INFLUENCE OF SNAP BEAN PHENOLOGY ON *HELIOTHIS ZEA* (BODDIE) (LEPIDOPTERA: NOCTUIDAE) OVIPOSITION

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ABSTRACT

In greenhouse preference tests *Heliothis zea* (Boddie) moths oviposited significantly more eggs on blooming snap bean, *Phaseolus vulgaris* L., than on pre-blooming plants. When moths were held in cages containing only 1 plant stage (non-preference tests) significantly more eggs were laid on blooming snap beans than on either pre- or post-bloom plants. Furthermore, this ovipositional response to blooming plants was much more striking after moths were caged for 3 nights. During nights 4-6, oviposition continued at a similar rate on blooming plants, while pre- and post-bloom plants received very few eggs. Regardless of plant stage, most eggs were laid on the top and bottom of large snap bean leaves.

Key Words: *Heliothis zea*, oviposition, snap bean, egg, bloom.

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INTRODUCTION

The corn earworm, *Heliothis zea* (Boddie), is the principal insect pest of snap bean, *Phaseolus vulgaris* L., in the south-central U.S. The insect presents a major problem in snap bean grown for processing because corn earworm larvae may enter pods and escape detection prior to canning. The pod burrowing nature also presents problems in corn earworm management. If the criterion for insect management decisions is the presence of larvae, the pod may be entered prior to insecticide application (McLeod 1985). Thus, using *H. zea* egg counts as criterion for management decisions may offer advantages over systems based on larva counts.

Numerous studies have examined *Heliothis* oviposition on a wide range of host plants, including soybean and cotton (Hillhouse and Pitre 1976); corn, tobacco, cotton and soybean (Johnson et al. 1975); tomato (Snodderly and Lambdin 1982); and peanut (Pencoe and Lynch 1982). *Heliothis* oviposition often has been greatest on blooming host plants. Parsons (1940), Alvarado-Rodriguez (et al. 1982) and Zalom (et al. 1983) detected greater numbers of *Heliothis* eggs on blooming tomato than on non-blooming plants. *Heliothis* ovipositional preference for blooming host plants also has been demonstrated with soybean (Hillhouse and Pitre 1976) and corn, cotton and soybean (Johnson et al. 1975).

Heliothis oviposition on snap bean has only recently been examined. Under field conditions, peak *H. zea* oviposition generally coincided with snap bean blooming (McLeod 1987). However, egg numbers on field-grown plants were low and significant differences in ovipositional preference for blooming snap beans were not demonstrated. In the development of *H. zea* management programs for snap bean, additional data on the relationship between host phenology and oviposition are needed. Thus a greenhouse study was initiated to examine *H. zea* ovipositional responses to different snap bean developmental stages.

MATERIALS AND METHODS

The study was conducted in 1.8 × 1.8 × 1.8 m saran cages (Chicopee Manufacturing Co., Gainesville, GA) maintained on benches in a greenhouse at the University of Arkansas Main Experimental Station, Fayetteville. Cage bottoms were covered with sand to a depth of approximately 2 cm. Snap bean (cv 'Galatin Valley') plants were grown to specific developmental stages in 16-cm diameter black plastic pots filled with Redi-Earth Peat-Lite Mix (W. R. Grace & Co., Cambridge, Mass.). The *H. zea* source was a laboratory culture maintained at the University of Arkansas Virology-Biocontrol Laboratory, Fayetteville. Field collected moths are introduced into the culture at ca. yearly intervals.

Experimental design for placement of plants in each preference cage was a 3 (plant stages) × 3 (plants per stage) Latin Square. Thus each cage held 9 plants. Plant stages were pre-bloom (V-5), bloom (R-1), and post-bloom (R-4 with no blooms) (Lebaron 1974). Two male and 2 female moths were obtained from rearing containers ca. 48 h after emerging and placed in the oviposition cage in late afternoon. After 2 nights were allowed for oviposition, moths were killed at ca. 8:00 am and plants were searched for number and location of eggs. Egg location was categorized as stem, bloom, pod, small (< = 3 cm) or large (> 3 cm) leaf. The test was repeated 14 times.

Non-preference tests were conducted by placing 9 plants (3 rows × 3 columns) of the same developmental stage in a cage. On each test date 3 cages (1 for each previously mentioned developmental stage) were maintained. Moths were introduced as previously described for the preference study. After 3 nights new plants of the same developmental stage were substituted for the original plants and the original moths were allowed to oviposit for an additional 3-day period. Plants were searched for number and location of eggs after each 3-day ovipositional period, as described for preference tests. The test was repeated 12 times.

The oviposition rate was determined by dividing the number of eggs counted on each plant for each test by (number of moths * number of nights). This represented the number of eggs laid per moth on a single plant each night. Data were subjected to analysis of variance and means were separated by Duncan's Multiple Range Test (Wilkinson 1986).

RESULTS AND DISCUSSION

In preference tests mean nightly oviposition rates were 0.95, 3.12, and 2.11 eggs for pre-bloom, bloom, and post-bloom plants, respectively. Significantly more eggs were detected on blooming plants than on pre-blooming plants ($F = 4.103$, $P = 0.021$). No additional significant differences were detected. To control variation resulting from differences in egg numbers between test dates, egg number was converted to percentage of eggs per plant stage for each test. Mean percentages of eggs were 14.1, 50.7, and 35.1 for pre-bloom, bloom, and post-bloom plants, respectively. By controlling variation between tests, significant differences in oviposition were detected for each developmental stage ($F = 6.039$, $P = 0.004$).

Mean nightly oviposition rates for the first 3 nights in non-preference tests were 1.53, 4.80, and 2.43 for pre-bloom, bloom, and post-bloom, respectively (Table 1). Significantly higher oviposition on blooming plants was again detected. During nights 4-6 oviposition rate significantly declined in cages with pre- and post-bloom

plants. However no significant decline in oviposition rate was observed in cages with blooming plants. During the second oviposition period the oviposition rate for blooming plants was 4.48 eggs per night, ca. 75 times higher than pre-bloom plants and 26 times higher than post-blooming plants. *Heliothis zea* adults may have retained sufficient nutrients to permit oviposition during the initial 3 night period. Following this period and lacking a carbohydrate source, moths maintained on non-blooming snap bean were unsuccessful at maintaining their rate of oviposition.

Table 1. Mean nightly *H. zea* oviposition rate per snap bean plant in non-preference greenhouse cages.

		Plant Stage		
Oviposition Period	N	Pre-bloom	Bloom	Post-bloom
night 1-3	108	1.53aB*	4.80aA	2.43aB
night 4-6	108	0.06bB	4.48aA	0.17bB

* Within column means followed by same lower case letter are not significantly different. Within row means followed by same upper case letter are not significantly different (α = 0.05; Duncan's multiple range test, Wilkinson 1986).

Regardless of developmental stage *H. zea* moths oviposited most eggs on large (> 3 cm) leaves (Table 2). Mean ovipositional rates were less than 0.1 eggs for snap bean stems, blooms, pods, small leaves and large leaf petioles. Large leaf top and bottom surfaces received 1.37 and 1.42 eggs per night, respectively.

Table 2. Within-plant distribution of *H. zea* eggs on snap bean plants during the initial oviposition period in non-preference greenhouse cages.*

				small leaf			large leaf		
Plant stage	stem	blooms	pods	top	bottom	petiole	top	bottom	petiole
Pre-bloom	0.02aA	—	—	0.00aA	0.00aA	0.00aA	0.94aB	0.55aB	0.02aA
Bloom	0.06aA	0.00aA	—	0.01aA	0.03aA	0.00aA	2.18bB	2.39bB	0.12aA
Post-bloom	0.04aA	0.00aA	0.02A	0.00aA	0.00aA	0.00aA	0.99aB	1.33aB	0.06aA
Mean for all stages	0.04 A	—	—	0.00 A	0.01 A	0.00 A	1.37 B	1.42 B	0.07 A

* Within column means followed by same lower case letter are not significantly different. Within row means followed by same upper case letter are not significantly different (α = 0.05; Duncan's multiple range test, Wilkinson 1986).

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