became motionless and died. These results demonstrate the importance of the complex nests that fire ants build underground in order to regulate their temperatures.

Keywords: temperature, behavior, mound, environment

The red imported fire ant has proven to be a major concern to both humans and domestic animals. The fire ant is not native to the United States. Over forty years ago they were introduced to North America and have expanded their distribution over most of the southeastern and south-central United States (Ross 1985). In order to survive and expand into different climates as they have done, adaptation must occur to ensure success of the colony. Being native to South America, fire ants are able to endure a much more severe climate in terms of heat. *Solenopsis invicta* invest a large amount of

energy in building mounds, and effect thermoregulation through transport of brood to the surface (Penick 2008). This experiment will focus on the effects of rising temperature of fire ants without the thermoregulatory nest relied upon.

Materials and Methods

In order to conduct this experiment, forty worker fire ants were gathered from a single ant colony on April 29, 2014, in Grimes County, and separated into two glass mason

jars filled with half of an inch of sand from the area surrounding the colony. Wax paper (Reynolds Illinois) was used to cover the opening of the Mason jar and several holes were poked through in order to allow air flow. The control group remained at room temperature which was 71°F. The test group was placed in a commercial food dehydrator which allowed the temperature to be regulated. Beginning at 100°F, the fire ants were left in the dehydrator for 30 minute intervals and their behavior was observed and compared back to the control group. After 30 minutes had passed, the temperature was increased by an increment of five degrees and this process was repeated until all the ants died.

Results

Forty worker fire ants were caught and separated into two groups which were placed into two different mason jars. In the control jar, the organisms were kept at room temperature which was 71°F. The other jar was placed in a dehydrator where temperature was monitored and gradually increased. At 100°F there was no significant changes observed. The behaviors of the test group remained similar to the control group. Thirty minutes later the temperature was raised to 105°F. at this point, the ants in the dehydrator began to act more aggressively as they tried to climb up the sides of the jar they were in. the behavior of the control group remained the same. At 110°F, no changes were noted in either jar. The control group's behavior remained the same while the other group remained agitated. As the temperature was raised to 115°F, one of the

test group ant's movements slowed down significantly after 13 minutes. This ant remained in the same spot with only small, insignificant movements and after another two minutes had passed as no more movements were noted. After being in the dehydrator for two hours, the temperature was raised to 120°F. Within five minutes of the temperature increase, there was a significant decrease in the amount of movement of the test group. After 12 minutes, only five of the twenty test ants were still moving. Eight minutes later, three of the ants continued to move and six minutes later only two had continued moving. The temperature was then raised to 125°F. After one minute there was only one ant that continued to show movement and after 17 minutes of being in a temperature of 125°F, the final ant died. After thirty minutes of being in temperatures of 125°F the jar containing the test group were removed from the dehydrator and returned to room temperature. The ants were observed for two hours to ensure that no movement occurred and were then disposed of. Throughout the duration of the experiment, the control groups' behavior remained the same.

Discussion

While the fire ant mound may not be as essential to the survival of this species in the United States, the behavior exhibited by the test group reveals that is necessary in areas where temperatures could rise to 115°F and higher. Since this test was done using a commercial food dehydrator, the effects of direct sunlight in conjunction with high

temperature could not be concluded. In a natural environment, sunlight would be a factor which would most likely alter the findings and result in lower temperatures being the highest a fire ant could withstand. As this experiment found, by the time temperatures rose to 115°F, a substantial change in behavior was noted. The most significant change was found at 120°F. The adverse reactions of the fire ants took place within minutes of the temperature rising.

This indicated that without the use of mounds that fire ants are at a much greater risk for death in the colony. The complexity of this process is necessary to the survival and growth of this species in all environments.

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