

Laboratory 1A

Effects of Environment on Reproductive Behavior of Bean Beetles**Objective**

Design and perform a set of experiments to evaluate whether female bean beetles (*Callosobruchus maculatus*) discriminate between different sizes of beans in one bean species.

Introduction

Bean beetles (cowpea seed beetles), *Callosobruchus maculatus*, are agricultural pest insects of Africa and Asia. Females lay their eggs on the surface of beans (Family Fabaceae). Eggs are deposited (=oviposition) singly and several days after oviposition, a beetle larva (maggot) burrows into the bean. At 30°C, pupation and emergence of an adult beetle occurs 25-30 days after an egg was deposited. Adults are mature 24 - 36 hours after emergence and they do not need to feed. Adults may live for 1-2 weeks during which time mating and oviposition occurs. Since larvae cannot move from the bean on which an egg was deposited, the oviposition choice of a female determines the future food resources available to their offspring. As a result, it is the most critical choice a female makes for her offspring, because it will influence their growth, survival, and future reproduction (Mitchell, 1975; Wasserman and Futuyma, 1981). Although females can be induced to lay eggs (oviposit) on a wide range of bean species, very few bean species result in normal development and the successful emergence of adults. Some bean species are very clearly toxic to *Callosobruchus maculatus* larvae (Janzen 1977) or too small to support the development of a beetle larva.

Materials

In class, you will be provided with live cultures of bean beetles containing adults that have been raised on mung (moong), *Vigna radiata*. Supplies of mung beans (both whole and split in half) that have not been exposed to bean beetles also will be available. Female beetles are easily identified in the live cultures because they have two dark stripes on the posterior of the abdomen, whereas the posterior abdomen of males is uniformly light in color (Figure 1).

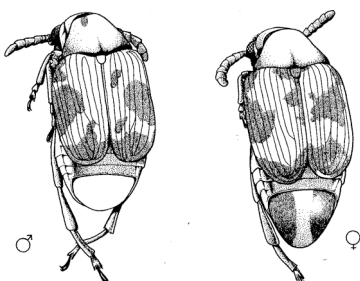


Figure 1. Dorsal view of male and female *Callosobruchus maculatus*. The sex specific coloration of the posterior abdominal plate (pygidium) is shown (Figure from Brown and Downhower, 1988).

Experimental Design

Since the oviposition choices of females influence the survival and future success of their offspring, females may be very sensitive to the size of the beans on which they are depositing eggs. Prior to the laboratory class, each group should design a set of experiments to address whether female bean beetles discriminate between beans on the basis of size and the consequences of those choices. Each group will present their designs to the class and common experimental approaches will be discussed.

After you have read the background information and before the laboratory class meeting:

- Describe at least TWO experimental designs for evaluating whether female bean beetles discriminate between beans of different sizes.
- Describe an ADDITIONAL experiment to evaluate the consequences of females laying eggs on different size beans.
- Predict the outcomes for each experiment.
- Identify and list the variables you would manipulate in each experiment.
- Identify and list the variables you would keep constant in each experiment.
- List the data you would collect to determine if your predictions were true.
- Describe the statistical analyses that you would carry out to test your predictions.

Come to class prepared to present your experimental designs.

Literature Cited

- Brown, L. and J.F. Downhower. 1988. *Analyses in Behavioral Ecology: A Manual for Lab and Field*. Sinauer Associates, 194 pages.
- Janzen, D.H. 1977. How southern cowpea weevil larvae (Bruchidae *Callosobruchus maculatus*) die on non-host seeds. *Ecology* 58:921-927.
- Mitchell, R. 1975. The evolution of oviposition tactics in the bean weevil, *Callosobruchus maculatus* F. *Ecology* 56:696-702.
- Wasserman, S.S. and D.J. Futuyma. 1981. Evolution of host plant utilization in laboratory populations of the southern cowpea weevil, *Callosobruchus maculatus* Fabricius (Coleoptera: Bruchidae). *Evolution* 35:605-617.

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