ATTRACTION OF FEMALE CABBAGE LOOPER MOTHS (LEPIDOPTERA: NOCTUIDAE) TO MALES IN THE FIELD

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ABSTRACT

Live male cabbage looper moths, *Trichoplusia ni* (Hubner), used to bait traps in cotton fields, attracted conspecific males and females which were captured in the bucket traps. Females captured in traps baited with males included unmated individuals as well as mated ones, with up to 7 spermatophores in the bursa copulatrix. Cabbage looper moths arrived at cages of males in cotton primarily during the first three hours of the night, beginning at dusk.

Key Words: *Trichoplusia ni*, sex pheromone, traps

RESUMEN

Los machos vivos de la polilla de la col, *Trichoplusia ni* (Hubner), usados para cebar trampas en campos de algodón, atrajeron machos y hembras conespecíficos que fueron capturados en trampas de cubeta. Las hembras capturadas en las trampas ce-

badas con machos incluyeron individuos apareados y no apareados, con hasta 7 espermatóforos en la bursa copulatrix. Las polillas de la col llegaron a las jaulas de machos en el algodón principalmente durante las tres primeras horas de la noche, a partir del crepúsculo.

Although laboratory and field cage studies indicate that adult males of the cabbage looper moth, *Trichoplusia ni* (Hubner), produce a 3-component sex attractant pheromone, there has been no direct evidence of female attraction to male pheromone in the field. In a flight tunnel, unmated females respond to males, male odor, and solvent extracts of males with upwind oriented flights (Landolt & Heath 1989). A sex pheromone (S-(+)-linalool, para-cresol and meta-cresol) that is attractive to females in a flight tunnel bioassay was isolated and identified from solvent washes of male hairpencils (Landolt & Heath 1989). Female attraction to live males has been observed also in field cages (Lenczewski & Landolt 1991). To date, however, there has been no demonstration of female cabbage looper attraction to natural or synthetic male pheromone under field conditions.

I report here the capture of cabbage looper moths in male-baited traps in the field, as well as the sex ratio of trapped moths and the mating status of trapped females. Also included is the diel activity rhythm of attraction of cabbage looper to caged males in the field. These findings support the results of previous laboratory experiments indicating a male-produced female attractant in this species, and indicate some potential for developing a female attractant for field use.

Materials and Methods

Cabbage looper pupae were obtained from a laboratory colony in Gainesville, Florida, and maintained according to the methods of Guy *et al.* (1985). Pupae were shipped to Fresno, California, and male pupae were placed in 30 x 30 x 30 cm aluminum and plastic screen cages in an open-air garage. Pupae were moved daily to new cages to provide emerged moths of discrete age groups. Males in cages were provided a 20% aqueous solution of a mixture of honey and sucrose in a 1:3 ratio on cotton. Water jars were placed on paper toweling on all cage tops to provide a continuous supply of water for the moths.

The trapping test was conducted during June and July 1992 in commercial cotton fields in the San Joaquin Valley of central California. Bucket traps, modeled after the design of Sharma *et al.* (1971), were made from 5-gallon (18.9 liter), nearly cylindrical, black plastic buckets (35.6 cm tall, 26.7 cm wide at the bottom, and 29.2 cm wide at the top). Four circular holes (12.7 cm diam) were cut equidistant in the side of each bucket, 0.5 cm from the bottom of the bucket, and were fitted with screen cones to allow access of attracted moths into the bucket. The screen cones had an inside hole diam of 3 cm. The top of the bucket was covered with clear plastic held in place with an elastic band. Baited traps contained a cylindrical screen cage (7×10 cm) with a wet cotton wick and 5 male cabbage looper moths placed at the center of the bottom of the bucket. Unbaited traps contained the same small cages with wet cotton wicks and no male cabbage looper moths.

Traps were suspended from wire hangers on wooden stakes so that the bottom of the bucket and the cages of males in buckets were near the top of the cotton canopy (about 40 cm). Traps were placed 10 ± 0.5 m apart in cotton fields. On three different

days, twenty traps were set up, with 10 baited and 10 unbaited traps. On a fourth day, 10 traps (five unbaited and five baited) were set up, providing a total of 35 trap replicates. Traps were baited with cages of males late in the afternoon and were checked the following day for captured moths. Each captured female moth was dissected to determine the number of spermatophores in the bursa copulatrix (an indication of the number of matings).

Attraction of moths to male cabbage loopers was also monitored visually by using a night vision pocket scope (Nite-eye™, Varo, Inc., Garland, TX). On three nights, a cage of 15 male cabbage loopers was watched continuously, from 30 min before dusk to 30 min after dawn, for visits by moths. The different species of moths known to be in the field, cabbage looper, *Helicoverpa zea* (Boddie), *Spodoptera exigua* (Hubner), and *Apantesis prolata* were easily distinguishable in flight at night using the night vision pocket scope, by their size and reflectance. Occasional netting of arriving moths confirmed that they were indeed cabbage looper moths.

Results

Significant numbers of both male and female cabbage looper moths were captured in the traps baited with live males, while no moths of any species were captured in control traps. Numbers of moths captured per night in male-baited traps ranged from 0 to 59. Means of 4.5 ± 1.9 (SEM) males ($t=2.37$, $df=34$, $p=0.02$) and 3.0 ± 0.6 females ($t=5.4$, $df=34$, $p<0.01$) were captured per trap per night in male-baited traps. Of the 105 females captured in male-baited traps, nearly one half were unmated, without spermatophores in the bursa copulatrix (Fig. 1). Mated females in traps contained from one to 7 spermatophores in the bursa copulatrix, indicating mating frequencies from 1 to 7 times. A similar pattern of spermatophore numbers was found in a smaller sample (24) of females captured in adjacent fields in traps baited with the female pheromone Z-7-dodecenyl acetate (Fig. 1), with mating frequencies up to 8. I assumed that female cabbage looper moths captured in traps baited with female pheromone were attracted to males releasing pheromone at the trap lure, as reported by Birch (1977). It is also possible that males captured in male-baited traps were attracted in part to pheromone released by attracted females.

In the three nights of observations of cages of male *T. ni* in a cotton field, 182 visits were noted of moths that appeared to be cabbage looper moths (28 on night 1, 32 on night 2, and 122 on night 3). One additional moth of an undetermined species of Sphingidae approached a cage of males. On all three nights of observations, cabbage looper moth visits to the cage of males began after sunset (near 2000 hour), but 30 min to 45 min before it was too dark to see without the aid of the night vision scope. Approaching moths were seen and followed from up to 10 m away from the cage early in the evening. Most moth visits at the cage occurred early in the night (Fig. 2), from 2000 to 2200 hour, with very little activity after midnight.

Discussion

These experiments constitute the first documentation of female cabbage looper moth attraction to males in the field, although it is likely that captures of females in traps baited with female pheromone (Birch 1977) were also a result of female attraction to males. The capture of females in male-baited traps indicate that the observed attraction of females to males, male extracts, and synthetic male pheromone in laboratory studies (Landolt & Heath 1989, 1990) is indeed an aspect of a mate-finding strategy that occurs under natural conditions in the field. The time of night that cab-

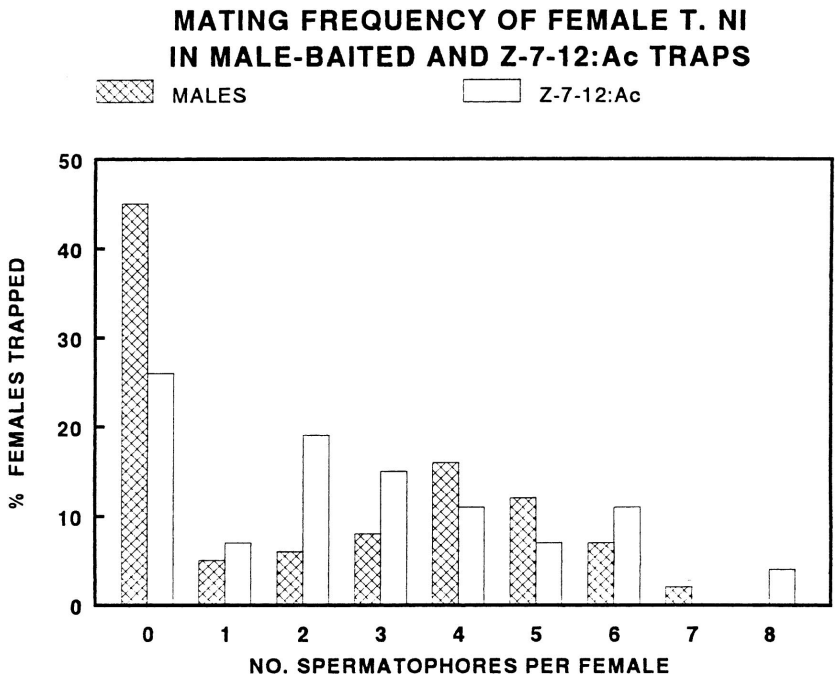

Fig. 1. Percentages of female cabbage looper moths captured that possessed different numbers of spermatophores in the bursa copulatrix. Crosshatched bars are for females captured in bucket traps baited with 5 live males. Open bars are for females captured in Universal™ moth traps baited with the female pheromone, Z-7-dodecenyl acetate.

bage looper moths visited males (Fig. 2) matches the pattern of female visits to males in a large field cage (Lenczewski & Landolt 1991). This early night activity period is distinct from the peak period of male attraction to females and of female calling later in the scotophase (Lenczewski & Landolt 1991; Shorey 1966).

Capture of female cabbage looper moths in traps baited with males provides incentive to develop a synthetic lure for females based on male pheromone compounds. Results of this trapping test indicate that such a lure should function to attract males, unmated females and females that have already mated. If a synthetic lure based on male pheromone is developed, it could provide a useful tool for sampling females on field crops and possibly also for population suppression.

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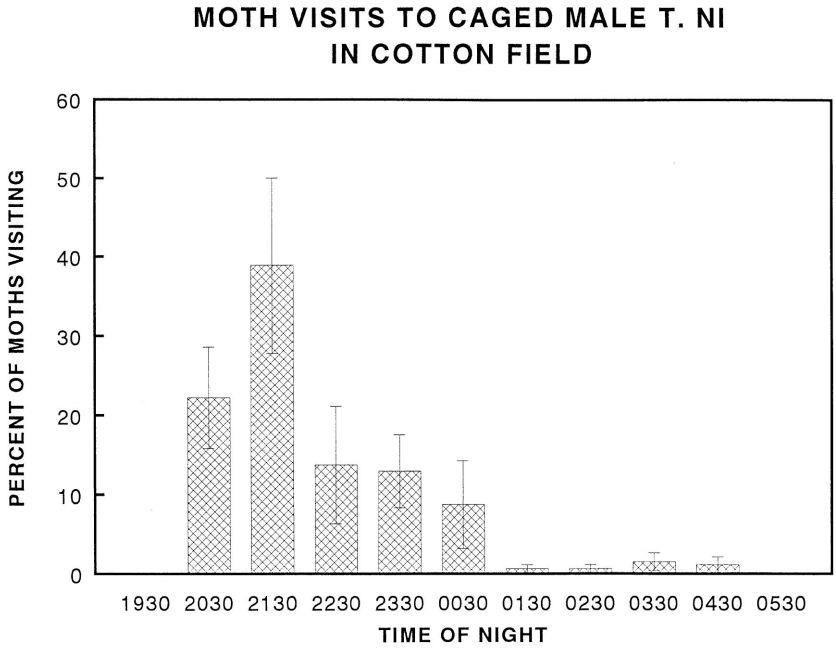

Fig. 2. Mean (± SEM) percentages of cabbage looper moth visits to cages containing 15 live cabbage looper males in a cotton field at different times of the night.

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