

# Substrate Size Selection by Bean Beetles

## Objective

Design and perform a set of experiments to evaluate whether female bean beetles (*Callosobruchus maculatus*) discriminate between different size beans of the same 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 (Brown and Downhower 1988). 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).

## Materials

In class, you will be provided with live cultures of bean beetles containing adults that have been raised on mung beans, *Vigna radiata*. Supplies of organic mung of various sizes 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.

## 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 different bean sizes within one bean species 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 different bean sizes with one bean species.
- Describe an ADDITIONAL experiment to evaluate the consequences of females laying eggs on beans of different sizes.
  - 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 Publishers.

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.

This study was written by C. Beck, S. Migabo and L. Blumer, 2010  
([www.beanbeetles.org](http://www.beanbeetles.org)).