OUTLOOK FOR STEWARD INSECTICIDE IN SOUTHEAST ARKANSAS

Marwan S. Kharboutli and Charles T. Allen
Southeast Research and Extension Center
Monticello, AR
Chuck Capps and Larry Earnest
Southeast Research and Experiment Station
Rohwer, AR

Abstract

Steward, a new insecticide with a novel mode of action, was evaluated in 1998 against worms, plant bugs, and boll weevils in addition to its effect on beneficial arthropods. Five separate tests were conducted at the Southeast Research and Experiment Station near Rohwer, AR in which Steward 1.25SC was evaluated at the rates of 0.09 and 0.11 lb ai/ac. Square inspection, sweep net and beat sheet samples in addition to visual rating of foliage damage were used to assess the efficacy of Steward and other insecticides used in this study. Our data show that Steward is an effective control agent against tarnished plant bug and beet armyworm. Tobacco budworm survival trends after treatment strongly indicate that Steward may effectively control tobacco budworm and reduce damage to squares. Adequate assessment of Steward efficacy on bollworm was not possible because of insufficient worm pressure. Increased lint yield was obtained with Steward in some tests, but not in others where insect pressure was not high enough to result in differential damages among treatments. Steward appeared to be soft on predaceous beneficials.

Introduction

A wide variety of arthropod pests attack cotton inflicting damages that can be very costly to cotton farmers. Arthropod pests of cotton caused a reduction of 9.42% in yield in 1997 in the U. S. with an estimated overall cost of management and loss totaling $1.63 billion (Williams 1998). With the rapid development of resistance in insects to insecticides of all classes, there is always a need for new insecticides with new modes of action. In recent years, several new products with good efficacy against pests, some degree of selectivity and novel modes of action have been introduced. Steward (DuPont Agricultural Products) is such a new product for use against a wide variety of lepidopterous insects and certain Lygus species in cotton (Bierman 1998). Steward has been reported to have no significant adverse effects on survival of beneficial insects (Tillman et al. 1998). The active ingredient (Indoxacarb) disrupts the nerve impulse transmission by inhibiting sodium ion entry into nerve cells which results in paralysis and death. Insects stop feeding shortly after ingesting the insecticide and knockdown occurs within 1-2 days (Bierman 1998). The primary route of entry is through ingestion but the product is also active through contact (Bierman 1998). In the light of Steward's reported low mammalian toxicity and favorable aquatic and wildlife profile (Hammes et al. 1998), it is imperative that intensive work be done to study the economic incentives of using Steward and test its fitness in cotton pest management programs. The purpose of this study was to examine the efficacy of Steward against worms, plant bugs and weevils in addition to examining its effects on beneficial arthropods.

Materials and Methods

Five separate tests were carried out in 1998 on the Southeast Branch Experiment Station near Rohwer, AR to evaluate the efficacy of Steward and various other insecticides on cotton insect pests. Plots were 40 feet long and four rows wide. We used a planting pattern of 4 x 2 skip row so that each plot was bordered on each side by a 2 row fallow strip. In all the tests we used a Randomized Complete Block Design with four replications. Efficacy tests were initiated when insect densities were at or approaching threshold levels. All research plots were maintained using standard production practices to produce the crop. Lint yields were determined by machine harvesting the middle 2 rows of the plots in all the tests on dates specified below. Data were processed using the Pesticide Research Manager 5 (PRM) and CoStat (CoStat Statistical Software). Analysis of Variance was run and the Least Significant Difference (LSD) was used to separate the means.

Test I

The main insect target in this test was bollworm. Suregrow 125 was planted on 6-9-98. Treatments were applied on 7-17 and 7-27-98 using a two row back pack sprayer with 2 Tx4 hollow cone nozzles/row. The sprays were applied at 40 PSI and10 gallons of finished spray per acre. Appropriate rates of surfactants were used. Post treatment counts were made 3 days after treatment by examining 25 terminals, 25 squares, and 25 bolls per plot and recording number of eggs, worms, and damaged parts. Cotton was harvested on 9-30-1998.

Test II and Test III

Our emphasis in test II and test III was primarily on tobacco budworm but data were taken on beet armyworm, plant bugs and boll weevil as well. In both tests, Suregow 125 was planted on 6-9-98. Treatments in test II were applied on 8-10, 8-17, and 8-24-98 while in test III treatments were applied on 8-15, 8-21, and 8-29-98. Insecticides were applied using a high clearance sprayer in10 gallons of total spray solution/acre. Appropriate rates of surfactants were used in both tests. Post treatment counts were made 3 days after treatment by examining 25 terminals, 25 squares, and 25 bolls per plot and recording counts of eggs, worms, and damaged parts. Insecticide efficacy on beet armyworm was assessed on 9-2-98 by visually rating each plot for

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1092-1095 (1999)
National Cotton Council, Memphis TN

defoliation on a scale of 0-10 where 0 indicated no defoliation and 10 indicated complete defoliation. Cotton in both tests was harvested on 11-6-98.

Test IV

The effect of Steward and other insecticides primarily on plant bugs but also on beneficial arthropods was examined in this test. Paymaster 1220 BGxRR was planted on 5-20-98. Insecticides were applied on 8-11-98 using a high clearance sprayer in 10 gallons of total spray solution/acre. Appropriate rates of surfactants were used. Posttreatment arthropod counts were taken 2 and 3 days after treatment by taking15 sweep samples (15 inch diameter sweep nets) from the middle two rows in each plot. Arthropods were counted and then released. At 7 days after treatment, 25 squares were examined in each plot and the number of insects and damaged squares was recorded. Cotton was harvested on 10-13-1998.

Test V

The emphasis in this test was also on plant bugs, but data were also taken on beneficial arthropods. Paymaster1220 BGxRR was planted on 5-22-98. Insecticides were applied on 7-6-98 using a high clearance sprayer in 10 gallons of total spray solution/acre. Appropriate rates of surfactants were used. Posttreatment arthropod counts were taken 3 days after treatment using a 3-foot beat sheet (6 row feet per plot). Arthropods were counted and then released Posttreatment plant mapping and fruiting counts were recorded and processed using COTMAN. Cotton was harvested on 9-30-1998.

Results and Discussion

Bollworm Control

Steward (at both rates used) significantly reduced bollworm count and damage compared to the check treatment (Table 1). Steward was as effective on bollworms as Baythroid or Tracer were in reducing worm count and damage. Bierman (1998) reported Steward gave excellent square protection against bollworm and tobacco budworm. However, worm densities in our test were much below the treatment threshold which would renders any comparative analysis of the results relatively weak. Low worm pressure did not allow insecticides to express their potential for bollworm control and yield protection. In light of that, it is not possible to draw accurate and meaningful conclusions regarding the efficacy of Steward on bollworms in Southeast Arkansas from this test. More work is needed.

Tobacco Budworm Control

Tobacco budworm count and damage in plots treated with Steward, in Test II, were not significantly different from those in the check plots (though numerically lower) (Table 2). In Test III, worm count in plots treated with Steward were similar to that in the check treatment but square damage was significantly lower (Table 3). Efficacy of Steward on tobacco budworm in both tests was not statistically different from that of the standard treatment (Tracer) which produced the lowest numerical worm count among all treatments used. In both tests (II and III), Steward exhibited a strong trend, though not always significant, of suppressing tobacco budworm populations and subsequent damage. Worm count and damage in plots treated with Steward were numerically lower than most of treatments used in both tests. More work needs to be done so that the true efficacy of Steward on tobacco budworm is well understood.

Beet Armyworm Control

In the two tests that generated beet armyworm efficacy data, Test II and Test III, Steward effectively minimized damage. Steward significantly reduced defoliation by beet armyworm compared to that of the check treatment (Table 2 and 3). Steward was as effective on beet armyworm as the standard treatment (Pirate) and resulted in defoliation rates similar to those obtained with the Tracer treatment (Table 2 and 3). With beet armyworm becoming a more destructive pest of cotton in the southern United States, Steward appears to offer cotton farmers an alternative against this pest.

Plant Bug Control

In all the tests where plant bugs were monitored, Steward topped the treatment list as far as efficacy was concerned. Plots treated with Steward had the some of the lowest plant bug counts seen in these tests. Plant bug control with Steward matched control obtained from plots treated with highly efficacious plant bug compounds such as Orthene, Provado and Regent (Table 2 through Table 5). Steward's efficacy on plant bugs was consistent through the various tests reported here. It was consistent using three different sampling methods to monitor plant bugs survival after treatments were applied. Data obtained from square inspection, sweep net, and beat sheet sampling methods all consistently showed Steward to be an effective treatment for controlling plant bugs. The development of insecticide resistance in populations of *Lygus lineolaris* in the Mid-south (Snodgrass 1996, Pankey et al. 1996) makes it vital for new and novel chemistries to be available in order to successfully manage these pests.

Boll Weevil Control

Looking at the data obtained from the tests where boll weevil populations were monitored, we can conclude that Steward appears to have little or no activity on boll weevil (Table 2 and 3).

Lint Yield

In Test I against bollworms, neither Steward nor other insecticides tested, with the exception of a combination treatment of Baythroid plus Tracer, provided a significant increase in lint yield compared to the check (Table 1). Steward yielded 798 and 817 lb lint per acre in plots treated with 0.09 and 0.11 lb ai/ac, respectively (Table 1). Steward treated plots yielded numerically approximately 150 lb more cotton lint than the check plot. This numerical increase in

yield in Steward treated plots is probably not entirely due to suppression of bollworm populations. The high efficacy of Steward on plant bugs and beet armyworm may have contributed to the numerically higher yield. Bollworm pressure in this test was low, therefore, Steward and the other insecticides tested did not fully express their efficacy on bollworm with significant increases in yield.

In Test II and Test III, where tobacco budworm was the dominant worm pest, lint yield in plots treated with Steward ranked among the highest among all treatments used (Table 2 and 3). In Test II, plots treated with Steward at 0.09 and 0.11 lb ai/ac produced 1011 and 1041 lb lint /ac, respectively, a significant increase compared to 708 lb lint/ac produced in the check plots (Table 2). A similar trend occurred in Test III where plots treated with Steward at 0.09 and 0.11 lb ai/ac produced 781 and 996 lb lint /ac, respectively compared to 648 lb lint produced in the check plots. The effect of Steward on lint yield is probably due to the broad-spectrum effects of the product on bollworm, tobacco budworm, plant bug and beet armyworm.

Effect of Steward on Beneficial Arthropods

All treatments produced statistically similar counts of beneficials in Test V (Table 5). However, beneficial counts in plots treated with Steward were numerically similar to those recorded in the check plots. Beneficial counts in the Steward plots were three folds higher than those found in plots treated with broad spectrum insecticides such as Orthene or Bidrin (Table 5). Beneficial arthropods are an important component in integrated pest management systems because they provide natural, low cost control of pests populations. Insecticides which are harsh on beneficials can disrupt populations of natural enemies of insect pests and may lead to outbreaks of secondary pests. Although our data are not fully conclusive, Steward appears to be soft on predaceous beneficial arthropods and may fit well in cotton pest management programs.

Conclusions

Our data showed that Steward is an effective insecticide against beet armyworm and plant bugs with activity against bollworm and tobacco budworm. Significant increases in lint yields were obtained in plots treated with Steward compared to other treatments used in these tests. The efficacy of Steward on bollworm and tobacco budworm was less apparent due, in part, to the low worm pressure. More work is needed to document the efficacy of Steward on boll worm and tobacco budworm. Steward appears to have little or no activity on boll weevil. The availability of Steward for cotton pests control will be beneficial to cotton farmers. Steward is a new insecticide with a novel mode of action. It will be helpful in management of resistance in insect pests to insecticides. As Arkansas enters boll weevil eradication in 1999, compound such as Steward which can provide bollworm and budworm control, plant bug control and protection from beet armyworm damage will be important. Post-eradication, these features along with Steward's apparent lack of activity against predaceous beneficial arthropods will improve its fit for cotton in our state.

Literature Cited

Bierman, R. H. 1998. Results of DPX-MP062 efficacy trials on cotton bollworm (*Helicoverpa zea*) and tobacco budworm (*Heliothis virescens*) in Texas. Proceedings Beltwide Cotton Conferences. Pp. 1167-1170.

Hammes, G. G., Sherrod, D., and Marsden, D. 1998. "Steward" (DPX-MP062), a novel new insecticide for cotton insect control. Proceedings Beltwide Cotton Conferences. Pp. 1275-1276.

Pankey, J. H., B. R. Leonard, J. B. Graves and E. Burris. 1996. Toxicity of acephate, cypermethrin and oxamyl to tarnished plant bugs in vial bioassays and cage studies on cotton. Proceedings Beltwide Cotton Conferences. Pp. 882-887.

Snodgrass, G. L. 1996. Insecticide resistance in field populations of the tarnished plant bug (Heteroptera: Miridae) in cotton in the Mississippi delta. J. Econ. Entomol. 89(4): 783-790.

Tillman, P. G., J. E. Mulrooney, and W. Mitchell. 1998. Susceptibility of selected beneficial insects to DPX-MP062. Proceedings Beltwide Cotton Conferences. Pp. 1112-1114.

Williams, M. R. 1998. Cotton insect losses 1997. Proceedings Beltwide Cotton Conferences. Pp. 904-925.

Table 1 (Test I). Efficacy of Steward on bollworms compared to various insecticides as indexed by insect count, damage, and lint yield[1,2]. Rohwer, AR

Treatment	Ratelb ai/ac	Bollworm Count	Bollworm Damage	Lint Yield lb/ac
Check		0.88 a	4.38 a	648 b
Steward 1.25SC	.09	0.25 b	0.38 b	798 ab
Steward 1.25SC	.11	0.13 b	0.63 b	817 ab
Tracer 4SC	.067	0.13 b	0.75 b	800 ab
Pirate 3SC + Baythroid 2EC	.2 + .028	0 b	0 b	713 ab
Pirate 3SC + Baythroid 2EC	.25 + .028	0 b	0.63 b	834 ab
Tracer 4SC + Baythroid 2EC	.031 + .028	0 b	0 b	847 a
Baythroid 2EC	.033	0 b	0.50 b	742 ab

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.

[2]All insect counts and damages are seasonal means of counts 3 days after treatment (2 applications) and reported per 25 squares inspected in each plot.

Table 2 (Test II). Efficacy of Steward on tobacco budworms (TBW), beet armyworms (BAW), boll weevils, and plant bugs compared to various insecticides as indexed by insect count, damage, and lint yield[1]. Rohwer, AR

Treatment	Ratelb ai/ac	TBW Count[2]	TBW Damage[2]	BAW% Def.[3]
Check		2.25 a	3.7 a	6.9 a
Baythroid 2EC + Orthene 90S	.03 + .5	2.1 ab	3.3 a	5.8 ab
Baythroid 2EC	.03	1.75 abc	2.8 ab	5.8 ab
Pirate 3SC + Curacron 8L	.2 + .5	1.75 abc	3.1 ab	3.3 c
Baythroid 2EC +Pirate 3SC	.03 + .35	1.58 abc	2.6 ab	3.0 c
Pirate 3SC + Curacron 8L	.25 + .5	1.17 abc	3.4 a	3.1 c
Baythroid 2EC +Steward 1.25SC	.03 + .09	1.17 abc	1.8 ab	2.6 c
Steward 1.25SC	.09	1.0 abc	1.5 ab	3.4 c
Steward 1.25SC	.11	0.83 abc	1.7 ab	2.8 c
Pirate 3SC	.35	0.58 bc	1.8 ab	2.6 c
Tracer 4SC	.063	0.33 c	1.5 ab	3.3 c
Baythroid 2EC +Tracer 4SC	.03 +.031	0.33 c	1.1 b	5.0 b

Treatment	Ratelb ai/ac	Boll Weevil Damage[2]	Plant Bug Count[2]	Lint Yieldlb/ac
Check		1.7 ab	6.3 abc	708 de
Baythroid 2EC + Orthene 90S	.03 + .5	1.9 a	0.7 f	920 abc
Baythroid 2EC	.03	1.4 ab	4.8 bcd	808 cde
Pirate 3SC + Curacron 8L	.2 + .5	1.4 ab	4.0 cde	718 de
Baythroid 2EC +Pirate 3SC	.03 + .35	1.5 ab	4.4 bcd	894 abc
Pirate 3SC + Curacron 8L	.25 + .5	1.9 a	5.0 bcd	770 cde
Baythroid 2EC +Steward 1.25SC	.03 + .09	1.5 ab	1.2 ef	1048 a
Steward 1.25SC	.09	1.7 ab	1.0 ef	1011 ab
Steward 1.25SC	.11	0.8 ab	1.1 ef	1041 a
Pirate 3SC	.35	1.2 ab	8.7 a	673 e
Tracer 4SC	.063	0.7 b	7.3 ab	728 de
Baythroid 2EC +Tracer 4SC	.03 +.031	1.1 ab	2.5 def	870 bcd

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.
[2]Seasonal means of counts 3 days after treatment (3 applications) and reported per 25 squares inspected in each plot.
[3]Rating was taken on 9-2-1998 on a scale of 0-10 where 0 = no defoliation and 10 = complete defoliation.

Table 3 (Test III). Efficacy of Steward on tobacco budworms (TBW), beet armyworms (BAW), boll weevils, and plant bugs compared to various insecticides as indexed by insect count, damage, and lint yield[1]. Rohwer, AR

Treatment	Ratelb ai/ac	TBW Count[2]	TBW Damage[2]	BAW% Def.[3]
Legend EC	3.75[4]	4.6 a	6.7 a	7.4 a
Provado 1.6F	.047	2.7 b	3.7 b	6.1 ab
Baythroid 2EC	.03	2.1 bc	4.0 b	5.4 bc
Check		1.5 bcd	3.4 a	4.3 c
Karate 1EC	.03	1.5 bcd	3.2 b	5.7 bc
Steward 1.25SC	.09	1.2 cd	2.1 bc	1.9 d
Steward 1.25SC	.11	0.92 cd	2.7 bc	2.2 d
Tracer 4SC	.067	0.33 d	0.67 c	2.1d

Treatment	Rate lb ai/ac	Boll Weevil Damage[2]	Plant Bug Count[2]	Lint Yield lb/ac
Legend EC	3.75[4]	1.2 bc	0.75 ef	784 ab
Provado 1.6F	.047	2.7 ab	2.4 cd	687 b
Baythroid 2EC	.03	1.5 abc	2.1de	626 b
Check		2.0 abc	3.7 bc	648 b
Karate 1EC	.03	1.1 c	4.7 b	689 b
Steward 1.25SC	.09	2.8 a	0.58 f	781 ab
Steward 1.25SC	.11	2.3 abc	0.50 f	996 a
Tracer 4SC	.067	2.8 a	6.7 a	821ab

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.
[2]Seasonal means of counts 3 days after treatment (3 applications) and reported per 25 squares inspected in each plot.
[3]Rating was taken on 9-2-1998 on a scale of 0-10 where 0 = no defoliation and 10 = complete defoliation.
[4]Oz Product per Acre.

Table 4 (Test IV). Efficacy of Steward on Plant bugs and beneficial arthropods compared to various insecticides as indexed by insect count and lint yield[1]. Rohwer, AR

Treatment	Rate (lb ai/ac)	Plant Bugs / 15 Sweeps[2]	Plant Bugs / 25 Squares[3]	Lint Yield lb/ac
Check		3.2 a	2.8 ab	961 a
Naturalis L	16[4]	2.3 ab	3.8 a	1020 a
Orthene AG 97SP	.5	1.4 bc	1.0 bc	1014 a
Naturalis L	10[4]	1.2 bc	1.3 bc	965 a
Regent 2.5EC	.05	1.0 c	0.5 c	1011 a
Steward 1.25SC	0.11	0.88 c	1.3 bc	1051 a
Steward 1.25SC	0.09	0.38 c	1.0 bc	945 a

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.
[2]Sweep net samples were taken on 8-13 and 8-14-1998, 2 and 3 days after a single application.
[3]Squares were inspected on 8-18-1998, 7 days after a single application.
[4]Oz Product per Acre.

Table 5 (Test V). Efficacy of Steward on Plant bugs and beneficial arthropods compared to various insecticides as indexed by insect count and lint yield[1]. Rohwer, AR

Treatment	Rate lb ai/ac	Plant Bugs Per 6 Row Feet[2]	Beneficials Per 6 Row Feet[2]	Lint Yield lb/ac
Check		2.3 a	6.0 a	511 ab
Orthene 90S	.5	1.0 b	1.8 a	385 b
Orthene 90S + Provado 1.6F	.5 + .0375	1.0 b	2.3 a	517 ab
Bidrin 8EC + Provado 1.6F	.25 + .125	0.8 b	2.0 a	494 ab
Provado 1.6F	.0375	0.5 b	5.0 a	436 ab
Steward 1.25SC	0.09	0.5 b	6.5 a	514 ab
Steward 1.25SC	0.11	0.5 b	6.0 a	503 ab
Strategy .16EC	0.01	0 b	6.3 a	558 a

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.
[2]Beat sheet samples were taken on 7-9-1998, 3 days after a single application.