



Ovipositioning of *Callosobruchus maculatus* is Unaffected by Natal Experience and Antennal Ablation

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Introduction

Insects lay their eggs selectively in order to increase the survival rate of their offspring (Ward et al. 1999). Possible stimuli that serve as markers for this ovipositioning behavior include the natal host experience, attractant or deterrent odors, and the topography of the oviposition sites. For example, *Culex* mosquitoes will lay their eggs in skatole water (normally a deterrent) if they were reared in that odor (McCall et al. 2001). Sambaraju et al. (2008) found that when wheat extract (an attractive odor) is added to non-host sites Indianmeal moths, *Plodia interpunctella*, will lay their eggs on these sites. Additionally, deterrent odors have been linked to toxic seed coats and therefore reduce ovipositioning frequency (Souza et al. 2011). Finally, yellow dung flies utilize topography by laying their eggs on hills rather than on points or in depressions to avoid desiccation or drowning, respectively (Ward et al. 1999). We tested to see which of these factors influenced the ovipositioning of *Callosobruchus maculatus*. We predicted that bean beetles would lay their eggs on their natal hosts and that they would use their antennae to detect attractive and deterrent odors innately present in each bean to determine which bean species to lay their eggs on.

Methods

We conducted two choice experiments to test ovipositioning of the bean beetle *C. maculatus* (See Figure 1). Both studies were analyzed through the use of Chi Squared Statistical Analysis.

In the first choice experiment thirty-six mung and thirty-six adzuki beans were placed into each petri dish. One female bean beetle was added to each dish. In 44 of the dishes, this was a beetle raised on adzuki beans and in 42 of the dishes this was a beetle raised on mung beans. Forty-eight hours later the beetles were removed and we counted the number of beans with at least one egg.



Figure 1. Female bean beetle laying eggs on a bean
<http://www.beanbeetles.org>

For the second experiment, female bean beetles received one of three treatments. After exposing the beetles to Fly Nap for one minute, we used microsurgical scissors to cut off the whole antennae of 201 beetles, half of the each antennae of 224 beetles, and performed a sham operation on 196 beetles.



Figure 2. Three out of four bean types used (mung, adzuki, and black-eyed pea, respectively).
<http://www.beanbeetles.org>

We filled the bottom of each petri dish with eleven of each type of bean (mung bean, adzuki bean, black bean, and black-eyed pea, see figure 2), and then added one female bean beetle from each treatment group. As in the first experiment, forty-eight hours later the beetles were removed and we counted the number of eggs on each bean type.

Results

Natal bean host had no effect on oviposition site (results not shown); therefore, we pooled the data from the two treatment groups (Figure 3).

In the second experiment, there was no effect of antennal treatment on oviposition (results not shown), so we used only the sham-operated group in result to test bean preference (Figure 4).

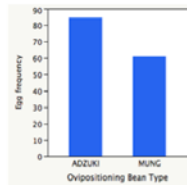


Figure 3. Frequency of eggs laid on bean types by female bean beetles. N=291 beetles. Beetles laid significantly more eggs on adzuki beans (P<0.01).

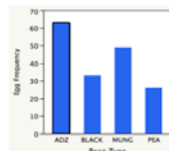


Figure 4. Frequency of eggs laid on beans by mung-reared bean beetles. N=196 beetles. Beetles laid significantly more eggs on adzuki beans (P<0.001).

Discussion

Contrary to our prediction, preference of natal oviposition sites was not shown by *C. maculatus*. *C. maculatus* preferred the adzuki bean for ovipositioning regardless of which bean it was reared on. Therefore, other explanations must be considered. One possibility is that the beetles prefer to lay their eggs on larger beans. The works of Samaraju et al. and Messina et al. support this possibility because moths chose larger-sized beads, and beetles chose larger beans, respectively (Samaraju et al. 2008, Messina et al. 2003). However, host size alone cannot fully

explain our results, as the larger black-eyed pea was not favored by the beetles. Souza et al. (2011) found that toxic compounds in the seed coat deterred beetles from laying their eggs. This suggests that the adzuki bean may have a less toxic seed coat or the coats of the black bean and black-eyed pea may be more toxic than the others. To test this we could apply the procedures of Souza et al. (2011) and test the toxicity of the coats of seeds used in our experiment. Further investigation into the effects of odors on ovipositioning also seem to be required. Magali et al. found that more odorous tomatoes elicited increased egg-laying from *Tuta absoluta*, which, when applied to our results, suggests that the adzuki bean had a more attractive odor (Magali et al. 2011). We could test the effects of such an attractive odor using the procedures of Sambaraju et al. (2008). Also, while antennae did not appear to have any effect on ovipositioning in our experiment, Mbata (1994) and Parr (1998) suggest that both the antennae and the palps play roles in chemical signal recognition. Thus the roles of olfaction could be further tested by repeating our ablation experiment with both the antennae and the palps. If we were able to discover why the beetles choose to lay their eggs on some hosts and not others, this information could be used along with genetic engineering to protect crops from this pest.

Literature Cited

Magali, Profira, Gíran Bingsonson, Marie Bingsonson, Eozaldo Reto Jr., Peter Witzgall, et al. 2011. Attraction and oviposition of *Tuta absoluta* females in response to tomato leaf volatiles. *Journal of Chemical Ecology*. 37(6): 665-674.
Mbata, George N. 1994. Sensory organs involved in egg distribution in *Callosobruchus subniveatus* Fie. (Coleoptera: Bruchidae). *Journal of Stored Products Research*. 30(4): 339-346.
McCall, P. J., and G. Eaton. 2001. Olfactory memory in the mosquito *Culex quinquefasciatus*. *Medical and Veterinary Entomology*. 15: 197-203.
Messina, Frank J. and Margaret E. Karen. 2003. Adaptation to a novel host modifies host discrimination by the seed beetle *Callosobruchus maculatus*. *Animal Behaviour*. 65: 201-207.
Parr, Martin J., Bruno M.D. Tsan, Monique S. J. Simmonds, and Peter F. Croftland. 1998. Duration of behaviour patterns during oviposition by the bruchid beetle, *Callosobruchus maculatus*. *Physiological Entomology*. 23: 150-157.
Sambaraju, Kishan R. and Thomas W. Phillips. 2008. Effects of physical and chemical factors on oviposition by *Plodia interpunctella* (Lepidoptera: Pyralidae). *Annals of the Entomological Society of America*. 101(5): 955-963.
Souza, Amanda J., Patrícia O. Santos, Marcio S. T. Pinto, Thierry T. Wermelinger, Elaine S. Ribeiro, et al. 2011. Natural seed coats provide protection against penetration by *Callosobruchus maculatus*. *Crop Protection*. 30: 651-657.
Ward, Paul L., Massimiliano Foglia, and Wolf U. Blanckenhorn. 1999. Oviposition site choice in the yellow dung fly *Scathophaga stercoraria*. *Ethology*. 105: 423-430.

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