



Oviposition Decisions by Indianmeal Moth

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Abstract

The Indianmeal moth, *Plodia interpunctella*, is a pest in the United States of stored grains. The larvae feed on grains, grain products, dried fruits, nuts, cereals and a variety of processed food products. Indianmeal moths can detect where other Indianmeal moths have laid eggs but it is unknown if they know where other species have been and laid eggs. So, does the colonization of flour by other species affect where an Indianmeal moth will lay her eggs? Our results showed there was no preference for colonized or uncolonized flour by the moths. The average number of eggs laid in both patches of flour was even. This data shows us that the moths do not have a preference where they lay their eggs, potentially increasing competition among species in food patches.

Purpose

The Indianmeal moth is one of the most commonly reported pests in the United States of grains, grain products, dried fruits, nuts, cereals and a variety of processed food products. Female Indianmeal moths can adjust pattern of egg laying and detect food patches that have Indianmeal moth larvae in them (Anderson & Löfqvist, 1996; Sambaraju et al. 2016). Because Indianmeal moth can often be found in locations that have multiple stored product insect species, we wanted to determine if they can detect when other species have been in a food patch and adjust where eggs are laid. The purpose of this research project was to determine if Indianmeal moth can discriminate between patches recently colonized by other stored product insects and uninfested flour patches.

Questions, Hypotheses, and Predictions

Question: Does the recent colonization of flour by other species affect where an Indianmeal moth will lay her eggs?

Hypothesis: Indianmeal moths will prefer uncolonized flour over flour colonized by other species.

Prediction: The amount of eggs laid in the control vs. control dishes will be even. In warehouse beetle vs. control, red flour beetle vs. control and cigarette beetle vs. control the amount of eggs laid in the control will be higher than in the conditioned flour.

Study System

The Indianmeal moth, *Plodia interpunctella* (Hubner), is a common household and grain pest. The larvae are found in grains, dried fruits, nuts, cereals, and a variety of processed food products. The Indianmeal moth received its name here in the United States where it was found to be a pest of "Indian corn" or maize. These pests are found throughout the food distribution system and are commonly found at the retail level. There have been reports of Indianmeal moths in 48 different countries and associated with 179 different stored products.



Adult Indianmeal moth
<https://www.rotllier.com/pests/profile/indian-meal-moth>



Adult Indianmeal moth showing underwings
<http://sisatilojentuholaiset.fi/en/food-pests/indianmeal-moth/>



Indianmeal moth larvae
<http://entnemdept.ufl.edu/creatures/urban/stored/indianmeal-moth.htm>

Methods and Experimental Design

Treatments:

- Indianmeal moth females (*Plodia interpunctella*)
- Flour (conditioned/warehouse beetle) vs. flour (control)
 - Flour (conditioned/red flour beetle) vs. flour (control)
 - Flour (conditioned/cigarette beetle) vs. flour (control)
 - Flour (control) vs. flour (control)

The flour was conditioned by adding 100 adults of each species to 50 gm of flour with oats on top for 5 days and then sieved through an 80 mesh sieve to obtain the flour to use in tests. Flour was used the same day it was sieved for testing.

Arena:

150 mm petri dishes with two patches containing 0.9 g of flour on a 55 mm filter paper disk.

Protocol:

Introduce one female (females from colony jar, at least 24 hours after emergence so of an age that they have likely mated).
 Hold dishes at 25°C, 60% RH, and 16:8 hours light:dark for 48 hours.
 Flour sieved (80 mesh) and number of eggs in flour or on filter paper counted.



Red flour beetles contaminating the flour

Petri dishes with conditioned and control flour

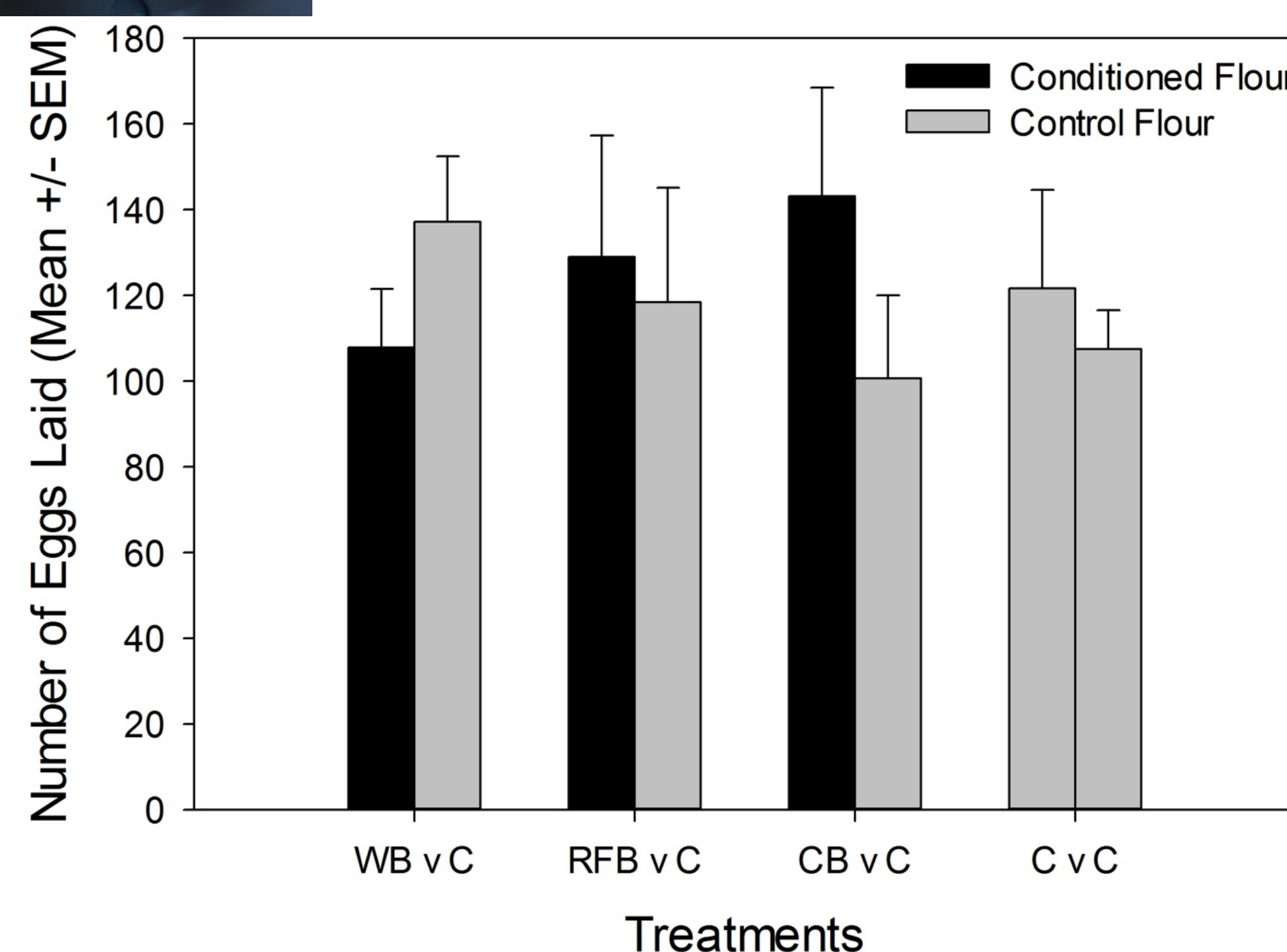
Indianmeal moth already laying eggs

Eggs in a petri dish under a microscope



Eggs that were laid around the flour on the paper

Results



- The total number of eggs laid (both patches) was not different among the treatments (ANOVA, $F=0.133$, $P=0.940$).
- Paired t-test showed no significant differences between conditioned and control flour in any groups ($P>0.05$).
- Control vs. control: $P=0.646$.
- Warehouse beetle vs. control: $P=0.145$.
- Red flour beetle vs. control: $P=0.833$.
- Cigarette beetle vs. control: $P=0.314$.

Conclusions

Indianmeal moth did not have a preference over infested or clean uninfested flour while laying eggs, regardless of the insect species tested. Other insects could have been there and they would still lay their eggs. With them having no preference to their flour, they don't have to compete with each other to find a place to lay their eggs. Not having the ability to discriminate between patches could mean that the larvae would be competing for the same food in the patch. This would be a cost to the females for laying their eggs this way. It is possible that Indianmeal moth is a better competitor than these other species, so there would be less of a cost to the potential competition.

Future Directions

If I were to continue this research, the first thing I would change would be the amount of time the beetles spend on the flour. We were just testing early colonization in this study, it is possible that it takes more time for cues indicating an infestation to build up before moths can discriminate or before there would be more of a cost to laying eggs in a previously infested patch. I would give the beetles more time to walk on the flour and contaminate it and even reproduce on it and lay more eggs in the flour. I would add on to this experiment by letting the moths stay on the flour longer too and lay more eggs. The eggs would then hatch and we would see if the moths that hatched in the flour they did, have more of a preference for that flour or not. I could also evaluate the results of competition between the larvae of the different species to determine if there is a cost.

References

- Anderson, P., & Löfqvist, J. (1996). Asymmetric Oviposition Behaviour and the Influence of Larval Competition in the Two Pyralid Moths *Ephestia kuehniella* and *Plodia interpunctella*. *Oikos*, 76(1), 47-56. doi:10.2307/3545747
- Sambaraju, K., Donelson, S., Bozic, J., & Phillips, T. (2016). Oviposition by Female *Plodia interpunctella* (Lepidoptera: Pyralidae): Description and Time Budget Analysis of Behaviors in Laboratory Studies. *Insects*, 7(1), 4. doi:10.3390/insects7010004

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