INFLUENCE OF BOLL WEEVIL ERADICATION ON MOTH ACTIVITY IN THE TEXAS ROLLING PLAINS

M. N. Parajulee and J. E. Slosser
Texas Agricultural Experiment Station
Vernon, TX

Abstract

The impact of boll weevil eradication on seasonal activity of bollworm, *Helicoverpa zea* (Boddie), tobacco budworm, *Heliothis virescens* (F.), and beet armyworm, *Spodoptera exigua* (Hübner), moths was evaluated in the Rolling Plains of Texas during 1996-1999. The central Rolling Plains eradication zone received several applications of ULV malathion during the fall of 1996 and 1997 and full-season applications in 1998 and 1999 based on predetermined threshold of two boll weevils per trap. The northern Rolling Plains was not under eradication program during the survey period. Moth activity was monitored weekly in both eradication and noneradication zones using sex pheromone traps; surveys were conducted from early April to mid-October every year. Average abundances of all moth species were similar between eradication and noneradication zones during preeradication (1996). Abundances of bollworm and tobacco budworm moths during the active eradication phase did not vary between eradication and noneradication zones, indicating no significant impact of boll weevil eradication on these moths. In contrast, boll weevil eradication significantly increased the beet armyworm moth activity. However, the influence of boll weevil eradication on beet armyworm moth activity was significant only during the first two years following the initiation of eradication. This suggests that the impact of boll weevil eradication on beet armyworms occurs during the active eradication phase and the impact tends to diminish during the posteradication maintenance phase.

Introduction

The boll weevil eradication program is known to have a direct impact on the incidence and population dynamics of many cotton insects. Use of pesticides, primarily ULV malathion (Fyfanon®), over a wide geographical region eliminates natural enemy complexes, causing secondary pest outbreaks in absence of natural enemies. Boll weevil eradication programs in Alabama, Mississippi, South Texas, and many other southeastern states have contributed to outbreaks of sporadic pests such as beet armyworms, and the emergence of new pests such as the sweetpotato whitefly in those regions. In light of developing pest management strategies during and after boll weevil eradication in the Texas Rolling Plains, we aimed to quantify the consequences of the weevil eradication program on seasonal activity patterns of key moth species, including cotton bollworm, tobacco budworm, and beet armyworm.

In the Rolling Plains of Texas, bollworm and tobacco budworm damage to cotton, *Gossypium hirsutum* L., accounts for ≈40% of the total insect pest damage, whereas beet armyworm has accounted for ≈23% of the total insect pest damage in some years (Stewart et al. 1996, Williams 1999). While beet armyworm is a sporadic pest in the Rolling Plains, bollworm-tobacco budworm complex has emerged as the number 1 pest of cotton in active eradication zones in Texas. Historically, the beet armyworm has been considered an occasional, late season pest in cotton associated with hot and dry conditions. However, most of the outbreaks during the past few years have occurred in areas actively attempting to eradicate the boll weevil, particularly with the use of ULV malathion (Stewart et al. 1996). Beet armyworm is now considered a secondary pest rather than an occasional pest. It has been documented in southeastern states that the elimination of natural enemies from the system is the primary reason for beet armyworm outbreaks (Ruberson et al. 1994), indicating that boll weevil eradication in Texas may have a direct influence on beet armyworm outbreaks. The information on the impact of boll weevil eradication on bollworm-tobacco budworm complex is generally lacking, but the early season applications of broad-spectrum insecticides have been reported to increase bollworm-budworm activity. The objective of our study was to quantify the effect of boll weevil eradication on seasonal activity patterns of three moth species.

Materials and Methods

A survey of bollworm, tobacco budworm, and beet armyworm moths was conducted in the central and northern Rolling Plains of Texas during 1996-1999. The central Rolling Plains, hereafter referred to as eradication zone, initiated its 21-County (700,000 acres) boll weevil eradication program in the fall of 1996 (diapause phase). Due to growers' litigation, the program could not undertake full-season eradication during 1997, but the program was reinitiated during the fall of 1997 (second diapause phase). The first season-long phase (full season) was launched in 1998 and continued through 1999 for a second-year full-season eradication. However, the weevil pressure in 1999 was reduced significantly (94% reduction) compared with that in 1998, reducing the insecticide load in 1999 by 80% compared with the first full-season program of 1998. The northern Rolling Plains (400,000 acres), which initiated its eradication program in the fall of 1999, was a noneradication zone during the survey period.

Weekly monitoring of all three species of moths were conducted in eradication (Knox County) and noneradication

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1180-1182 (2000)
National Cotton Council, Memphis TN

(Hardeman County) zones; surveys were conducted from early April to mid-October every year. The Texas pheromone trap (TP) was used to monitor bollworm and tobacco budworm moths, whereas beet armyworm moths were monitored using a bucket type moth trap (Trécé, Salinas, CA). Three traps (replications) were deployed for each species in each zone. Bollworm and tobacco budworm moth traps within a replication were 0.5-1 km apart, and the beet armyworm trap within a replication was paired with bollworm or tobacco budworm moth trap; replications within each zone were 5-15 km apart. Each bollworm and tobacco budworm trap were baited every other week with a fresh strip of Luretape (Zealure and Virelure for bollworm and tobacco budworm moths, respectively; Hercon Environmental Co., Emigsville, PA), whereas each beet armyworm trap was baited every month with a rubber septum impregnated with synthetic beet armyworm sex pheromone (Trécé, Salinas, CA). Traps for bollworm and tobacco budworm moths did not receive any insecticide 'kill strip,' whereas beet armyworm moth traps received a Vaportape (Hercon Environmental Co., Emigsville, PA) every month for killing the moths after they entered the trap.

Analysis of variance was performed on moth count data (seasonal averages) for each species, with survey zone, year, and zone x year interaction as sources of variability (Abacus Concept 1989). Also, separate ANOVAs were performed on average monthly moth count data for July and August to determine the impact of boll weevil eradication on moth activity during the most sensitive phenological stage of the crop with regard to economic damage by these pests.

Results and Discussion

Bollworm Moths

Analysis of variance of seasonal average moth counts showed that the bollworm moth activity in the Rolling Plains did not significantly vary between boll weevil eradication and noneradication zones (Table 1). Moth numbers varied with years, but there was no significant interaction between zone and year of survey. Average numbers of bollworm moths were significantly higher in 1996 (preeradication) compared with the numbers during each of the next three eradication years in both eradication and noneradication zones (Table 2). The 1996 growing season was one of the three most severe bollworm years during the past 18 years (Parajulee et al. 1998). Number of bollworm moths captured during the months of July or August did not significantly vary between eradication and noneradication zones (Tables 3-4). However, bollworm moth activity was significantly higher in noneradication zone compared with eradication zone in August during the preeradication year (Table 4), but the difference in moth abundance between the two zones decreased through the eradication years. This indicates a marginal impact of eradication on bollworm moth activity in August.

Tobacco Budworm Moths

Average numbers of tobacco budworm moths did not significantly vary between eradication and noneradication zones. Moth numbers also did not vary significantly among years, and there was no significant interaction between eradication and year of survey (Tables 1-2). Number of tobacco budworm moths captured during July were similar between eradication and noneradication zones (Table 3). During August, the difference in moth abundance between eradication and noneradication zones was markedly higher during the first year of full-season eradication (1998) compared with other years, but the difference was not statistically significant (Table 4). Layton et al. (1996) also reported no significant difference in tobacco budworm infestations between eradication and noneradication zones during the 1995 tobacco budworm outbreak in Mississippi.

Beet Armyworm Moths

Average numbers of beet armyworm moths varied significantly with boll weevil eradication zone and year, but the interaction between eradication zone and year of survey was not significant (Table 1). Average numbers of beet armyworm moths were similar between eradication and noneradication zones during preeradication, but the numbers increased significantly in eradication zone following the first year of fall-diapause program (Table 2). A significant impact of first year of eradication program on beet armyworm moth activity the following year is particularly evident from a record low abundance of beet armyworm in noneradication zone (5.5 moths per trap in 1997) while the numbers in eradication zone were 15-fold higher than in noneradication zone (Table 2). Following the first year of full-season eradication program, beet armyworm moth activity remained significantly higher in eradication zone compared with the noneradication zone. Differences in moth abundance between the two zones was not significant during the second year of full-season eradication. Also, it is to be noted that the 1998 growing season was the most severe beet armyworm year in the Rolling Plains history, requiring several insecticide applications for beet armyworm control; the beet armyworm pressure was much higher in eradication zone compared with the noneradication zone. Consequently, the abundances of beet armyworm moths in 1998 were higher in both zones, with significantly higher numbers in eradication zone compared with the noneradication zone. Average number of beet armyworm moths captured during the months of both July and August were significantly higher in eradication zone compared with the noneradication zone (Tables 3-4).

In summary, our data suggest that the insecticide applications as part of boll weevil eradication did not significantly influence the bollworm moth seasonal activity in the Rolling

Plains. The influence of eradication program on tobacco budworm seasonal activity was also minimal, with a slight increase of budworm moth activity only in August 1998, the first full year of eradication. However, eradication had a significant impact on beet armyworm moth activity during the first two years following the initiation of eradication. The impact of boll weevil eradication on moth activity diminished two years after the initiation of eradication program.

References

Abacus Concept. 1989. SuperANOVA, accessible general linear modeling. Abacus Concepts, Berkeley, CA.

Layton, M. B, M. R. Williams, G. Andrews, and S. D. Stewart. 1996. Severity and distribution of the 1995 tobacco budworm outbreak in Mississippi. Proceedings, Beltwide Cotton Conferences, pp. 820-822. National Cotton Council, Memphis, TN.

Parajulee, M. N., J. E. Slosser, and E. P. Boring. 1998. Seasonal activity of *Helicoverpa zea* and *Heliothis virescens* (Lepidoptera: Noctuidae) detected by pheromone traps in the Rolling Plains of Texas. Environ. Entomol. 27: 1203-1219.

Ruberson, J. R., G. A. Herzog, W. R. Lambert, and W. J. Lewis. 1994. Management of the beet armyworm (Lepidoptera: Noctuidae) in cotton: Role of natural enemies. Fla. Entomol. 77: 440-453.

Stewart, S. D., M. B Layton, and M. R. Williams. 1996. Occurrence and control of beet armyworm outbreaks in the cotton belt. Proceedings, Beltwide Cotton Conferences, pp. 846-848. National Cotton Council, Memphis, TN.

Williams, M. R.. 1999. Cotton insect losses, 1998. Proceedings, Beltwide Cotton Conferences, pp. 785-806. National Cotton Council, Memphis, TN.

Table 1. Analysis of variance of weekly abundance of bollworm, tobacco budworm, and beet armyworm moths as affected by boll weevil eradication zone and year, central and northern Rolling Plains, Texas, 1996-1999.

		Bollworm		Budworm		Beet Armyworm	
Source	**df**	***F***	***P***	***F***	***P***	***F***	***P***
Zone	1	1.57	0.23	1.27	0.28	9.11	<0.01
Year	3	9.99	<0.01	0.85	0.49	6.85	<0.01
Zone x year	3	0.38	0.77	0.12	0.95	0.91	0.46
Error	16						

Table 2. Average (±SE) number of moths captured per week in pheromone-baited traps in eradication and noneradication zones during April-October.

	Bollworm		Budworm		Beet Armyworm	
Year	**Erad**	**Nonerad**	**Erad**	**Nonerad**	**Erad**	**Nonerad**
1996	194.4a	249.9a	30.8a	19.0a	45.6a	20.3a
	(26.4)	(45.1)	(18.7)	(8.3)	(12.9)	(8.7)
1997	78.7a	120.5a	38.6a	23.4a	74.5a	5.5b
	(14.7)	(31.3)	(24.3)	(13.1)	(36.5)	(3.5)
1998	92.0a	98.1a	38.9a	19.5a	196.4a	87.3b
	(13.6)	(51.4)	(23.5)	(10.0)	(43.5)	(48.4)
1999	73.7a	76.3a	10.2a	8.2a	60.8a	25.1a
	(7.2)	(19.3)	(1.9)	(4.0)	(13.8)	(15.6)

Means followed by same letter within a row and within species are not significantly different (P>0.10).

Table 3. Average (±SE) number of moths captured per week in pheromone-baited traps in eradication and noneradication zones during July.

	Bollworm		Budworm		Beet Armyworm	
Year	**Erad**	**Nonerad**	**Erad**	**Nonerad**	**Erad**	**Nonerad**
1996	490.0a	402.1a	26.4a	19.1a	17.8a	19.9a
	(69.6)	(143.2)	(21.0)	(8.5)	(5.5)	(9.1)
1997	111.7a	113.7a	10.3a	5.5a	12.6a	2.3a
	(16.5)	(47.9)	(6.6)	(3.5)	(5.5)	(2.2)
1998	128.1a	94.5a	13.5a	13.6a	386.0a	26.5b
	(61.9)	(66.8)	(7.9)	(10.4)	(134.8)	(19.9)
1999	67.1a	98.1a	11.3a	9.0a	70.9a	25.4a
	(9.3)	(49.5)	(3.1)	(4.4)	(22.5)	(17.0)

Means followed by same letter within a row and within species are not significantly different (P>0.10).

Table 4. Average (±SE) number of moths captured per week in pheromone-baited traps in eradication and noneradication zones during August.

	Bollworm		Budworm		Beet Armyworm	
Year	**Erad**	**Nonerad**	**Erad**	**Nonerad**	**Erad**	**Nonerad**
1996	308.8b	508.7a	48.3a	47.0a	44.3a	28.1a
	(39.6)	(23.7)	(25.8)	(29.4)	(16.2)	(20.0)
1997	179.4a	280.8a	51.5a	48.0a	36.1a	1.4a
	(55.3)	(112.3)	(36.4)	(37.0)	(17.2)	(1.3)
1998	198.7a	180.0a	75.9a	34.7a	407.6a	114.2b
	(69.6)	(159.4)	(64.6)	(29.8)	(167.4)	(83.9)
1999	45.0a	42.3a	19.3a	19.0a	35.8a	33.5a
	(0.8)	(21.0)	(10.1)	(14.0)	(18.4)	(23.9)

Means followed by same letter within a row and within species are not significantly different (P>0.10).