Consequences of Oviposition Substrate Choice by Female Bean Beetles

Objectives

- Evaluate characteristics of the prey (beans) of bean beetles, *Callosobruchus maculatus*, that could influence prey choice.
- Design and perform an experiment to determine whether female bean beetles distinguish among prey species.
- Design and conduct an experiment to evaluate the consequences of bean species choice by female bean beetles.

Introduction

Bean 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. Larval growth and pupation occur inside the bean and are consequently difficult to observe. 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 7-10 days during which time mating and oviposition occur. 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. The choice of prey bean is the most critical choice a female makes for her offspring, as it will influence their growth, survival, and future reproduction (Mitchell, 1975; Wasserman and Futuyma, 1981).

Methods and Materials

Prior to class, design an experiment in which you could address the following question: Do female bean beetles choose prey beans randomly? Alternatively, do female bean beetles prefer some bean species and avoid others?

Material

In class, you will be provided with live bean beetle cultures and supplies of dried beans (seeds) from a variety of species. The seeds available for this experiment will include: mung beans (*Phaseolus aureus*), black-eyed peas (cowpea) (*Vigna unguiculata*), garbanzo (*Cicer arietinum*), kidney, pinto, navy, and black beans (*Phaseolus vulgaris*), soy beans (*Glycine max*), adzuki beans (*Phaseolus angularis*), urad beans (black gram) (*Vigna mungo*), fava beans (horsebean) (*Vicia faba*), lima beans (sieva bean) (*Phaseolus lunatus*), and green pea (*Pisum sativum*). 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 species and condition of the beans on which they are depositing eggs. Prior to the laboratory class, each group should design a set of experiments to determine whether female bean beetles discriminate among

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:

- List characteristics of bean species that might be important to a female bean beetle, and how you would measure these characteristics.
- Describe an experimental design for evaluating whether female bean beetles discriminate among different bean species.
- Describe an ADDITIONAL experiment to evaluate the consequences of females laying eggs on different bean species.
- 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 of Lab and Field.* Sinauer Associates, 194 pages.

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* Fabrivius (Coleoptera: Bruchidae). Evolution 35:605-617.

This experiment was written by L. Blumer and C. Beck (www.beanbeetles.org) and is based on an experimental protocol originally published by Luther Brown and Jerry F. Downhower (Brown and Downhower, 1988).