



# Learning with an Aversive Stimulus in *Helicoverpa zea* (Lepidoptera: Noctuidae)

Christopher Sims and Dr. Anthony J. Lentz

Bellarmino University, Department of Biology, Louisville, KY 40205

## Abstract

- Condition *Helicoverpa Zea* larvae using an aversive stimulus paired with a non-aversive stimulus
- Perform experiments to test memory formation and retention
- Pairing olfactory stimulus with an electric shock
- Pairing a tactile stimulus with an electric shock
- Pairing a tactile stimulus with aversive prodding
- Use choice tests to determine effectiveness of conditioning



## Introduction

- *H. zea* larvae grow to 25mm and 500-600mg, and undergo complete metamorphosis
- Extensive learning studies have been done on *Lepidoptera*, but none specifically with *H. zea*



## General Methods

- **Conditioning.** Larvae exposed to non-aversive stimulus for 10 sec then exposed to non-aversive and aversive stimulus for 10 more seconds (5 sessions, 45 min apart)
- **Testing.** Allow larvae to choose between different non-aversive stimuli for both test and control groups

**Experiment 1:** Forward Shock-Pairing with Olfactory Stimulus (vanilla/ethyl acetate and ambient air)

**Experiment 2:** Forward Shock-Pairing on Two Different Agar Substrates (1% and 3% agar)

**Experiment 3:** Prodding as an Aversive Stimulus on Two Different Surfaces (Rough and Smooth Agar)

## Results

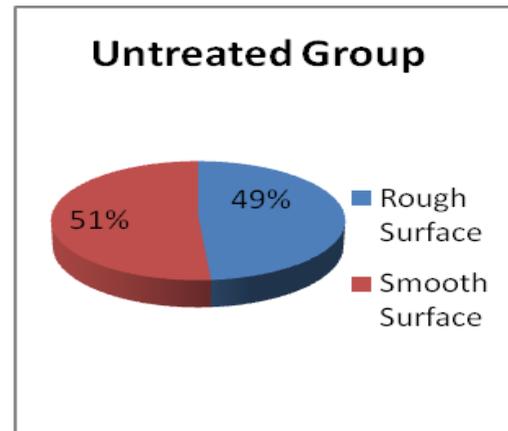


Figure 1. Experiment 3 Control

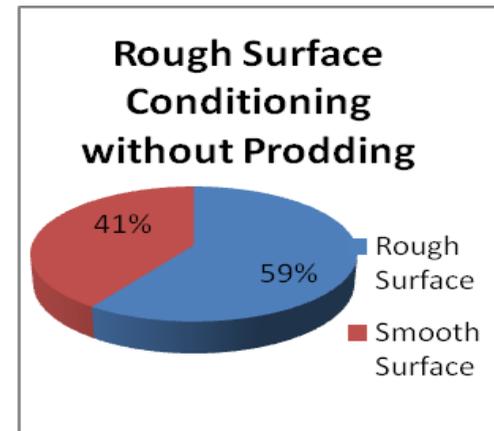


Figure 2. Experiment 3 Control

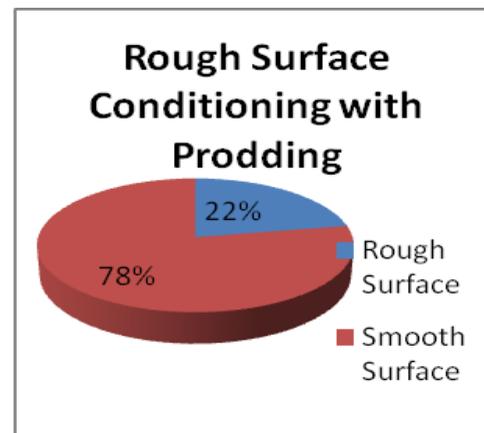


Figure 3. Experiment 3 Test Group

### Experiment 1 (N = 40 larvae per group)

- Larvae didn't move from starting location; no results

### Experiment 2 (N = 15 larvae per group)

- Majority of larvae from all groups chose 3% agar

### Experiment 3 (N ~ 40 larvae per group)

- Larvae conditioned without prodding did not prefer one surface over another
- Larvae that were prodded on a rough surface significantly preferred the smooth surface in subsequent choice test (Chi-square,  $p=0.002$ )

## Discussion

### Experiment 1

- The lack of results suggests (a) experimental error in conditioning or testing apparatuses or (b) lack of olfactory-associated behaviors in *H. zea*

### Experiment 2

- 1% agar may have been too unstable for larvae to select despite their conditioning
- Shock might not have worked in all cases or wasn't enough to deter larvae their conditioning

### Experiment 3

- Prodding is a simulated form of predation that clearly elicited strong avoidance behavior

### Other Explanations

- *H. zea* are nocturnal but Experiments 1 and 2 were performed around noon
- *H. zea* are different from other species used in conditioning experiments



## References

- Blackiston DJ, Silva Casey E, Weiss MR (2008). Retention of Memory through Metamorphosis: Can a Moth Remember What It Learned As a Caterpillar? *PLoS ONE* 3(3): e1736.
- Capinera, JL. Corn Earworm. *Featured Creatures*. University of Florida, 2007. Web. 16 July 2009 <[http://www.entnemdept.ufl.edu/creatures/veg/corn\\_earworm.htm](http://www.entnemdept.ufl.edu/creatures/veg/corn_earworm.htm)>.
- Ghumare SS, and Mukherjee SN (2005). Absence of Food Aversion Learning in the Polyphagous Noctuid, *Spodoptera litura* (F.) Following Intoxication by Deleterious Chemicals. *J. Insect Behav.* 18.1: 105-14.
- Pszczolkowski MA, and Brown JJ (2005). Single Experience Learning of Host Fruit Selection by Lepidopteran Larvae. *Physiol Behav.* 86.1-2: 168-75.
- Ruey-Jane F, Anderson P, Hansson BS (1997). Behavioral Analysis of Olfactory Conditioning in the Moth *Spodoptera littoralis* (Boisd) (Lepidoptera: Noctuidae). *J. Exp Bio.* 200: 2969-976.