EVALUATION OF NEW CHEMISTRIES FOR BOLLWORM MANAGEMENT IN THE TEXAS HIGH PLAINS

Emilio Nino
Texas AgriLife Extension Service, Castro and Lamb Co.
Dimmitt, TX
David Kerns
Texas AgriLife Research and Extension Center
Lubbock, TX
Brant Baugh
Texas AgriLife Extension Service, Lubbock Co.
Lubbock, TX
Greg Cronholm
Texas AgriLife Extension Service, Hale and Swisher Co.
Plainview, TX

Abstract

The cotton bollworm, *Helicoverpa zea* (Boddie), is one of the most damaging pests of cotton in the Texas High Plains. Traditionally, pyrethroids are the products of choice for managing bollworms. However, when concurrent infestations of beet armyworms, *Spodoptera exigua* (Hübner) are encountered, pyrethroids are not a stand only choice since they lack efficacy towards beet armyworms. Our objective in this study was to identify an insecticide with acceptable activity towards bollworms and beet armyworms. Two trials were conducted 1) to determine efficacy of insecticides to beet armyworms in cotton, 2) to determine efficacy of insecticides to bollworms in cotton. In the beet armyworm test, Belt, Coragen and Steward all appeared to have excellent activity towards beet armyworms in cotton. In the bollworm test, at 5 DAT, Belt, Coragen, Steward and Karate, all had significantly fewer larvae than the untreated, but none of the treatments had reduced the bollworm population to sub-threshold levels. By 9 DAT, all of the insecticides had significantly fewer larvae than the untreated, but at this time only Karate had reduced the population below threshold. Results were similar at 15 DAT. The temperature during the test averaged a high of 80ºF and a low of 58ºF, whereas the long-term average for this time of year is an approximate high of 85ºF and a low of 58ºF. Since much of the activity for Belt and Coragen, and to a lesser extent Steward, is derived from ingestion, the cool temperatures may have reduced feeding activity to a point where some efficacy appeared to be somewhat compromised. Yield data was not entirely supportive of the findings based on bollworm counts. Belt was the only treatment to significantly yield more cotton than the untreated, but did not differ from Coragen. It is plausible that although the larvae in the Belt plots were alive, feeding may have been minimal. Thus, it appears that Belt, Coragen and Steward all exhibit good activity towards beet armyworms, and in addition to Karate, express efficacy towards bollworms when targeting small larvae. More research is required to determine the efficacy of these products toward larger sized bollworm larvae.

Introduction

Although Bt transgenic cotton varieties have resulted in a dramatic reduction in damage due to ledipopteran pests, the cotton bollworm, *Helicoverpa zea* (Boddie), continues to be one of the most damaging pests of cotton in the Texas High Plains. In 2007, an estimated 714,462 acres of cotton was infested with bollworms, resulting in 26,658 lost bales (Williams 2008). Undoubtedly, most if not all of this cotton was comprised of non-Bt varieties which made up about 75% of the planted acreage in the High Plains in 2007. Because the High Plains of Texas continues to produce a significant acreage of non-Bt cotton, insecticidal control of bollworms is often an important component of a cotton IPM program. Traditionally, pyrethroids have been the products of choice for managing bollworms. However, there are a number of drawbacks to using pyrethroids. Applications of pyrethroids have been implicated in causing secondary pest outbreaks of aphids and spider mites, and in 2008, concurrent infestations of beet armyworms, *Spodoptera exigua* (Hübner), brought up the question of which insecticides could control both species without having to tank mix an additional product with the pyrethroid. Commonly used insecticides for targeting beet armyworms on the High Plains include Intrepid and Steward. Of these two products, only Steward includes bollworms on its label, and the label specifies that very small larvae or egg hatch should be targeted. Several new insecticides have potential for controlling concurrent populations of bollworms and beet armyworms, Coragen and Belt. Both of these products have demonstrated activity towards bollworms in cotton in other states (Hardke et al. 2008a, Hardke et al. 2008b), and both list beet armyworms on their labels.

Materials and Methods

The beet armyworm test was conducted at the Texas AgriLife Research and Extension Center in Lubbock, Texas. Cotton 'DeltaPine 174 RF' was planted on 4 June 2008 on 40-inch rows and irrigated using furrow run irrigation. The plots were 4-rows wide × 80-feet long. The bollworm test was conducted in Castro County near Dimmitt, TX. Cotton 'FiberMax 9058 F' was planted on 19 May 2008 on 30-inch rows. The plots were 4-rows wide × 60-feet long. In both tests, plots were arranged in a randomized complete block design with 4 replicates. The insecticide treatments and rates are outlined in Table 1. All treatments were applied with a CO_2 pressurized hand boom calibrated to deliver 10 gallons/acre. The boom consisted of 2 TwinJet 8001VS nozzles per row.

Table 1. Insecticide treatments and rates.

Treatment	Active ingredient	Rate (product/ac)
Beet armyworm Test		
1) Untreated	--	--
2) Belt 480SC	Flubendiamide	3.0 fl-oz
3) Coragen 1.67SC	Chlorantraniliprole	5 fl-oz
4) Steward 1.25EC	Indoxacarb	11.3 fl-oz
Bollworm Test		
1) Untreated	--	--
2) Belt 480SC	Flubendiamide	3.0 fl-oz
3) Coragen 1.67SC	Chlorantraniliprole	5 fl-oz
4) Karate 1EC	Lambda Cyhalothrin	3.85 fl-oz
5) Steward 1.25EC	Indoxacarb	11.3 fl-oz

All treatments included the non-ionic surfactant Liberate at 0.156% v/v.

Treatments were applied on 25 and 27 August 2008 for the beet armyworm and bollworm tests, respectively.
Beet armyworm populations were estimated utilizing a 36-inch x 40-inch black drop cloth. Drop cloths were laid between the rows and approximately 1.5 row-ft of cotton were shaken onto the drop cloth from each row, and the armyworms counted. Four samples were taken per plot. Bollworm populations were estimated by counting the number of bollworms from 10 whole plant inspections per plot. On both tests larvae size was estimated by length; small larvae (<1/4 inch), medium larvae (1/4 to 5/8 inch) and large (>5/8 inch). The bollworm test was harvested on 7 November 2008, using a 28-inch HB hand basket stripper. A 1/1000th acre portion was harvested from the middle two rows of each plot. All samples were weighed, ginned and classed.

All data were analyzed using PROC MIXED and the means were separated using an F protected LSD ($P \leq 0.05$) (SAS Institute 2003).

Results and Discussion

The beet armyworm population was moderate in density when the test was conducted, averaging at the time of application 915, 1,179 and 2,156 small, medium and large larvae per acre, respectively. There were no differences among treatments in the pretreatment counts (Figure 1). Predators and parasitoids were plentiful in this test and by 7 days after treatment (DAT), the population had declined to very low numbers. Thus, the only meaningful data derived from this test occurred at 4 DAT. At this time, the untreated was averaging 4,574 larvae per acre. All of the insecticide treated plots contained fewer small, large and total larvae than the untreated, but there were no differences among the insecticides (Figure 2). Although this test was not conducted under the best of conditions, these data suggest that all of these treatments may prove equally successful in mitigating beet armyworm infestations in cotton.

In the bollworm test, the bollworm population was extremely high and was initially comprised of primarily small larvae. Thus, based on label recommendations, the timing for using Steward for bollworm control was optimal. On 27 August (pretreatment) plots were averaging 20,750, 4,500 and 1,500 small, medium and large larvae per acre respectively, and there were no statistical differences among treatments (Figure 3). The Texas AgriLife Extension Service action threshold for bollworms post bloom is 10,000 small larvae per acre and 5,000 medium and large larvae per acre (Kerns et al. 2008). Thus we were exceeding the action threshold for bollworms in this test.

Medium larvae were the predominant size at 5 DAT. At this time the all of the insecticides had fewer small and total larvae than the untreated; there were no differences for medium and large size larvae (Figure 4). However, none of the treatments had reduced the bollworm population to sub-threshold levels.

At 9 DAT, large larvae were the most numerous size. All of the insecticides has significantly fewer medium, large and total larvae than the untreated, but did not differ for small larvae (Figure 5). Among the insecticides, Karate and Steward contained significantly fewer medium sized larvae than Coragen, but did not differ from Belt. Karate was the only treatment that was below the action threshold.

At 15 DAT, all of the insecticides contained fewer large and total bollworms than the untreated, but did not differ among each other (Figure 6). There were no differences in small of medium size larvae. Although 15 days had passed since application, Karate was the only treatment that reduced the bollworm population below the action threshold. However, based on yields, crop protection may not have been compromised. Plots treated with Belt produced the most cotton at 1,011 lbs-lint/acres, but did not differ from Coragen. Belt was the only treatment that differed from the untreated, which yielded 876 lbs-lint/acre. It is plausible that although the larvae in the Belt plots were alive feeding may have been minimal (Figure 7).

Summary

At all dates when counts were taken all insecticides had significantly fewer bollworms than the untreated check Plots. However, bollworm populations remained above action threshold until 15 DAT and the only product to reduce populations below threshold was Karate. The reason for the slow activity and inability of most of the insecticides to reduce the bollworm population below the action threshold is not certain. However, unusually cool conditions coupled with a very large bollworm population may have been contributing factors. The temperature during the test averaged a high of 80ºF and a low of 58ºF, whereas the long-term average for this time of year is an approximate high of 85ºF and a low of 58ºF. Since much of the activity for Belt and Coragen, and to a lesser extent Steward, is derived from ingestion, the cool temperatures may have reduced feeding activity to a point where some efficacy was apparently compromised. However based on yields, crop protection may not have been compromised. Plots treated with Belt produced the most cotton at 1,011 lbs-lint/acres, but did not differ from Coragen. Belt was the only treatment that differed from the untreated, which yielded 876 lbs-lint/acre. It is plausible that although the larvae in the Belt plots were alive, feeding may have been minimal. Thus, it appears that Belt, Coragen and Steward all exhibit good activity towards beet armyworms, and in addition to Karate, express efficacy towards bollworms when targeting small larvae. More research is required to determine the efficacy of these products toward larger sized bollworm larvae.

Acknowledgements

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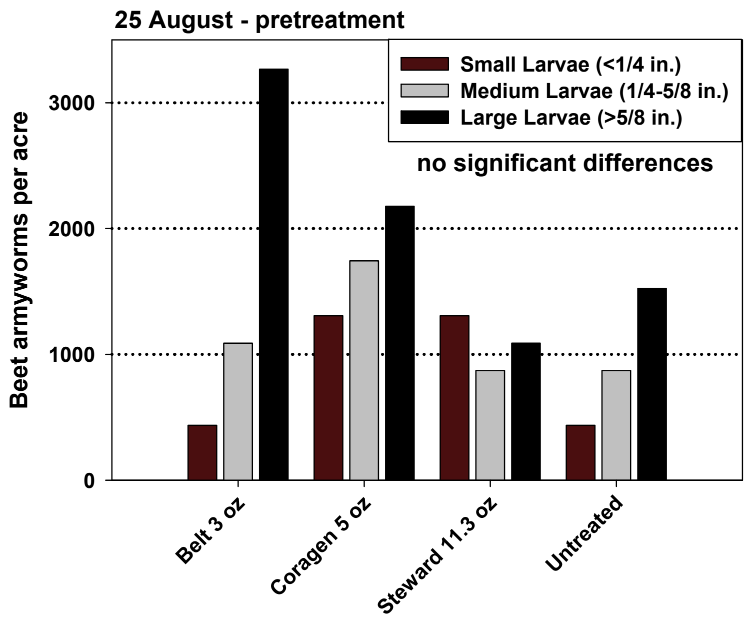

Figure 1. Number of beet armyworm larvae per acre, pretreatment; No significant differences for any size or total larvae based on an F protected Mixed Procedure (LSD, $P < 0.05$).

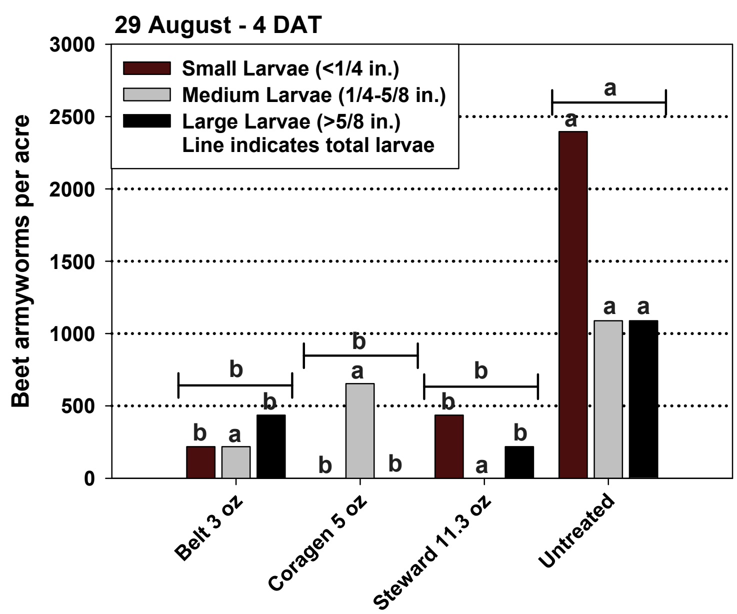

Figure 2. Number of beet armyworm larvae per acre, 4 DAT; Same colored bars or line (total larvae) capped with the same letter are not significantly different based on an F protected Mixed Procedure (LSD, $P < 0.05$).

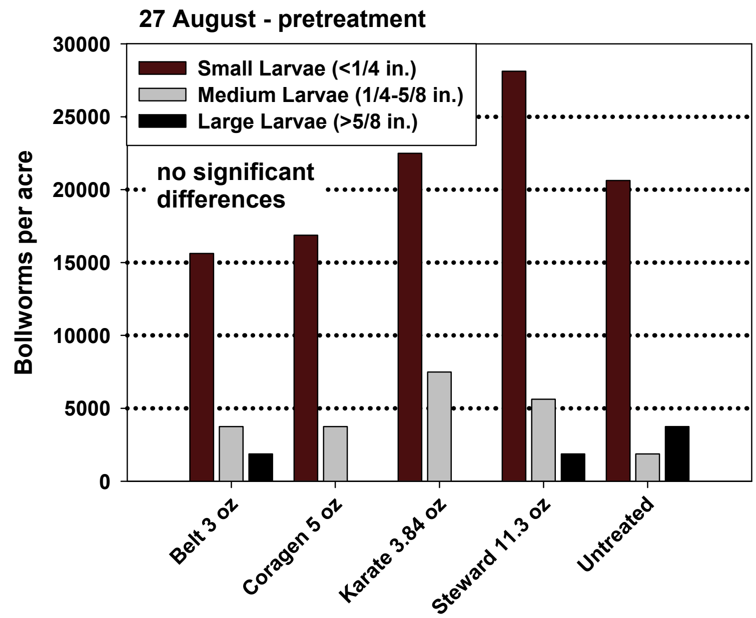

Figure 3. Number of bollworm per acre, pretreatment; No significant differences for any size or total larvae based on an F protected Mixed Procedure (LSD, $P < 0.05$).

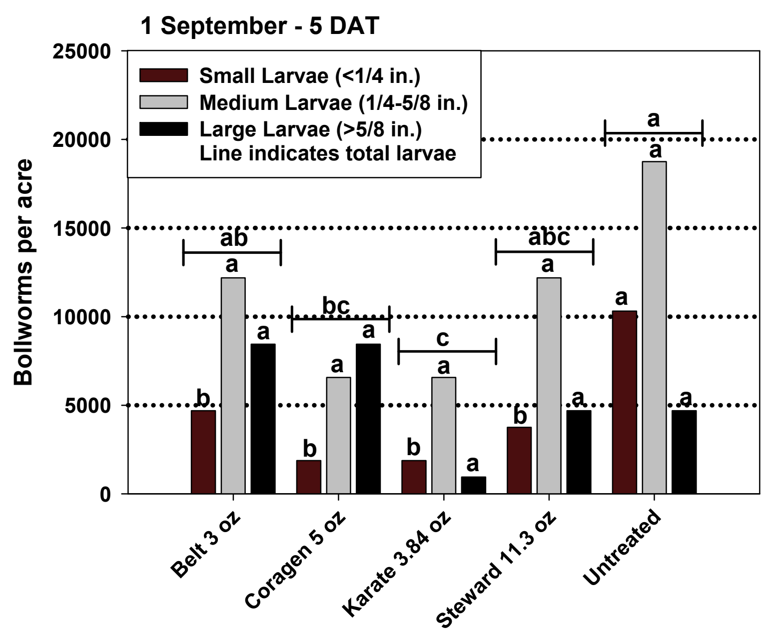

Figure 4. Number of bollworm larvae per acre, 5 DAT; Same colored bars or line (total larvae) capped with the same letter are not significantly different based on an F protected Mixed Procedure (LSD, $P < 0.05$).

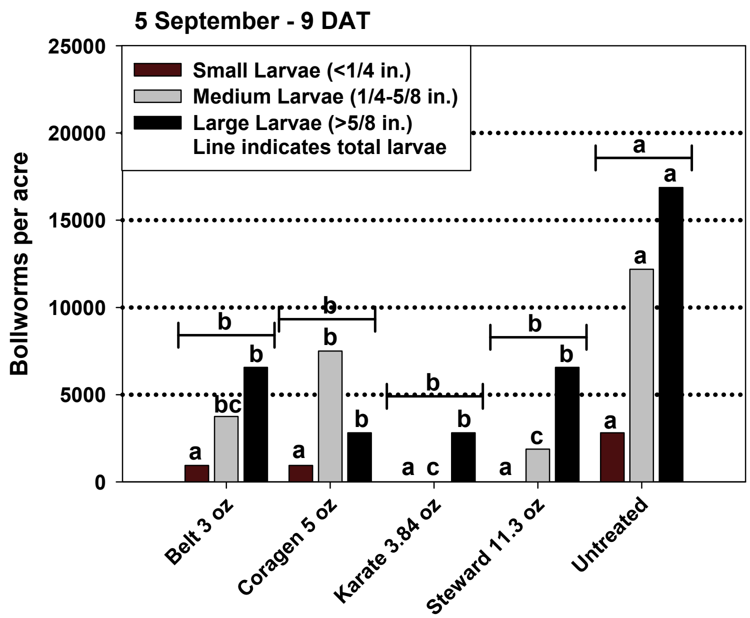

Figure 5. Number of bollworm larvae per acre, 9 DAT; Same colored bars or line (total larvae) capped with the same letter are not significantly different based on an F protected Mixed Procedure (LSD, $P < 0.05$).

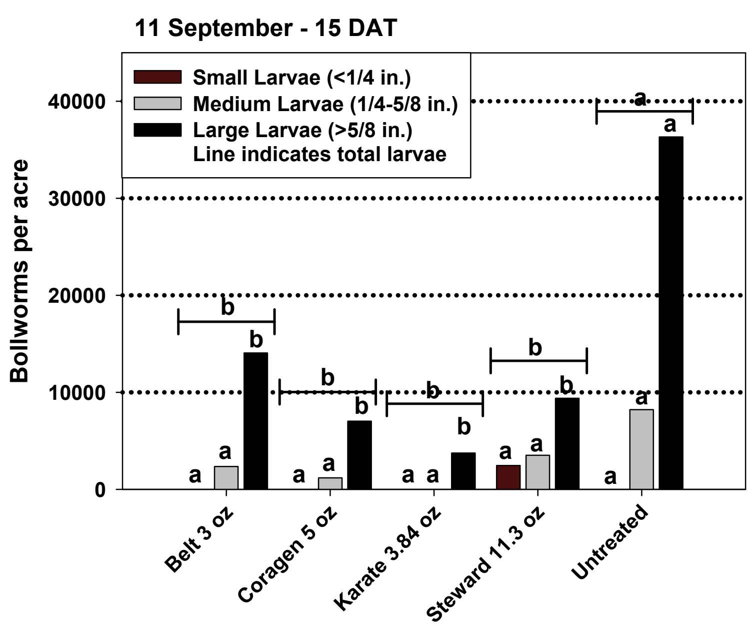

Figure 6. Number of bollworm larvae per acre, 15 DAT; Same colored bars or line (total larvae) capped with the same letter are not significantly different based on an F protected Mixed Procedure (LSD, $P < 0.05$).

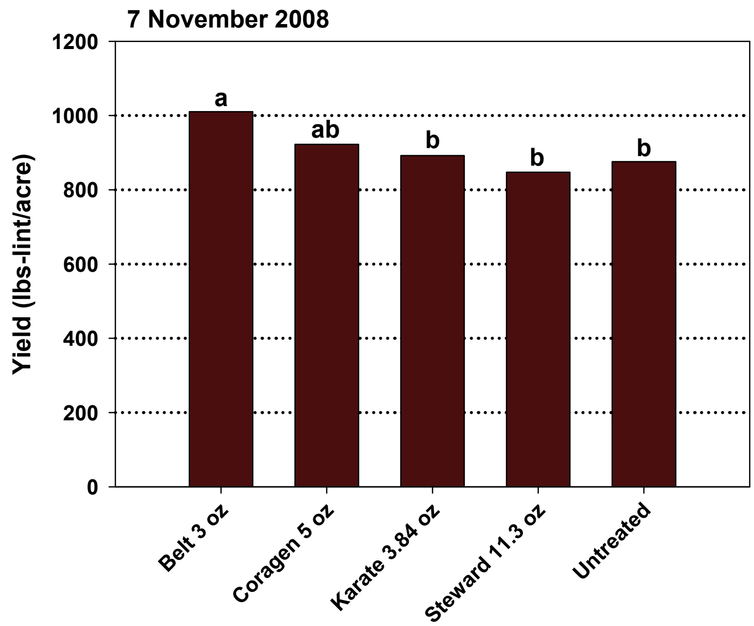

Figure 7. Yield of cotton treated for bollworms; bars capped with the same letter are not significantly different based on an F protected Mixed Procedure (LSD, $P < 0.05$).