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USING FARM RECORDS TO EXPLORE SPATIAL AND TEMPORAL PATTERNS OF HELIOTHINE DISTRIBUTIONS ON COTTON IN HETEROGENEOUS CROPPING ENVIRONMENTS IN SOUTHEAST ARKANSAS

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Abstract

The distribution of bollworm, *Helicoverpa zea*, and tobacco budworm, *Heliothis virescens*, was examined across a large farm company in southeastern Arkansas. Farm records for R. A. Pickens and Son Co., a 10,000 acre farm located in Desha County, AR, were obtained from 2001-2004. Pheromone trap captures suggested a decline of *H. virescens* moths in the area during the sampling period. No significant differences were detected in the capture of *H. zea* moths among the years. No significant differences were detected in number of either *H. virescens* or *H. zea* moths collected among the four pheromone trap locations on the farm. Positive significant correlations between *H. zea* moth captures and the number of eggs recorded in scouting records were observed in three of the four years. Although not significant, a negative correlation coefficient resulted for number of *H. virescens* moths and egg populations on cotton had a in three of the four years.

Introduction

The bollworm, *Helicoverpa zea*, and the tobacco budworm, *Heliothis virescens*, collectively called heliothines, have historically been two of the most destructive insect pests of cotton. *H. zea* is an economically important pest of at least four crops in southeastern Arkansas including corn, cotton, sorghum, and soybeans. *H. virescens* is also polyphagous but is mainly a pest of cotton in southeastern Arkansas (Lincoln et al. 1967). A better understanding of the movement and concentration of these insects may help validate or repudiate ideas such as area-wide management (Knipling and Stadelbacher 1983) of these important agricultural pests. Much of the information gained about the spatial and temporal distribution of these insect pests in cotton has been conducted on small farm research plots. The historical approach to control is to sample and treat economically damaging populations on a field by field basis. Records from large farms, such as insect scouting and spray records, may aid in our understanding of their distribution over a large area of connected fields for multiple years. Previous efforts have been made to correlate heliothine trap captures to the number of eggs and moths in proximate cotton fields with varying results (Harstack and Witz 1981, Johnson 1983, Leonard et al. 1989). Pheromone trap and insect scouting records from large farm units allow us to study these trends over larger areas and multiple years.

Materials and Methods

Records were obtained from R. A. Pickens and Son Co. Farm for the years 2001-2004. Records included a farm map, insect scouting records for each cotton field, pheromone trap captures of *H. virescens* and *H. zea*, and yield records. A spatial map of the production fields and yield records were used to identify which crops were grown on the various farm fields. Insect scouting records were collected twice weekly by an agricultural consultant and used to quantify the distribution of heliothine eggs on all cotton fields across the land company. Pheromone trap records from four trapping locations on the farm were used as an index of adult populations on the farm.

Trap captures were recorded three times a week. The average daily capture was used to compare the differences in the number of *H. virescens* and *H. zea* moths collected among years and among trap locations from 2001-2004. These data were analyzed using an analysis of variance with means separated by LSD. Correlation analysis was used to examine the relationship between the average daily capture of *H. virescens* and *H. zea* moths with the number of heliothine eggs averaged across all cotton fields on the farm (approximately 100 fields each year).

Results and discussion

The number of *H. virescens* moths captured on the farm steadily decreased over the past four years. The average daily number of *H. virescens* moths caught during 2001 was significantly greater than those caught during 2003 or 2004, and the average number caught during 2002 was greater than the average caught during 2004 ($p = 0.0006$)

(Table 1). The largest average daily capture of *H. zea* moths was during 2002, but there was not a significant difference (p = 0.2497) among the four years in the sample (Table 1). No differences in yearly average daily moth capture were detected among the four pheromone trap locations for either *H. virescens* (p = 0.8474) or *H. zea* (p = 0.2032) (Table 2).

Table 1. Mean(SEM) daily pheromone trap captures during 2001-2004 averaged over four trap locations on R. A. Pickens and Son Co. Means within a column not followed by a common letter are significantlyl different (P<0.05, LSD)

Year	*H. virescens*	*H. zea*
2001	6.19(0.282)a	9.47(2.74)a
2002	4.16(1.34)ab	17.06(3.61)a
2003	1.96(0.60)bc	10.70(1.46)a
2004	0.20(0.08)c	15.37(3.35)a

Table 2. Mean(SEM) daily pheromone trap captures at four trap locations on R.A Pickens and Son Co. averaged over the years 2001-2004. Means within a column not followed by a common letter are significantly different (P<0.05, LSD)

Trap location	*H. virescens*	*H. zea*
Central	3.80(1.93)a	11.04(3.53)a
North	3.45(1.17)a	18.86(2.18)a
South	3.21(1.40)a	11.62(3.28)a
West	2.06(1.18)a	11.09(2.15)a

The average number of heliothine eggs found on all cotton fields on the farm for a particular sample date is shown in Figure 1. Generally, moderate numbers were seen in the mid-June, then higher populations are encountered the second week of July through August. Pheromone traps have been used on the farm to gain information about increasing populations of heliothine moth activity and also to gain some insight about the species composition of heliothine eggs and larvae present in cotton. Relationships of average daily trap captures of *H. virescens* and *H. zea* moths to the average number of heliothine eggs found on all cotton fields on the farm was summarized for each year (Figures 2-5).

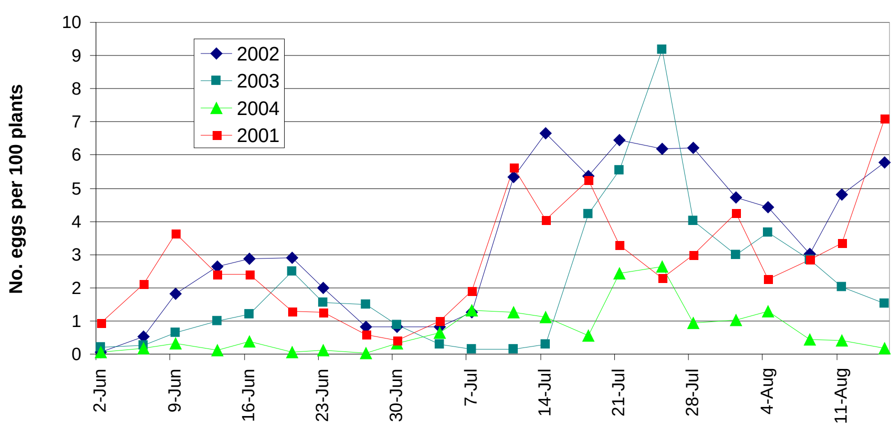

Figure 1. Average number of heliothine eggs observed in all cotton fields across R. A. Pickens and Son Co.

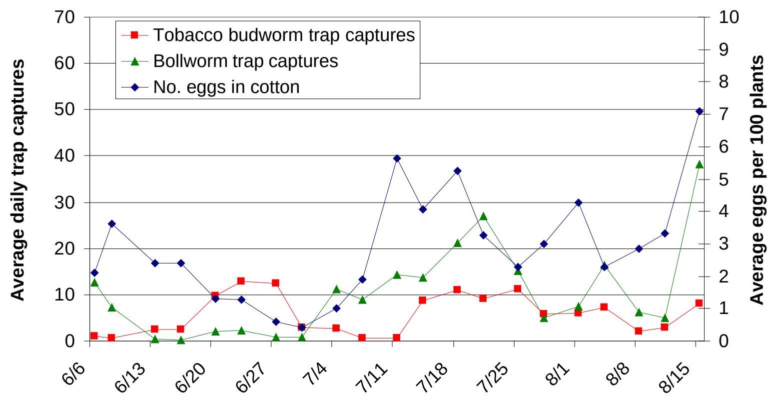

Figure 2. 2001 average daily heliothine trap captures versus average number of observed eggs on cotton Across R. A. Pickens and Son Co.

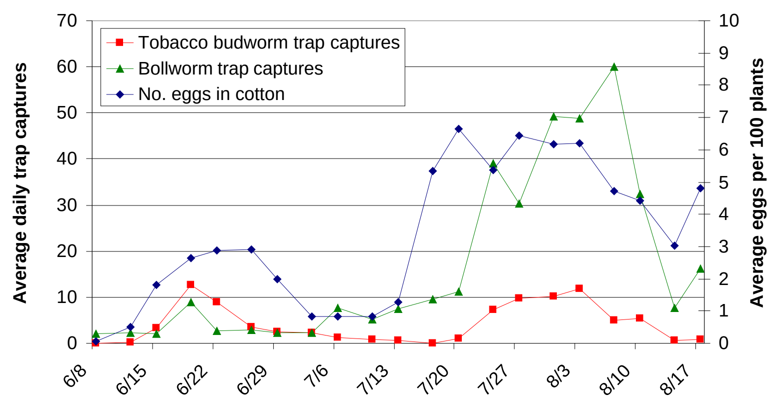

Figure 3. 2002 average daily heliothine trap captures versus average number of observed eggs on cotton Across R. A. Pickens and Son Co.

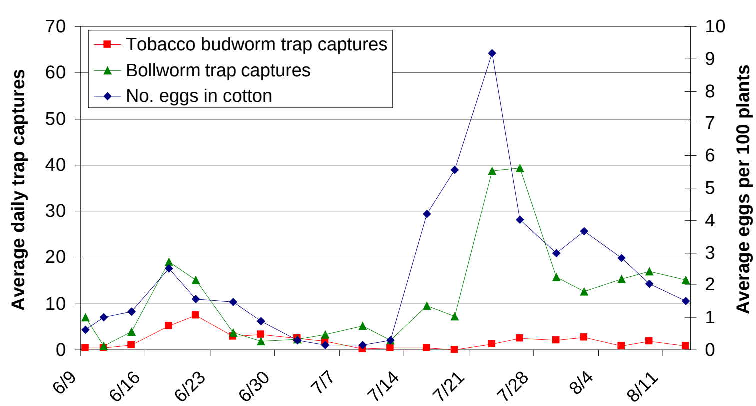

Figure 4. 2003 average daily heliothine trap captures versus average number of observed eggs on cotton Across R. A. Pickens and Son Co.

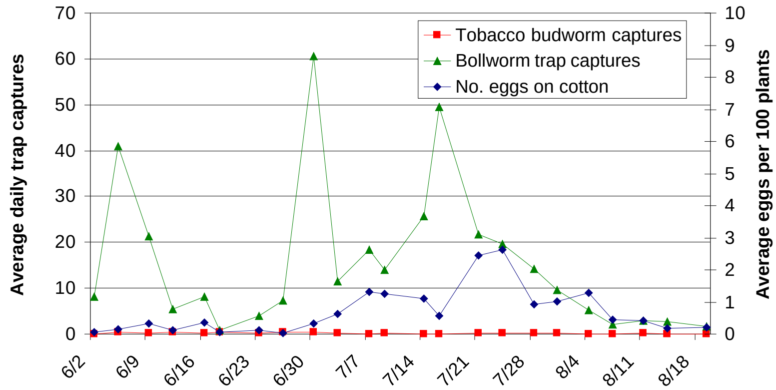

Figure 5. 2004 average daily heliothine trap captures versus average number of observed eggs on cotton Across R. A. Pickens and Son Co.

Correlation analysis was used to further examine the relationship between heliothine moth trap captures and egg populations on cotton (Table 3). A significant ($p < 0.05$) positive correlation existed between *H. virescens* trap captures and egg populations on cotton during 2002, but negative coefficients resulted for the three remaining years (none were significant). The relationship between *H. zea* moth captures and heliothine populations in cotton was found to be positively correlated in all four years, with 2001-2003 being significant. These results suggest that the relationship between *H. virescens* trap captures and heliothine egg densities appear to be sporadic. During 2001, the largest average daily captures were recorded, but there was a negative correlation between these captures and heliothine egg populations in cotton. The average daily trap captures of *H. virescens* provides evidence of a decline in the population of this insect since 2001. Based upon pheromone trap captures, as an index of overall population density, *H. zea* appeared to be the predominate heliothine species in this area during the sample period. Although there were positive significant correlations between *H. zea* trap captures and heliothine eggs on cotton, peak trap captures often lagged behind the peak egg populations found in cotton.

Table 3. Correlation analysis of moth trap captures and and the heliothine eggs in cotton fields across R.A. Pickens and Son Co. during 2001-2004. (* Significant correlations ($P<0.05$)).

Year	*H. virescens*	*H. zea*
2001	-0.029	**0.691***
2002	**0.487***	**0.702***
2003	-0.079	**0.722***
2004	-0.194	0.135

Farm records may be a valuable tool in our understanding of heliothine distributions or related insect management practices over a large area. Insect scouting and insecticide spray records allow us to analyze the variability in the severity of heliothine populations for a farm over multiple years. Records from farms with a heterogeneous cropping system can be compared to records from farms with less diversity. In the future, records may be used to explain differences in the resistance levels of insects collected from different farming environments. For example, spray records allow us to examine levels of pyrethroid resistance in field collected heliothines and relate this to the number of pyrethroid sprays over an area. Also, differences in the levels of *H. zea* tolerance to Bt toxins can be examined by collections of this insect from farms with high or low levels of Bt crops planted.

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