THE HOODED BEETLE: A PREDATOR OF THE TOBACCO BUDWORM

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Abstract

The hooded beetle, *Notoxus* spp., was tested in laboratory cages to determine its consumption rate of tobacco budworm eggs at four densities (5, 10, 15, and 20 eggs) and three 24-hr intervals. Consumption rate was highest during the first 24 hours after starvation and reached 87.4% after 72 hours. There were no significant differences among the egg density groups within each time interval. While there are no reports of larval consumption by the hooded beetle, consumption rate of tobacco budworm larvae was determined. A comparison of egg and larval consumption resulted in no significant differences between the percent consumption of eggs and larvae in 30 ml cups. More eggs than larvae were consumed in the larger cages (12 cm x 14 cm). The hooded beetle consumed eggs at a lower rate than the bigeyed bug, *Geocoris punctipes*, at all densities after 48 hr.

Introduction

With increased cotton acreage and emphasis on integrated pest management, the role of natural enemies in regulating insect pests such as the tobacco budworm, *Heliothis virescens* (F.) is important. Predaceous arthropods that are abundant in cotton and prey on budworms include the bigeyed bugs, *Geocoris* spp. (Heteroptera: Lygaeidae); damsel bugs, *Nabis* spp. (Heteroptera: Nabidae); green lacewings, *Chrysopa* spp. (Neuroptera: Chrysopidae); hooded beetles, *Notoxus* spp. (Coleoptera: Anthicidae); lady beetles (Coleoptera: Coccinellidae); ants; and spiders (Greene 1995, Massey and Young, 1974).

Laboratory studies have compared efficacy of insect predators of the tobacco budworm, *Heliothis virescens* (F.) (Lopez et al. 1976). Predation studies have been conducted with the bigeyed bugs and other predators using various densities of prey (Ables et al. 1977, Hutchison and Pitre, 1983). None of these studies included the hooded beetle.

It has been reported from field studies that predator density in early-season pyrethroid-treated cotton was significantly higher than predator density in early-season untreated cotton (Greene 1995). This difference was attributed to hooded beetles and lady beetles. In early-season treated cotton, hooded beetle density was 104/30.0 m of row and coccinellid larval density was 90/30.0 m of row. In early-season untreated cotton, hooded beetle density was 60/30.0 m of row, and coccinellid larval density was 3/30.0 m of row (Greene 1995). Field cage studies indicated that a pyrethroid was tolerated by the hooded beetle when introduced 4-hr post-treatment. (McCutcheon and DuRant 1993). Because hooded beetles occur in high density, it is important to learn more about its efficacy. The purpose of this laboratory study was to determine the consumption rate of hooded beetles and conduct preliminary comparisons to other predators that are effective in the cotton ecosystem.

Materials and Methods

The hooded beetle, *Notoxus* spp. was collected from cotton plants at the Pee Dee Research and Education Center, Florence, S. C. Collections were made by shaking plants over a plastic dishpan (33.4 cm x 28.6 cm x 14 cm) and using an aspirator to place the beetles into a cardboard container (9.5 cm x 9.8 cm) with a stoppered hole in the center of the lid. Eggs of tobacco budworm were obtained by placing 11.5 cm x 28 cm strips of paper towel in plastic oviposition cages (20.5 cm diam. x 19.3 cm) with tobacco budworm moths. Eggs were washed by submerging paper towel in 1.66% Clorox® solution. They were rinsed with distilled water and placed in petri dishes. Tests were conducted at 26°C and 60% RH.

Consumption Rate:
Hooded beetles were placed individually into 30 ml plastic cups lined at the bottom with moistened paper towel and covered with cardboard lids. They were starved for 16 hours. Cotton leaf discs (2.7 cm diam.) were placed in the cups atop the moistened paper with the undersurface of leaf facing upwards. Eggs of tobacco budworm were taken from petri dishes using a camel's hair brush and placed on the leaves. A completely randomized design was used with four treatments (5, 10, 15, and 20 egg densities) replicated 25 times, including one as a control without hooded beetles. Egg consumption was recorded after 24, 48, and 72 hrs using a Bausch and Lomb Microscope (Bausch & Lomb Incorporated, Rochester, New York) with a Cole Palmer illuminator (Cambridge Instruments Incorporated, Buffalo, New York). In order to determine if hooded beetles have the potential to consume larvae, one-day-old tobacco budworm larvae were placed in 30 ml plastic cups containing cotton leaf discs as described above and covered with a plastic lid. Ten larvae were exposed to one hooded beetle, and this was replicated eight times. Rate of consumption was recorded after 24, 48, and 72 hours.

In order to compare the feeding rate of *Notoxus* spp. to another common predator, four treatments of 5, 10, 15 and 20 eggs were exposed to bigeyed bugs. There were 15 replications for each egg density group and a control which did not contain bigeyed bugs.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:796-798 (1996)
National Cotton Council, Memphis TN

Host Searching Ability:
The bottom of a canister (12 cm x 14 cm) was lined with grade 360 qualitative filter paper. Cotton bouquets consisting of four cotton leaves with stems were placed in the canister. Five eggs or neonate larvae of tobacco budworm were placed on top of each leaf in the bouquet for a total of 20 eggs or larvae/treatment. There were 19 replicates for eggs and 15 replicates for larvae. The tip of a camel's hair brush was dipped in albumen and then used to pick eggs from petri dishes and secure them onto cotton leaves. Five hooded beetles were placed into the cage covered with a *Lumite® 52 x 52 mesh screen (Lumite 25) screw top. No hooded beetles were placed into control cages containing eggs and larvae as described above. The number of prey and number of viable hooded beetles were recorded after 24 and 72 hr.

Results and Discussion

Consumption Rate:
Hooded beetles consumed tobacco budworm eggs at all densities and time intervals. After 72 hr, percentage consumption of the total eggs tested at densities of 5, 10, 15, and 20 was 80, 86, 84, and 88%, respectively (Fig. 1). Statistical analysis indicated that there were no significant differences of mean percent consumption among the egg density groups within each time interval. The average number of eggs consumed by the hooded beetle increased after each 24 hr interval. However, the average consumed at 24 hr was nearly half of the average consumed after 72 hr. Therefore, it appears that more feeding was done during the first 24 hr after starvation than during each of the other 24 hr. periods (Table 1). In a similar study conducted at 26°C, 60% RH, and a 14:10 L:D regimen, percentage of budworm eggs damaged by hooded beetle reached 66.25% when 20 eggs were exposed to one hooded beetle (Reyes and McCutcheon, 1992).

While no evidence of larval feeding has been detected in the literature, hooded beetles consumed 22.5% and 92.5% of one-day-old larvae after 24 and 72 hr., respectively. Hooded beetles consumed eggs at a higher rate than larvae during the first 24 hr. There was no significant difference between the percent consumption of eggs and larvae after 72 hr.

McDaniel and Sterling (1979) conducted radioactive studies in cotton that showed evidence of predation on budworm eggs by bigeyed bugs. Consumption rate of budworm eggs by hooded beetles compared to bigeyed bugs is shown in Figs. 2, 3, and 4 for 24, 48, and 72 hr, respectively. Rates that were significantly different are shown with different lower case letters at the top of the bars. The hooded beetle consumed eggs at a lower rate than the bigeyed bug at all densities after 48 hr. Lopez et al. (1976) reported that bigeyed bugs were the most effective of four predators tested on newly hatched larvae. The hooded beetle was not tested in their study.

Host Searching Ability:
The hooded beetle searched for eggs and small budworm larvae in canisters. Beetles consumed tobacco budworm eggs at a significantly higher rate than larvae. Figure 5 depicts the mean rate of consumption for eggs and larvae. The hooded beetle has the potential to have a major impact in pest management decisions because of its potential as a consumer of eggs. With increased interest in transgenic cotton which is toxic to larvae, it is important to target the egg stage in order to minimize the amount of plant feeding. The hooded beetle should be included in integrated pest management decisions in which population densities of both pest and predator are considered.

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Table 1. Average number of tobacco budworm eggs consumed by individual hooded beetles at four egg densities during three 24-hr time intervals.

	Consumption Time		
Density (eggs)	24 hr	48 hr	72 hr
5	2.5	3.4	4.0
10	4.4	5.7	8.6
15	7.4	8.5	12.6
20	8.0	12.3	17.5

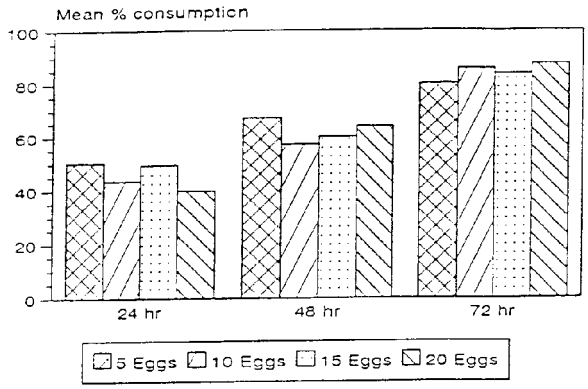

Fig. 1. Budworm egg consumption by hooded beetle. No means are significantly different (DMRT,P=.05).

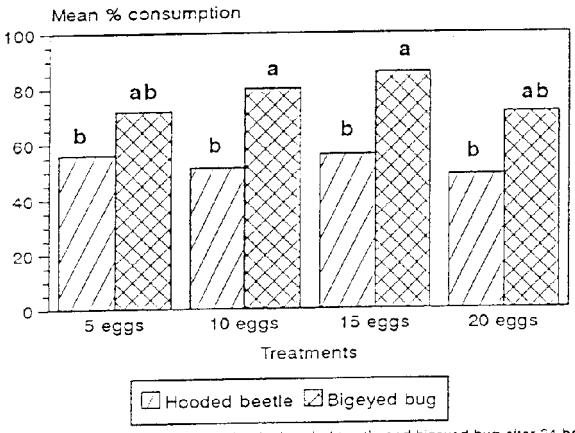

Fig. 2. Budworm egg consumption by hooded beetle and bigeyed bug after 24 hr. Bars with the same letter are not significantly different (DMRT,P=.05).

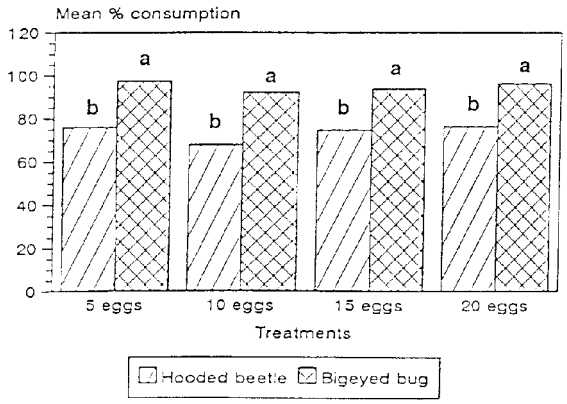

Fig. 3. Budworm egg consumption by hooded beetle and bigeyed bug after 48 hr. Bars with the same letter are not significantly different (DMRT,P=.05).

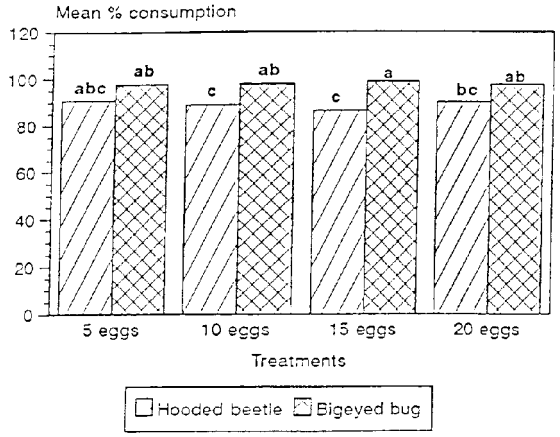

Fig. 4. Budworm egg consumption by hooded beetle and bigeyed bug after 72 hr. Bars with the same letter are not significantly different (DMRT,P=.05).