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Authors: Adamczyk, J. J., Williams, M. R., Reed, J. T., Hubbard, D. W., and Hardee, D. D.

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SPATIAL AND TEMPORAL OCCURRENCE OF BEET ARMYWORM (LEPIDOPTERA: NOCTUIDAE) MOTHS IN MISSISSIPPI

J. J. ADAMCZYK, JR.[1], M. R. WILLIAMS[2], J. T. REED[2], D. W. HUBBARD[1] AND D. D. HARDEE[1]
[1]USDA, ARS, Southern Insect Management Research Unit
P.O. Box 346, Stoneville, MS 38776

[2]Mississippi State University, Department of Entomology and Plant Pathology
Clay Lyle Building, Mississippi State, MS 39762

ABSTRACT

Throughout 1994-2000, adult beet armyworm, *Spodoptera exigua* (Hübner) populations were monitored in the delta and hill regions of Mississippi using pheromone traps. Significant differences in the mean number of moths trapped were found among different geographical areas of the state. A trend was observed where the greatest number of moths was found in the Mississippi Delta, located in the western region of the state. The lowest number of moths was found in the hills located in the eastern region of the state. An annual profile of beet armyworm populations in the western section of the Mississippi Delta also revealed that wide-scale immigration of this pest typically begins at 200 Julian days (mid-July). This date could be used as a benchmark to determine when and if population levels are high enough to have the potential to cause economic damage to crops in the Mississippi Delta.

Key Words: Spodoptera, migration, movement

RESUMEN

A travéz de los años 1994 a 2000, se realizaron un monitoreo de las poblaciones de adultos del gusano trozador de la remolacha, *Spodoptera exigua* (Hübner) en las regiones de la Delta y las colinas del Estado de Mississippi usando trampas de feronomas. Se encontraron diferencias significativas en el número promedio de la polillas atrapada entre las áreas geográficas diferentes del Estado. Se observó un patrón donde se encontró el número más alto de las polillas en la Delta del Mississippi, ubicada en la región occidental del Estado. Se encontró el número de polillas más bajo en las colinas ubicadas en la región oriental del Estado. Un perfíl anual de la población del gusano trozador de la remolacha en la sección occidental del Delta del Mississippi tambien reveló que una inmigración de amplia escala de esta plaga tipicamente empieza a los 200 dias Julianos (en medio de julio). Esta fecha puede ser utilizada como un estandar o norma para determinar cuando y si el nivel de la población es suficiente alto para tener el potencial de causar daño económico a los cultivos del Delta del Mississippi.

The beet armyworm, *Spodoptera exigua* (Hübner), is an occasional but serious pest of various vegetable and row crops in the mid-southern United States of America. This Old-World species was first documented in the state of Mississippi in 1920 (Mitchell 1979). Compared to other North American armyworm species (e.g., the fall armyworm, *Spodoptera frugiperda* (J. E. Smith)), knowledge of the ecology of this pest in the Mid-South is limited. Although this pest has no known photoperiod or temperature induced diapause mechanism (Kim & Kim 1997), it is able to overwinter by continuous generations in southern Florida and Texas. Therefore, initial populations of beet armyworms found throughout the state of Mississippi are believed to be the result of immigration from those areas. Hendricks et al. (1995) profiled populations of beet armyworms in the lower Mississippi Delta and noted that moths were found in all months, but the greatest numbers were found in the fall months (September and October). However, in that study, populations were only monitored for one season and consequently conclusions concerning population structure were limited. The purpose of this study was to examine the occurrence of beet armyworm moths across different geographical regions of Mississippi and to profile yearly moth populations to better understand the ecology of this pest in the Mid-South.

MATERIALS AND METHODS

Adult populations of beet armyworms were monitored throughout agricultural areas of Mississippi using pheromone traps. Reusable bucket style traps (Gempler's™) were baited routinely with synthetic pheromones and traps were checked weekly as described by Hendricks et al. (1995).

The primary objective of this study was to examine the population structure of beet armyworms across different geographical regions of Mississippi. An extensive trap line was conducted from 1995-1996, and 1998-2000. Traps were located in 51 counties across the state. For each year, traps were typically run between 100 and 300 Julian days. Geographical regions of the state were separated into 5 groups (W. Delta, 5 counties; C. Delta, 10 counties; E. Delta, 13 counties; C. Hills, 9 counties; NE. Hills, 14 counties) (Fig. 1). For comparisons among groups, Julian dates were separated into periods of 30 d, with the exception being the first time period which was increased to 60 d to increase numerical entries for analysis. Across multiple years and counties, cumulative mean numbers of moths trapped per time period were generated for each group. Differences among the groups were analyzed using PROC MIXED (SAS Institute 2001). Furthermore, cumulative means for the entire time period (117-326 d) were separated using the LSMEANS option of PROC MIXED (Littrell et al. 1996).

A secondary objective was to examine the seasonal profile of beet armyworms in the Mississippi Delta by using an additional data set. A continuation of a one-year survey described in Hendricks et al. (1995) was conducted. Traps (15) were run continuously (i.e., 365 d, 12 mo, 7 y) from 1994-2000 in Washington Co., W. Delta, Mississippi. A scatter plot of the data was generated using the graphics option of SAS Analyst (SAS Institute 2001), and a 2nd-order polynomial equation that described the majority of the data (190-350 d) also was generated using simple regression (SAS Institute 2001).

Results and Discussion

Throughout the agricultural areas of Mississippi, a strong trend existed where the highest population density of beet armyworm moths was located in the West Delta near the Mississippi River (Fig. 2). Between 117 and 206 Julian days, there were no significant differences ($P > 0.05$) in the cumulative mean numbers of moths trapped between the 5 geographical regions (117-176 d: $F = 2.16$, $P = 0.089$; 117-206 d: $F = 1.69$, $P = 0.169$). The fact that the beet armyworm has no known obligatory diapause (Mitchell 1979) could explain why low numbers of moths were trapped so early in the year (i.e., before wide-scale migration from southern latitudes). However, as the growing season progressed, there were significant differences ($P < 0.05$) in the cumulative mean numbers of moths trapped between the 5 geographical regions (117-236 d: $F = 3.44$, $P = 0.015$; 117-266 d: $F = 9.49$, $P < 0.001$; 117-296 d: $F = 13.28$, $P < 0.001$; 117-326 d: $F = 12.78$, $P < 0.001$). In addition, mean comparison between the 5 geographical regions showed that the population of moths found in the West Delta (i.e., the area closest to the Mississippi River) was significantly higher than populations found in all other areas (Table 1). The beet armyworm overwinters by continuous generations in southern latitudes (e.g., Florida, Texas, Caribbean, and Central America) (Mitchell 1979) and these populations probably invade Missis-

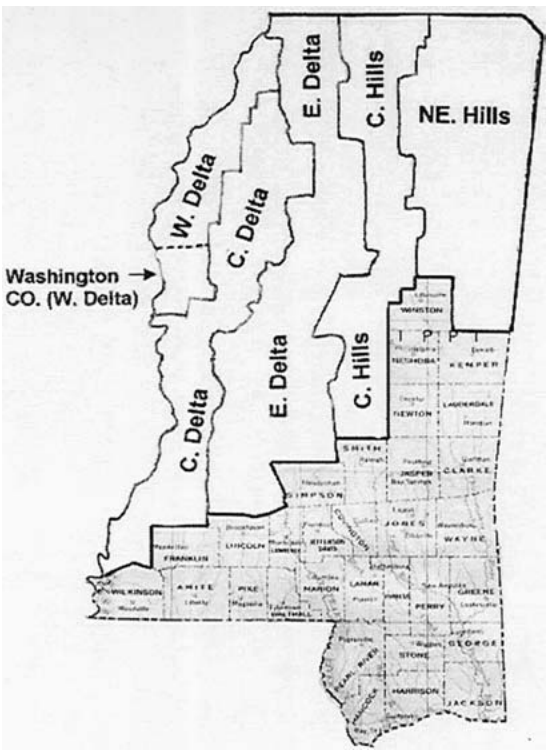

Fig. 1. Geographical regions of Mississippi monitored or BAW moth populations.

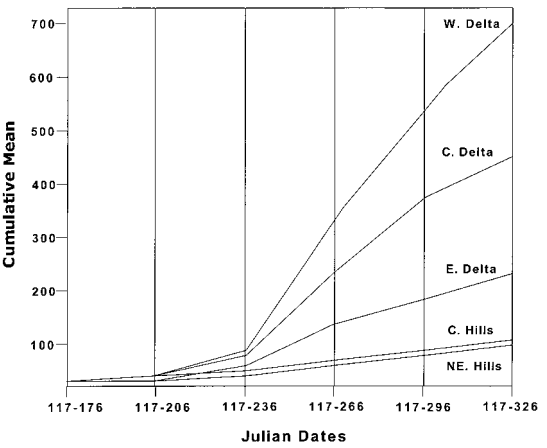

Fig. 2. Number of beet armyworm moths found in different geographical regions of Mississippi.

TABLE 1. NUMBER OF BAW TRAPPED THROUGHOUT THE 1995-1996, 1998-2000 GROWING SEASON FROM VARIOUS GEOGRAPHICAL REGIONS OF MISSISSIPPI.

Group[1]	Cumulative Mean[2] ± SE
W. Delta	733.98 ± 91.92 a
C. Delta	450.54 ± 65.00 b
E. Delta	204.89 ± 57.01 c
C. Hills	101.62 ± 68.52 c
NE. Hills	82.62 ± 57.01 c
df	4, 45
F value	12.78
(*P* > *F*) ANOVA	<0.01

Means in a column followed by the same letter are not significantly different (α = 0.05; LSMEANS option of PROC MIXED, SAS Institute 2001).

[1]See Figure 1 for geographical map of Mississippi.

[2]Between 117-326 Julian days.

sippi (Todd 1975; Mitchell 1979). It seems likely that seasonal weather patterns including wind currents and atmospheric disturbances from the south-central U.S. (Muller 1985; Johnson 1995; Westbrook et al. 1995) could influence the distribution of migratory beet armyworm moths across the different geographical regions of Mississippi. Furthermore, even though this pest feeds on numerous hosts (>50) (Mitchell 1979), it is possible that differences in the population density of local and migratory moths are due to differences in larval host range and abundance among the different geographical regions of Mississippi.

The robust seasonal distribution pattern of beet armyworm moths in the Mississippi Delta suggests that the general time for wide-scale migration of this highly vagile pest may be predicted in most years (Fig. 3). Although moths were caught in all months, numbers were very low until approximately 200 Julian days. Hendricks et al. (1995) suggested that beet armyworm pupae could overwinter in the Mississippi Delta; however, without a photoperiod or temperature induced mechanism, pupal diapause seems unlikely. A more plausible explanation is that during mild winters, populations of beet armyworm larvae are able to survive and develop into pupae by feeding on wild-hosts that survive freezing temperatures in the Mississippi Delta (JJA, unpublished). In addition, Kim & Kim (1997)

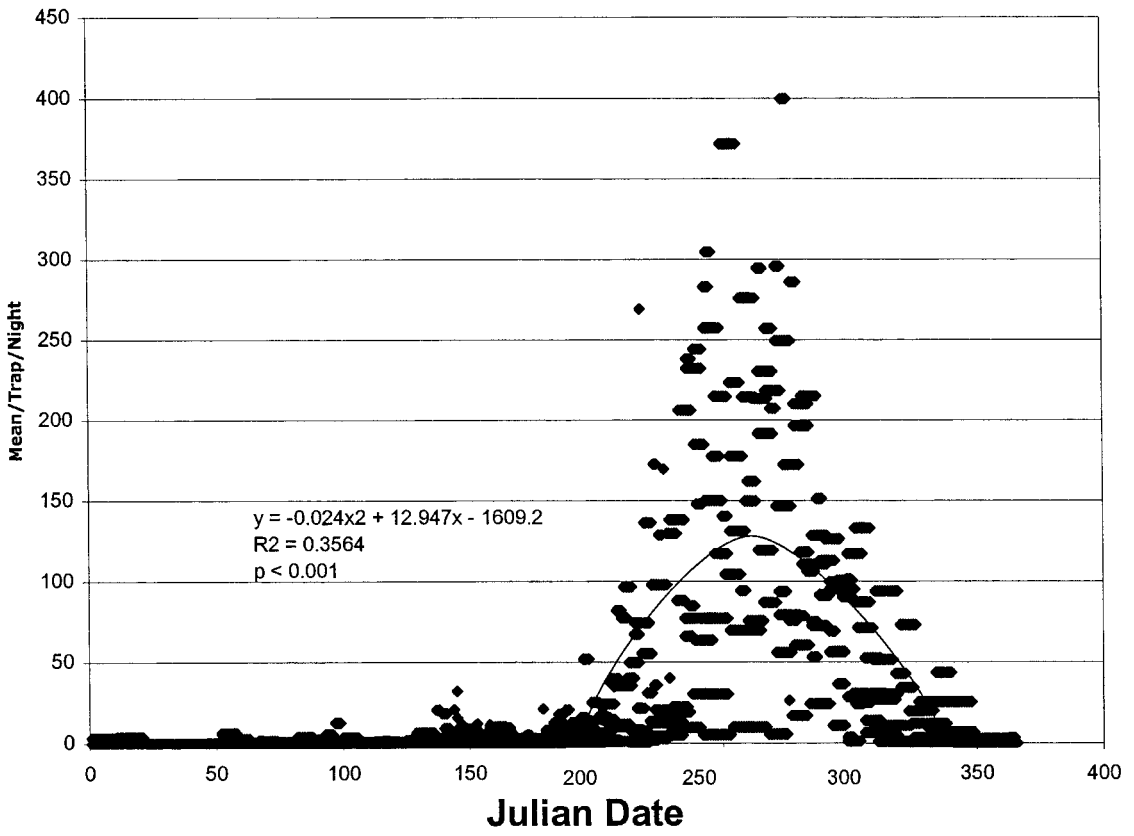

Fig. 3. Distribution of beet armyworm moths throughout Washington Co., W. Delta, Mississippi.

showed that all life-stages of beet armyworms are able to survive periods of subzero temperatures due to an efficient supercooling capacity. Therefore, low numbers of moths caught during the winter months are probably from local populations of larvae feeding on fall hosts (JJA, unpublished). The contribution and influence of this winter population on the summer and fall populations needs to be further investigated.

The seasonal distribution curve indicates a predictable period when beet armyworm migrants are likely to be an economic threat to local crops in the Mississippi Delta. Moth populations in the Mississippi Delta also were monitored in 2001, but very low levels of moths were caught in traps, and the bell-shaped curve was not apparent (data not shown). Consequently, infestations of larvae on local crops and wild-hosts were virtually non-existent throughout the year in the Mississippi Delta. Thus, it may be advantageous for consultants, growers, and researchers to begin monitoring populations of beet armyworms at 200 Julian days (mid-July) to predict if this serious pest will be numerous enough during the season to cause economic damage to crops in the Mississippi Delta.

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