The Amazing Aggregation Skills of the Red Flour Beetle

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Abstract

The Red Flour Beetle is a major pest of grain processing plants. They are commonly found in temperate areas, such as the southern parts of the United States. The beetles are usually reddish brown, with adults ranging about 1/8 of an inch in size. It's very common to find large numbers of Red Flour Beetles clumped together within infested grain (Baldwin and Fasulo, 2003). This dense clumping has caused speculation on whether this strange aggregation behavior is due to environmental factors or related to shared genetic traits. Scientists can look at the influence of genes on behavior by using a mathematical formula called a heritability estimate. Heritability estimates give information about how much of an impact genes have on a behavior in a certain environment (Khan Academy, 2018). Instinctive behavior is also connected to the genetic information, when best determines behavior when a species' environment varies little from generation to generation (Breed and Sanchez, 2010). This instinctive behavior theory correlated with the hypotheses, if you place Red Flour beetles with different genetic strains into an environment together then the Red Flour Beetles with similar genetic strains will aggregate together.

While conducted the research which included placing different Beetles with different genetic strains into the same environment, and recording the data, the result supported the hypothesis and helped further prove the instinctive behavior that organisms possess when it comes to their genetic information. When using the graphs theory to analyze the data, the results showed that in the first day of observation, the largest percentage of interactions per group was for neither the genetic traits nor the environmental traits. However, when observing the second day the largest percentage of interactions per group was the genetic traits, helping to support the question of the different effects genetic and environmental traits have on the aggregation of Red Flour Beetles. The results seem to support the fact that genetic information is a major key in helping to create interactions between organisms of the same genetic strain, as well as bringing these interactions back to equilibrium when the population is shuffled. These finding are huge for the Animal Sciences and Industry field, by helping to prove that instincts and behavior coexist and are more significant than just an environmental change, when it comes to organisms. This research also helps to pinpoint different aggregation habits.

Purpose

The purpose of the research is to access whether the aggregation of Red Flour Beetles is linked towards genetics or environmental traits.

Questions, Hypotheses, and Predictions

Question: What are the different effects, genetics and environmental trait have on the aggregation of Red Flour Beetles?

Hypothesis: If you place Red Flour Beetles with different genetic strains into an environment together, then the Red Flour Beetles with similar genetic strains will aggregate together.

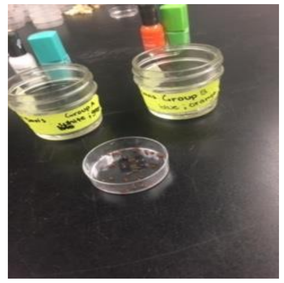
Study System

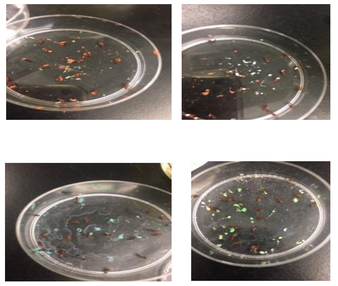
The Red Flour Beetles is of Indo – Australian origin, found in temperate area, such as the southern United States. It is usually found in infested grain, cracks, and crevices. The beetles are usually a reddish brown color, and around 1/8th inches, with a life cycle 40 to 90 days.

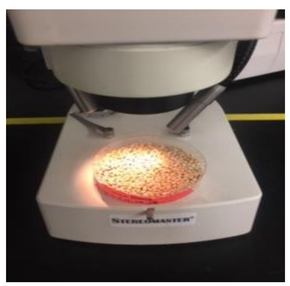
Methods and Experimental Design

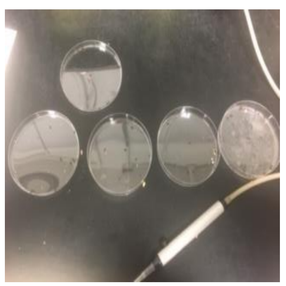
Step-by-Step

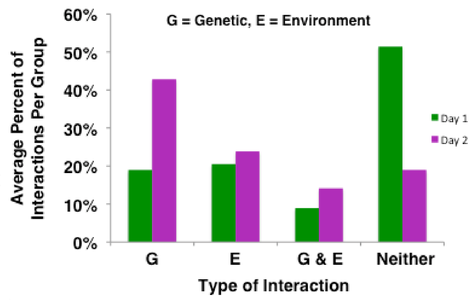
1.) I obtained two different Red Flour Beetle groups with different genetic Strain, one with a Canadian and Arkansas
2.) I took 40 beetles with the Canadian strain and painted half of them with a single small dot of blue nail polish, and the other half with a single small dot of white nail polish.
3.) I took 40 beetles with the Arkansas strain and painted half of them with a single small dot of orange nail polish, and the other half with a single small dot green nail polish.
4.) I placed 20 white and 20 green in a jar with some grain and placed 20 blue and 20 orange in another jar with grain.
5.) I left the jars with the beetles for a week.
6.) After leaving the jars, I took 15 beetles of each color and placed them in 3 separate small containers with grain.
7.) I left the containers for a day.
8.) I placed each container under a microscope and recorded the different aggregation groups.











Day	Trial	Group	G	E	G&E	Neither
1	1	1	0.33	0.27	0.13	0.27
		2	0	0	0	1
	2	1	0	1	0	0
		2	0.67	0	0.33	0
		3	0	0	0	1
	3	1	0.33	0.165	0.165	0.33
		2	0	0	0	1
		Average	0.190	0.205	0.089	0.514
2	1	1	0	0.67	0.33	0
		2	0	0	0	1
		3	0.33	0.33	0	0.33
	2	1	1	0	0	0
		2	0	0.67	0.33	0
		3	1	0	0	0
	3	1	0.67	0	0.33	0
		Average	0.429	0.239	0.141	0.190

Results

When looking at the data from the research conducted, its clear to see that the data supports the hypothesis, that if you place Red Flour Beetles with different genetic strains into an environment together, then the Red Flour Beetles with similar genetic strains will aggregate together. On the first day of observations the largest average percentage of interactions per group was corresponded with neither the genetic or environmental trait, but by the second day of observations, the largest average percentage of interactions per group was corresponded with the genetic trait. This supports the instinctive behavior which connects with the genetic information which best determines behavior when a species' environment varies little from generation to generation. Although the environment on the first day changed as far as the population, throwing off the beetles instincts, but by the second day the beetles instincts and genetic information strengthened and the change in population had less of an affect on the beetles.

Conclusions

The research builds a strong inference that genetic traits play a strong factor in the aggregation of Red Flour Beetles. When looking at the data, it's clear to see that in the second day genetic interactions had the highest percentage, which is very significant to the animal science and industry field, because understanding the different key factors that affect interactions along species and organisms can help in determining different environments and habitats for certain organisms and their connection with the other organisms around them.

Future Directions

If I were to continue this research further, I would continue to collect data on the current Red Flour Beetles for an extended period of them, in order to observe the interactions further. After using these beetles I would conduct another experiment in the same manner, but use different genetic strains other than the Canadian and Arkansas strains. While conducting this experiment I would look for similar results that show that genetics play a crucial role in the aggregation between organisms of the same species. Besides changing the genetic strains as allowing a longer data collecting time, I would also increase the sample sizes from 15 to 30, because a larger population sample would allow more variations of interactions. These changes would help show more variations in the data as well as narrow down which trait, rather genetic or environmental, is a huge factor in determining the different aggregation groups.

References

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Acknowledgements

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