STEWARD (INDOXACARB) PERFORMANCE IN COTTON

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Abstract

Two small plot trials were conducted in Jefferson Co., Arkansas, in 2000 to evaluate Steward for the control of the Heliothine complex in conventional (non-*B.t.)* cotton. In the first trial, Steward (indoxacarb) was compared to various pyrethroids and other new cotton insecticides. In the second trial, Steward was evaluated alone and at a reduced rate with tank-mix partners. Steward at 0.11 lb (AI)/acre provided heliothine control comparable to Tracer at 0.067 lb (AI)/acre. It also outperformed the traditional pyrethroid standards. In addition, Steward at the reduced rate of 0.075 lb (AI)/acre in combination with standard rates of Orthene, Curacron, or Asana XL provided heliothine control comparable to Steward at 0.11 lb (AI)/acre which is its labeled rate for heliothine control.

Introduction

The heliothine complex, composed of the bollworm, *Helicoverpa zea* (Boddie), and the tobacco budworm, *Heliothis virescens* (Fab.), occurs each year at damaging levels in Arkansas cotton. In Arkansas, during the 1999 growing season, all of the 970,000 planted cotton acres were infested by the heliothine complex. Half of this acreage required insecticide treatment for heliothine control. Of all the cotton pests impacting the 1999 cotton crop in Arkansas, damage caused by the heliothine complex resulted in the greatest yield reduction at 1.3% (Williams, 2000a; Williams 2000b). Continued reliance on pyrethroid insecticides as the major control measure for the Heliothine complex has resulted in increased levels of resistance for both species (Bagwell, 1999, Brown *et al.,* 1998, Sparks *et al.*, 1993). Continued discovery of new pest control technology is essential to maintain a viable cotton production industry in Arkansas. Steward (indoxacarb) is a new insecticide that received EPA registration for use on cotton on 30 October 2000 (Edmund, 2000). This material exhibits broad-spectrum activity against lepidopterous pests (Bierman, 1998). Ingestion is the primary route of entry into target species, although absorption through the cuticle also occurs. Steward's novel mode of action acts to block sodium ion entry into nerve cells, resulting in paralysis and death of the pest. When pest species are exposed to a toxic dose of Steward, there is a rapid cessation of feeding (within 1-4 hours) and knockdown occurs within 1-2 days (Mitchell, 1999). The objective of these studies was to evaluate the efficacy of Steward, alone and with tankmix partners, for heliothine control compared to traditional pyrethroids and other new insecticides.

Methods

Two trials were conducted on the Robert Fratesi Farm in Jefferson Co., Arkansas, in 2000 to evaluate Steward for the control of the Heliothine complex in non-*B.t.* cotton. This farm was located within the boll weevil eradication zone and received programmed sprays of ULV malathion that greatly reduced boll weevil and plant bug pressure.

In Test 1, Steward was compared to various pyrethroids and other new cotton insecticides. In Test 2, Steward was evaluated alone and in combination with tank-mix partners. Treatments were evaluated in small plots (8-40" rows x 50 ft) arranged in a randomized complete block design with 4 replications. The cotton variety used was Deltapine 5415RR and was planted on 1 May 2000. The crop was furrow-irrigated on an as needed basis. Insecticide treatments were initiated based on state recommendations of one Heliothine damaged square per row foot with eggs and small larvae present. Applications were made with a John Deere 6000 hi-cycle equipped with a compressed air delivery system. The boom was equipped with conejet TXVS 6 nozzles on a 20" spacing. Operating pressure was 45 psi with a final spray volume of 8.6 gpa. Treatments evaluated were:

Test 1.

UTC	-
Tracer 4SC	0.067 lb (AI)/A or 2.1 floz/A
Steward 1.25SC	0.11 lb (AI)/A or 11.3 floz/A
Intrepid 2SC	0.15 lb (AI)/A or 9.6 floz/A
Denim 0.16EC	0.01 lb (AI)/A or 8.0 floz/A
Karate Z 2.09CS	0.025 lb (AI)/A or 1.5 floz/A
Decis 1.5EC	0.01 lb (AI)/A or 0.9 floz/A
Decis 1.5EC	0.02 lb (AI)/A or 1.7 floz/A
Fury 1.5EC	0.037 lb (AI)/A or 3.2 floz/A
Leverage 2.7SE	0.079 lb (AI)/A or 3.8 floz/A
Baythroid 2EC	0.03 lb (AI)/A or 1.9 floz/A
S-1812 35WP	0.15 lb (AI)/A or 0.43 oz/A

Test 2.

Steward 1.25SC	0.11 lb (AI)/A or 11.3 floz/A
Steward 1.25SC	0.075 lb (AI)/A or 7.7 floz/A
Asana XL 0.66EC	0.032 lb (AI)/A or 6.2 floz/A
Asana XL 0.66EC	0.04 lb (AI)/A or 7.8 floz/A
Curacron 8E	0.5 lb (AI)/A or 8.0 floz/A
Orthene 90S	0.5 lb (AI)/A or 0.55 oz/A
Asana XL 0.66EC + Steward 1.25SC	0.032+0.075 lb (AI)/A or 6.2+7.7 floz/A
Asana XL 0.66EC + Steward 1.25SC	0.04+0.075 lb (AI)/A or 7.8+7.7 floz/A
Curacron 8E + Steward 1.25SC	0.5+0.075 lb (AI)/A or 8.0+7.7 floz/A
Orthene 90S + Steward 1.25SC	0.5+0.075 lb (AI)/A or 0.55 oz/A +7.7 floz/A
UTC	-

Treatments were applied as foliar sprays on 6 July, 20 July, 27 July, and 3 August. Insect counts and damage ratings were made on 10 July (4DAT#1), 24 July (4DAT#2), 31 July (4DAT#3), and 7 August (4DAT#4). Data were collected by examining 50 squares and 50 terminals at random from the center of each plot for the presence of live larvae (<1/4 + >1/4") and square damage. The center two rows of each plot were machine harvested with a commercial two-row John Deere cotton picker on 13 October (165DAP) and lint yields were determined based on a 36% gin turnout. Data were processed using Agriculture Research Manager Ver. 6.0.1. Analysis of variance was run and Duncan's New Multiple Range Test (P=0.05) was used to separate means only when AOV Treatment P(F) was significant at the 5% level.

Results and Discussion

At the site for Test 1 and Test 2, the Heliothine population mix was approximately 75% cotton bollworm / 25% tobacco budworm during the initial portion of these trials. The heliothine population shifted to approximately 20% cotton bollworm / 80% tobacco budworm at about the time of the second treatment application. During the remainder of the test period, the population mix averaged 27% cotton bollworm / 73% tobacco budworm (Figure 1). The seasonal average for % heliothine damaged squares and total live heliothine larvae per 50 squares and 50 terminals were obtained by averaging the data across the four rating dates.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1081-1084 (2001)
National Cotton Council, Memphis TN

Test 1

Intrepid (0.15 lb (AI)/acre), Karate (0.025), Decis (0.01), Leverage (0.079), and Baythroid (0.03) failed to differ significantly from the untreated control with respect to % heliothine square damage. Denim (0.01), Decis (0.02), Fury (0.0375), and S-1812 (0.15) were intermediate in their ability to reduce heliothine square damage. Tracer (0.067) and Steward (0.11) significantly reduced the level of heliothine square damage compared to the other treatments (Table 1). Intrepid (0.15), Karate (0.025), Decis (0.01), Fury (0.0375), Leverage (0.079), Baythroid (0.03), and S-1812 (0.15) failed to differ significantly from the untreated control with respect to the live heliothine larvae count. Denim (0.01) and Decis (0.02) were intermediate in reducing the live larvae count. Tracer (0.067) and Steward (0.11) significantly outperformed the other treatments with respect to the live larvae count (Table 1). Decis (0.01) was the only treatments that failed to significantly out yield the untreated control. The pyrethroid treatments, while out yielding the untreated control, tended to yield less than Intrepid (0.15), Denim (0.01) Steward (0.11), and S-1812 (0.15). Tracer significantly out yielded all other treatments except Steward (0.11) and S-1812 (0.15) (Figure 2). Under predominantly budworm pressure, the pyrethroids tested were the least effective in controlling the heliothine complex. Intrepid, Denim, and S-1812 provided a higher level of control, while Tracer and Steward provided the highest level of control along with high yields. Similar results indicating Steward efficacy against the heliothine complex have been shown by Kharboutli et al. (1999a and 1999b)

Test 2

In this test, Orthene (0.5 lb (AI)/acre), Asana XL (0.032), Asana XL (0.04), Steward (0.075), and Curacron (0.5) failed to differ significantly from the untreated control with respect to % heliothine square damage. Steward alone at 0.11 lb (AI)/acre along with the following tank mixtures; Asana XL + Steward (0.04 + 0.075), Curacron + Steward (0.5 + 0.075), Orthene + Steward (0.5 + 0.075), and Asana XL + Steward (0.032 + 0.075), provided the greatest reduction in heliothine square damage compared to the untreated control (Table 2). Asana XL (0.032), Asana XL (0.04), and Orthene (0.5) failed to differ significantly from the untreated control with respect to the live heliothine larvae count. Curacron (0.5), Steward (0.075), Orthene + Steward (0.5 + 0.075), and Asana XL + Steward (0.032 + 0.075) were intermediate in reducing the live larvae count. Steward (0.11), Curacron + Steward (0.5 + 0.075), and Asana XL + Steward (0.04 + 0.075) provided the best performance with respect reducing the live larvae count (Table 2). Orthene (0.5) was the only treatments that failed to significantly out yield the untreated control. The low rate (0.032) of the pyrethroid, Asana XL resulted in an intermediate yield. Orthene + Steward (0.5 + 0.075), Steward (0.11), Asana XL (0.04), Curacron + Steward (0.5 + 0.075), Curacron (0.5), Asana XL + Steward (0.04 + 0.075), Steward (0.075), and Asana XL + Steward (0.032 + 0.075) were statistically, the highest yielding treatments in the test (Figure 3). In this test, Steward alone at 0.11 lb (AI)/acre provided excellent control of the heliothine complex and was among the treatments producing the highest yields. Steward alone at 0.075 lb (AI)/acre, Orthene alone, Asana XL alone, and Curacron alone were less effective. When these materials were tank mixed with Steward (0.075), efficacy of the tank mixture was similar to that of Steward alone at the high rate (0.11).

Summary

These studies were conducted to evaluate Steward alone and in combination with tank mix partners for heliothine control in conventional cotton. Based on these results, Steward at 0.11 lb (AI)/acre provided heliothine control comparable to Tracer, which is becoming the new standard in cotton for lepidopterous pest control It also outperformed the traditional pyrethroid standards. In addition, Steward at the reduced rate of 0.075 lb (AI)/acre in combination with standard rates of Orthene, Curacron, or Asana XL provided heliothine control comparable to Steward at 0.11 lb (AI)/acre, its recommended labeled rate.

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Acknowledgments

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Table 1. **Test 1**-Seasonal Average for % Heliothine Damaged Squares and Live Heliothine Larvae Count: Steward vs. Alternative Insecticides for Heliothine Control in Cotton. AR. 2000.

Treatment	Rate lb (AI)/acre	Seasonal Average % Heliothine Damaged Squares	Seasonal Average Total Live Heliothine Larvae/ 50 Sq & 50 Term
UTC		17.8a	4.2a
Tracer 4SC	0.067	4.3d	0.6e
Steward 1.25SC	0.11	7.3cd	1.3de
Intrepid 2SC	0.15	14.0ab	4.1a
Denim 0.16EC	0.01	9.8bc	1.6cde
Karate Z 2.09CS	0.025	13.5ab	3.3ab
Decis 1.5EC	0.01	14.0ab	4.0ab
Decis 1.5EC	0.02	11.8bc	2.4bcd
Fury 1.5EC	0.0375	10.8bc	3.6ab
Leverage 2.7SE	0.079	12.8abc	3.1abc
Baythroid 2EC	0.03	13.0ab	3.3ab
S-1812 35WP	0.15	10.0bc	2.6a-d
LSD (P=.05)		4.93	1.45

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL

Table 2. **Test 2**-Seasonal Average for % Heliothine Damaged Squares and Live Heliothine Larvae Count: Steward Alone and In Combination for Heliothine Control in Cotton. AR. 2000.

Treatment	Rate lb (AI)/acre	Seasonal Average % Heliothine Damaged Squares	Seasonal Average Total Live Heliothine Larvae / 50 Sq & 50 Term
Steward 1.25SC	0.11	4.5bc	0.4c
Steward 1.25SC	0.075	7.0abc	1.3bc
Asana XL 0.66EC	0.032	8.3ab	2.2ab
Asana XL 0.66EC	0.04	9.0a	2.9a
Curacron 8E	0.5	6.5abc	1.4bc
Orthene 90S	0.5	10.3a	2.6a
Asana XL 0.66EC + Steward 1.25SC	0.032 + 0.075	4.9bc	1.0bc
Asana XL 0.66EC + Steward 1.25SC	0.04 + 0.075	3.6c	0.9c
Curacron 8E + Steward 1.25SC	0.5 + 0.075	4.3c	0.7c
Orthene 90S + Steward 1.25SC	0.5 + 0.075	4.8bc	1.1bc
UTC		9.4a	2.6a
LSD (P=.05)		3.49	1.12

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL

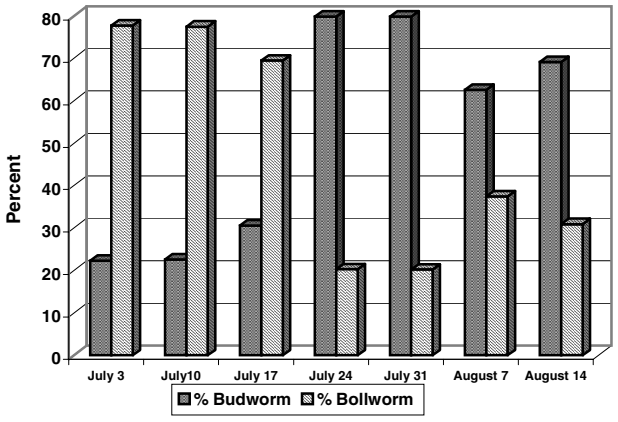

Figure 1. Heliothine Population Density Based on Phermone Trap Catches - July through Mid-August: Jefferson Co., AR. 2000.

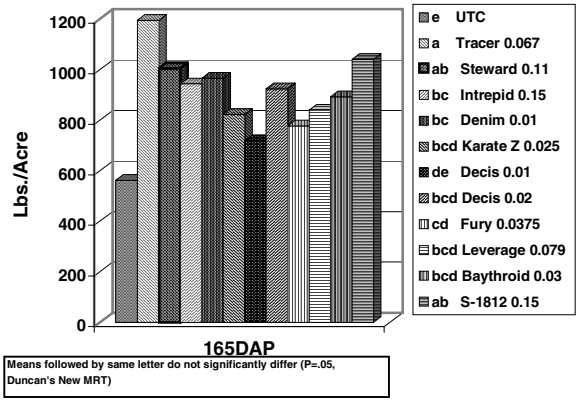

Figure 2. Lint Yield: Steward vs. Alternative Insecticides for Heliothine Control in Cotton. AR. 2000.

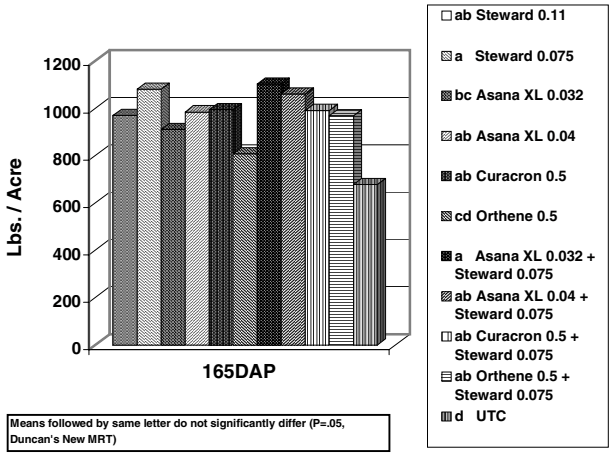

Figure 3. Lint Yield: Steward Alone and in Combination for Heliothine Control in Cotton. AR. 2000.