Effects of Genetics and Environment on Red Flour Beetle Aggregation

J. E. Toothaker[2] and Dr. Jeremy Marshall[1]

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

Abstract

Red Flour Beetles are major pests for farmers storing grain and cause large profit losses. These beetles infest grain stores and their presence leads to mold growth (Baldwin). Learning the cause of aggregation groupings in Red Flour Beetles will help with pest control and would be a great step in the Nature versus Nurture Debate (Breed). Males produce a pheromone to attract females that seems to influence social behaviors (Boake). The effects genetics and environment have on aggregation behaviors of Arkansas and Brazilian strains have never been evaluated. This project was designed to fill this research gap by assessing the impacts of genetics and environment on aggregation groupings of Arkansas and Brazilian strains of Red Beetles. The results of the study show that environment has the largest influence on groupings on the first day, but then genetics has the largest influence in the days following. This leads to the implication that genetics has a deeper effect on aggregation than environment overall; but environment has a stronger effect for a short amount of time.

Purpose

Assess the impacts of genetics and environment on aggregation groupings of Arkansas and Brazilian strains of Red Beetles.

Red Flour Beetles

- "*Tribolium castaneum*"
- From Tenebrionidae family (Darkling Beetles)
- 1/8 inch long
- 3 year lifespan
- Thrive in temperate climates
- Attracted to grains with high moisture content
- Infestation leads to mold growth
- Large problem in grain processing facilities

Questions, Hypotheses, and Predictions

Question: Do genetics or environment have any impact on beetle colonization?
Hypothesis: Genetics and environment have no impact on beetle grouping.
Prediction: The beetles will colonize and group at random.

Methods and Experimental Design

- Two strains of beetles were chosen: Brazil and Arkansas
- The strains were divided into two groups of twenty with per strain. Each group was labeled a different color.
  Brazil; orange(n=20), blue(n=20)
  Arkansas; green(n=20), white(n=20)
- One group from each strain was paired with the other and given one month to socialize.
  Group A; orange(n=20), white(n=20)
  Group B; blue(n=20), green(n=20)
- After one month, five bugs from each strain were put together in three trials and left overnight. The colonies were observed for the next three mornings and all groupings were recorded.
- All data was analyzed using graph theory and excel.

Results

Day 1

Clumps	G	E	G + E	Neither	Total
Trial 1					
a	4	0	2	0	6
b	0	0	1	0	1
c	2	0	1	0	3
d	0	1	0	0	1
e	0	0	1	0	1
f	4	4	3	3	14
g	0	2	1	0	3
Trial 2					
a	2	2	1	2	7
b	2	0	1	0	3
c	0	1	0	0	1
Trial 3					
a	0	0	0	1	1
b	0	1	0	0	1
c	0	0	3	0	3
d	2	0	1	0	3
e	0	2	1	0	3
totals	23%	35%	32%	11%	

Day 2

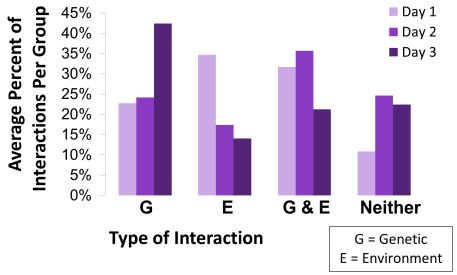
Clumps	G	E	G + E	Neither	Total
Trial 1					
a	2	2	2	4	10
b	2	2	1	0	5
c	0	0	0	1	1
d	0	1	0	0	1
e	0	0	1	2	3
Trial 2					
a	3	3	1	1	8
b	0	0	3	0	3
c	2	0	1	0	3
d	0	0	1	0	1
e	0	0	1	0	1
f	0	0	1	0	1
g	1	0	0	0	1
Trial 3					
a	1	2	1	2	6
b	2	6	4	3	15
c	1	0	0	0	1
d	0	0	0	1	1
e	0	0	1	0	1
totals	24%	17%	36%	25%	

Day 3

Clumps	G	E	G + E	Neither	Total
Trial 1					
a	0	0	0	1	1
b	1	0	0	0	1
c	2	2	0	2	6
d	1	0	0	0	1
e	1	0	0	0	1
Trial 2					
a	2	2	1	2	7
b	0	0	0	1	1
c	1	1	0	1	3
d	1	0	0	0	1
Trial 3					
a	1	0	0	0	1
b	0	0	3	0	3
c	0	0	1	0	1
d	0	0	1	0	1
e	0	1	0	0	1
totals	42%	14%	21%	22%	

G = Genetic
E = Environment

Progression of Interactions



Conclusions

The results show that both environment and genetics have an impact on aggregation grouping behaviors. In the first day of observation the beetles aggregated in groups with bugs they had shared an environment with for a month. On the second day there was no outstanding pattern in aggregation. The third day, the beetles associated with their own genetic strains. This leads to the conclusion that environmental association has a large impact in the short run; but genetic association has a deeper and stronger impact in the long run.

Future Directions

To continue with this research I would design a very similar experiment with different strains of Red Flour Beetles. The trials would last for varying periods of time to see how the beetles would react. I would love to expand on the Nature versus Nurture aspect of it as well.

References

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