Red Flour Beetle Aggregation

Logan Collingham and Jeremy Marshall

[1]Department of Entomology, College of Agriculture, Kansas State University
[2]Department of Animal Science, College of Agriculture, Kansas State University

Abstract

The Red flour beetle feeds on grain which is why it is considered a pest. Understanding their aggregation behavior can help us to find new ways to control them. What we don't yet know is what makes them group together the way they do, whether it be instinctive or a learned behavior. If the beetles are driven by strain-specific behaviors, then we should see a greater proportion of them aggregate with the same strain, which would mean they follow instinctive behavior. The results showed to be contradictory to the original hypothesis. The beetles seemed to show learned behavior due to them grouping more with beetles from the same starting environment rather than the same strain. These results tell us that we need to consider the environment, not just genetic strains, when trying to develop control strategies.

Questions, Hypotheses, and Predictions

Question: What role do genetic and environmental factors play in the aggregation behavior of Red Flour Beetles?

Hypothesis: If the beetles are driven by strain-specific behaviors, then we will see a greater proportion of the beetles aggregate with the same strain even after several days.

Prediction: I predict that the beetles from the same strain (Genetic) will aggregate more than with others from the alternative strain.

Study System

I studied the Red Flour Beetle, specifically the Canadian and Brazilian strains. Flour beetles feed on damaged grain, which means they tend to appear in areas where grain is either stored or spilled (Gerken, Skully, & Cambell 2018). The Red Flour Beetle is of Indo-Austrailian origin and is found in temperate areas but will survive the winter in protected places (Baldwin & Fasulo 2014). These flour beetles are reddish-brown in color but the different strains have some slight differences in size and other biological components.
These differences may affect their aggregation behaviors. Specifically the Canadian strain (NDG-2, Argyle, MB) has been in a lab colony for 30 years and produces very little aggregation pheromone. The Brazilian strain has only been in lab a few years and its pheromone levels are unknown.


Methods and Experimental Design

1. Painted random beetles a variety of colors to first see which colors were most visible and stayed on for a period of time.
2. Sorted out 40 beetles from each of the two strains
3. Painted 20 of the beetles from the Canadian strain orange and 20 blue. Painted 20 of the Brazilian white and 20 yellow.
4. Placed the orange Canadian beetles in with the yellow Brazilian and the blue Canadians in with the white Brazilian beetles.
5. After one week, I sorted out the usable beetles (clearly marked & living) and distributed four of each color into three separate dishes labeled trials 1, 2, & 3.
6. After two days, looked at beetles under the microscope and counted the number of groups (<2 grain kernels apart) and the number of individuals of each color.
7. Repeated this process every two days for 4 separate days
8. While counting the groups, I looked at the relationships between the colors and counted them (Genetic, Environmental, both G & E, or neither)
9. At the end of the experiment, I analyzed the data and came up with the following results.
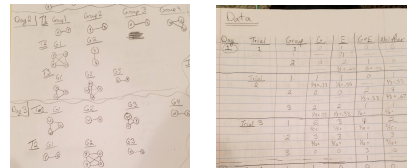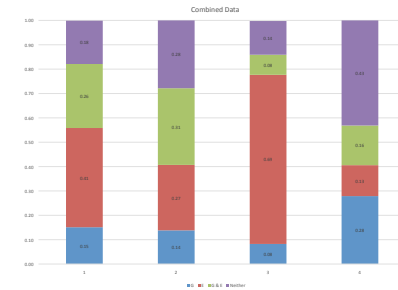
Results

After analyzing the data, it is evident that the beetles that were from the same environment, rather than same genetic strain, aggregated the most.
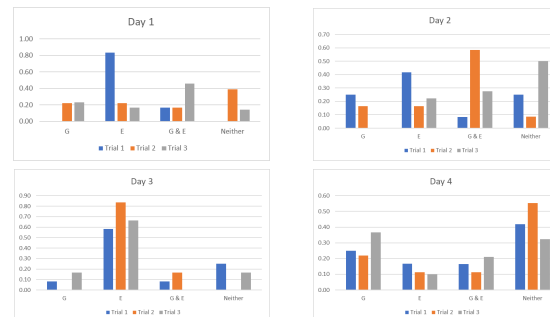
Conclusions

The results showed the original hypothesis to be false due to the evidence pointing towards the beetles aggregating based on learned behaviors rather than strain-specific instinctive behavior. These results suggest that control strategies that focus on environmental factors could be successful.

Future Directions

I think that If I were to continue this research, I would get more days of counting and analyzing groups to see if the data stayed consistent over a longer period of time. If I was to conduct a follow up experiment, I would look at more strains to see if it is consistent across strains. With this experiment, I have learned that there are factors that simply cannot be controlled. One factor being death of one or several beetles. Another factor is the possibility of a paint marker falling off during the observation period, potentially skewing the results.

References

Gerken, A.R, E.D Scully, and J.F Cambell. 2018. Red Flour Beetle Response to Volatile Cues Varies With Strain and Behavioral Assay. Environmental Entomology 47(5):1252-1265

Breed, M. & Sanchez, L. 2010. Both Environment and Genetic Makeup Influence Behavior. Nature Education Knowledge 3(10):68

Baldwin, R. & Fasulo, T.R 2014 Featured Creatures. Entomology & Nematology EENY-289

Acknowledgements