



Preferences of the Red Flour Beetle, *Tribolium castaneum*, for Nutritionally Different Dog Foods

Kasey Wagner^{1,2}, Jamie Aikins¹ and Thomas Phillips¹

¹Department of Entomology, College of Agriculture, Kansas State University

²Department of Animal Science and Industry, College of Agriculture, Kansas State University



Abstract

Tribolium castaneum, known as the red flour beetle (RFB) is a common pest of stored grain and milled grain products. This research studied how RFBs orient to and lay eggs in their standard flour diet and in two kinds of dog food. We tested whether RFBs have a preference toward two different dog foods, one with low protein, the "Light" food, and the other with high protein, the "Dark" food. We predicted the beetles would prefer the Light kibble with the lower protein. When given the choice between the two foods, 60% of beetles preferred the Light product, which had only 20% of the protein as the dark food, which was chosen by 40% of beetles. When the beetles were given the choice between either Light or Dark kibble, vs. their regular flour-based lab diet, flour was the preferred food. However, the two-choice test showed a higher proportion of beetles were in the Light compared to Dark food. These results are important because they will help the pet food industry further understand what the RFBs prefer, and thus help us take appropriate measures to prevent infestation.

Purpose

The purpose of this experiment is to see how the Red Flour Beetles react to different nutritional values when presented in different foods, and their preference for them.

Questions, Hypotheses, and Predictions

Question: Do RFBs prefer dog foods with either higher or lower protein contents?

Hypothesis: If the RFBs are given a choice between two different dog foods, they will choose the lower protein food.

Prediction: We think they will prefer the lower protein food due to its higher concentration of grains, the preferred food for RFBs.

Study System

The red flour beetle (RFB) is an important pest of stored grain and grain products. RFBs are small, approximately 4mm at adulthood, and have chewing mouthparts. The RFB is a common household pest in addition to being a serious commercial pest of grain and grain products. Our goal was to determine if RFBs prefer one dog food over another, and the possible causes for those preferences. These beetles are known to frequently infest dog food, so it is important to understand what they may prefer among different products. We performed a series of behavioral 2-choice experiments so that the beetles were forced to pick between the 2 different dog foods and show the preferences.



Figure 1. Diagram of the RFB life cycle (left); RFBs infesting dog food kibbles (center); a group of beetles on their preferred food of wheat flour.

Methods and Experimental Design

We chose two commercial dog foods that differed greatly in their ingredients. We labeled these "Light" and "Dark". The two dog foods were ground up using a blender so the resulting fine particles were similar in size to those the flour-based lab diet (referred to below as "flour") and not large, hard kibbles typical of the commercial product. A series of choice experiments were conducted to evaluate the preference of RFBs for different foods. The experimental unit was a plastic box with dimensions 30 cm long x 18 cm wide x 10 cm deep; three replicates were conducted for each food comparison (Fig. 2). We compared light food versus dark food, light versus flour and dark versus flour. A small piece of filter paper (7 cm dia. circle) with 1.0 g of food was set flat on each side of the plastic tub. Fifty adult beetles were counted and released onto the center of the plastic tub's floor. Prepared two-choice tubs were placed in a dark laboratory cupboard (approx. 25 C and 30% RH) for 24 hours. The filter papers were put into a Petri dish so the number of beetles on each sample could be counted and recorded. The experiments were then repeated with new beetles, new food and cleaned containers. Larval infestation of foods exposed to beetles in the two-choice tests was then evaluated. After the beetles were counted for the dog food choices, the food and filter paper were placed into ventilated 12 ml glass jar and incubated for 3 weeks 27°C and 60% RH) to allow the larvae to develop. The larvae were then counted by pouring the contents of the glass jar into a glass petri dish and stirring the food around until larvae were found and separated.



Figure 2. Dark and Light kibbles, with corresponding ground material, and the standard flour diet (top left); releasing 50 RFB adults in a typical 2-choice bioassay (top right); a series of three 2-choice assay boxes (bottom).

Results

Our research found that the RFBs prefer their lab diet over either of the dog foods given. If they are forced to choose between the Light and Dark food, they preferred the Light with a 68% response, compared to the Dark food at 38%. When the dog foods were paired against flour, although flour was clearly preferred in all cases, the proportion of beetles preferring Light food was higher, at 13%, compared to a 9% proportion choosing the Dark food.

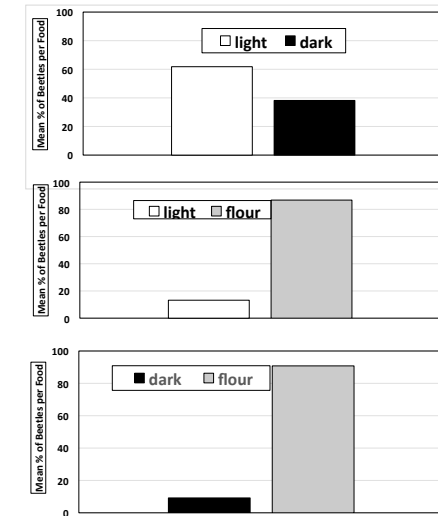


Figure 3. RFBs responding to different foods in three different 2-choice experiments. Top, mean percent of beetles responding to Light vs Dark; middle is the mean percent responding to Light vs Flour; bottom is mean percent of beetles responding Dark vs Flour.

Conclusions

Red Flour Beetles orient to and prefer to colonize their standard flour diet. However, RFBs preferred the light dog food over the dark dog food when flour was not a choice. When flour was a choice compared to one of the foods, the Light dog food had a higher proportion of beetle select light compared to a lower proportion choosing Dark when paired with flour.

Future Directions

Future research could be more specific in variables tested, or could examine more varieties of pet foods. Experiments with foods of different protein content can be extended. Additional studies could also look at moisture levels and/or other nutrients to determine if the beetles have a higher preference for certain conditions.

References

- Puss Caterpillar (Larva), Southern Flannel Moth (Adult) *Megalopyge opercularis*, entnemdept.ufl.edu/creatures/urban/beetles/red_flour_beetle.htm.
- "Confused Flour Beetle and Red Flour Beetle (Department of Entomology)." *Department of Entomology (Penn State University)*, ento.psu.edu/extension/factsheets/flour-beetle.
- "Red Flour Beetle." *Earwig | Horticulture and Home Pest News*, hortnews.extension.iastate.edu/red-flour-beetle.

Acknowledgements

We appreciate the supplies and space provided in the Department of Entomology. This work was partially funded by grants from the USDA and from the Undergraduate Research Experience program at KSU.