



# Oviposition Decisions by Red Flour Beetle [*Tribolium castaneum*]

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## Abstract

The red flour beetle [*Tribolium castaneum*] and the confused flour beetle [*Tribolium confusum*] are very important flour pest. We tested if the red flour beetle can discriminate between flour infested by the same species or congeneric species and lay different number of eggs. Results of the choice tests were inconclusive, because oviposition across all the treatments was very low. Future research will be needed manipulating the female age and the length of time in the arenas to be able to address the proposed question. With this future research, it will hopefully help us better understand how these beetles exploit flour patches and improve management in flour mills.

## Purpose

The red flour beetle [*Tribolium castaneum*] [RFB] and the confused flour beetle [*Tribolium confusum*] [CFB] are important pests in food facilities such as flour mills (Campbell et al., 2010). They are very important pests because they can find and exploit small amounts of flour (in equipment, walls, floors, etc.) which makes them very difficult to find and eliminate (Campbell and Rynnion, 2003). Literature shows that the RFB changes the flour when they infest it (Halliday and Blouin-Demers, 2016). They release quinones, pheromones, and other materials that could change how beetles respond to that flour patch. Both RFB and CFB can be found within the same location and can be competing for resources. The purpose of this study is to see if the RFB exploit (egg laying) the flour differently based on whether it has already been utilized by the same species or by a different species.

## Questions, Hypotheses, and Predictions

**Question:** Can the red flour beetle discriminate between infested and uninfested flour patches and between flour infested by the same species or a congeneric species.

**Hypotheses:** Beetles will prefer newly colonized flour over uncolonized flour (2 week vs control flour), beetles will prefer uncolonized flour over heavily colonized flour (uncolonized vs 6 week flour), and beetles will avoid flour colonized by congeneric species.

**Prediction:** The beetles will be able to detect infestation and adjust their oviposition behavior.

## Study System

The RFB and the CFB are morphologically very similar species. The two beetles used to be considered members of the same species, until researchers found small differences. They have differences in the eye shape and antenna shape. Also, the RFB can fly while the CFB cannot. The RFB is a primary colonizer while the CFB is a secondary colonizer. RFB are more known to exploit smaller patches of flour compared to the CFB. Typically, at a location that has these species, you will find one or the other. However there are some cases where they can coincide together.

## Methods and Experimental Design

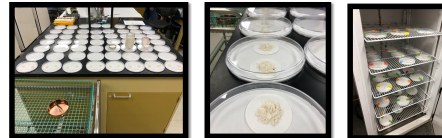
Treatments:

- Flour (2 week conditioned/red flour beetle) vs. flour (control)
- Flour (6 week conditioned/red flour beetle) vs. flour (control)
- Flour (2 week conditioned/confused flour beetle) vs. flour (control)
- Flour (6 week conditioned/confused flour beetle) vs. flour (control)
- Flour (2 week conditioned/red flour beetle) vs. (2 week conditioned/confused flour beetle)
- Flour (4 week conditioned/red flour beetle) vs. (4 week conditioned/confused flour beetle)
- Flour (control) vs. flour (control)

Flour was sieved through an 80 mesh sieve to remove any insects and eggs and to make it easier to sieve the eggs from the flour at the end of the bioassay

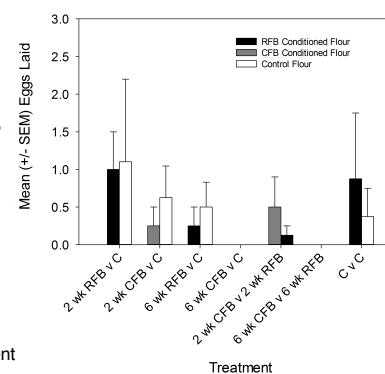
Arena:

- In 150 mm petri dishes (filter paper inserted into lid and dishes inverted for assays)
- Two patches containing 0.9 g of flour on small filter paper disk (55 mm) were added and the rep and flour type using marked using pencil on the edge of the filter paper.
- Replication: 8 dishes for each combination of flour x 7 treatment combinations = 56 dishes
- Introduce 1 female (held individually overnight before the start of the experiment) and place dishes in incubator at 25 °C, 60% rh
- After 48 hrs, beetles were removed and flour sieved through an 80 mesh sieve
- Number of eggs in each patch was counted



Left: All 56 of the petri dishes  
Middle: The flour set up in the arena  
Right: The incubator where the beetles stayed for two days

## Results



The graph to the right shows the results of the experiment. The number of eggs laid was very low across the many treatments, including controls, so cannot draw any conclusions from the experiment

The lowest number of eggs appeared to be laid in treatments with the 6 wk conditioned flour, so this suggests if overall oviposition levels can be improved some treatment effects might be present

## Conclusions

Cannot make any conclusions about treatment effects since the level of oviposition were so low across all the treatments. Although the same conditions have been used in other similar experiments, there are several possible reasons for the low oviposition.

Could be because of the age of the female beetles

- If they haven't mated within the colony before selection
- If the females were not physically mature enough to lay eggs

The environmental conditions were not suitable or the handling of the arenas might have suppressed egg laying.

Experiment could have been run longer to allow time to lay eggs, but if did this females could have changed the patches more which could effect decisions and eggs would have had time to hatch.

## Future Directions

Since the oviposition was so low in this experiment, there are numerous ways alter the experiment to see a different outcome:

- Repeat with different batch of beetles to see if it was the particular colony of beetles
- Run the test within a higher temperature.
- Giving the beetles a little more time in the colony to mate and mature eggs before the experiment
- Instead of 2 days run it for 4 days

## References

Campbell, J. F., & Rynnion, C. (2003). Patch exploitation by female red flour beetles, *Tribolium castaneum*. *Journal of insect science* (Online), 3, 20.

## Acknowledgements

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