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EFFICACY OF SELECTED INSECTICIDES FOR CONTROL OF HELIOTHINES IN ARKANSAS, 2003

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Abstract

Due to increasing pyrethroid resistance in the Heliothine population, cotton producers are constantly looking for more economic means of controlling these lepidopterous pests. The purpose of this experiment was to examine the effectiveness of selected insecticides and compare the efficacy of each for control of a Heliothine population with respect to traditional pyrethroids. The selected insecticides for this experiment were novaluron (Diamond®), indoxacarb (Steward®), spinosad (Tracer®), esfenvalerate (Asana XL®), lamda cyhalothrin (Karate Z®), gamma cyhalothrin (DE-225®), a bifenthrin and spinosad mix (Double Threat®) Significant differences were observed among treatments in mid to late season observations. Additional data needs to be obtained to increase overall significance. The two different application levels of bifenthrin and spinosad that were selected for this test had the highest yield increase above the untreated check area. The individual treatment of indoxacarb contained the least amount of damaged squares across four different evaluation dates with an average of 3.00.

Introduction

The Arkansas recommendation for Heliothine control is to use the higher recommended rates when a cotton production area is under heavy Heliothine pressure (Greene 2003). However, Heliothine resistance to pyrethroid insecticdes has been documented several times in the past few years (Payne et. al 2001; Williams et. al 1999). Tank mixing pyrethroids with non-pyrethroids has shown to be effective in controlling the Heliothine population (Reaper et. al, 2002). As a result of resistance to pyrethroid insecticides many companies have begun to take an interest in non-pyrethroid insecticdes. Compounds such as novaluron (Diamond®), indoxacarb (Steward®), and spinosad (Tracer®) have been introduced as a means of controlling the Heliothine complex. When compared to traditional pyrethroids these products tend to be costlier on a per acre basis. Previous studies have concluded that when tank mixed with a non-pyrethroid, a traditional pyrethroid such as esfenvalerate (Asana XL®) provides equal control with labeled rates (Hopkins et. al 2001; Reaper et. al 2001). The purpose of this experiment was to compare the effectiveness of pyrethroids, non-pyrethroids, and non-pyrethroids and pyrethroid tank mixes in controlling a heliothine population that existed in a 2003 cotton production area. The insecticides that were applied in this study that are recommended for Heliothine control in the MP144 2003 Insecticide Recommendations for Arkansas (lamda cyhalothrin, indoxacarb, spinosad, esfenvalerate, and the bifenthrin and spinosad mix) were applied at low and reduced rates to determine their effectiveness in controlling Heliothine at these rates. The insecticides that were not recommended for Heliothine control (novaluron and gamma cyhalothirn) were applied at selected rates to establish an effective Heliothine control range for these insecticides. All subsequent treatments were made according to statewide threshhold recommendations (Greene 2003).

Materials and Methods

This trial was conducted at Hooker Farms in Jefferson County, AR in 2003. The field location is approximately three miles south of Pine Bluff Arkansas. This location is inside the Arkansas Boil Weevil Eradication zone. Sure-Grow 521R was planted on May 23, 2003. The field was subdivided into plots that were approximately 25.3 feet wide and 50 feet in length. Plots were setup in a randomized complete block with four replications. Treatments were applied with a John Deere Hi-Cycle 6000 using a compressed air delivery system combined with an eight row boom on 19 inch nozzle spacing. The nozzles used for application were Tee-Jet TXVS 6 cone type spray tips. Operating pressure was 45 pounds per square inch (PSI) and 8.3 gallons per acre of volume. Treatments were foliar applied on July 9, July 23, and August 4 of 2003. The insecticide treatments were applied as follows: A high and low rate of novaluron (0.039 and 0.078 lbs. ai / A) were selected to establish an effective range of control for Heliothine in cotton. The lower rate of novaluron (0.039 lbs. ai / A) was combined with the lower recommended rate of lamda cyhalothrin (0.03 lbs. ai / A). Three rates of indoxacarb were applied in this study (0.06, 0.09, and 0.104 lbs. ai / A). Also, there were four different applications of esfenvalerate at the same rate (0.036 lbs. ai / A). One of the applications of esfenvalerate was applied individually, while two of the applications were combined with the two lower applied rates of indoxacarb (0.06 and 0.09 lbs. ai / A). The fourth application of esfenvalerate was combined with spinosad (0.067 lbs. ai / A). An individual application of spinosad (0.067 lbs. ai / A) was also applied. Two rates of the bifenthrin and spinosad combination (bifenthrin at 0.05 with spinosad at 0.044 lbs. ai / A, and bifenthrin at 0.067 with spinosad at 0.059 lbs. ai / A) were also applied. Observations were conducted on July 11, July 28, July 31, and August 8 of 2003. Data were collected randomly from the middle six rows of each plot. Heliothine damage assessments were taken from 25 terminals, 25 squares, 25 blooms, and 25 bolls from each plot. The data was then analyzed using Analysis of Variance and LSD (P=0.05) in the Agriculture Research Manager (ARM) version 6.1.

Results and Discussion

The highest incidence of damage across all evaluated plant locations occurred in the untreated check (UTC) (Table 1). Also, the UTC also contained the largest population of Heliothine larvae and the highest number of Heliothine eggs. The amount of lint cotton from the UTC also proved to be the lowest from the test, producing only 695.02 lbs. of lint per acre (Table 2). This is 52.8 % lower yield than the bifenthrin (0.067 lbs. ai / A) with spinosad (0.059 lbs. ai / A) treated area (Table 4). All percentages are based on evaluation numbers taken from the UTC areas (Table 3 and 4). On an average across four evaluation dates, the indoxacarb (0.06 lbs. ai / A) and esfenvalerate (0.036 lbs. ai / A) mix had the highest number of damaged squares, for the treated areas, at a 8.75 average (Table 1). This is a cotton square damage reduction of only 22.2 % (Table 3). This same treated area also contained the highest Heliothine larvae population of the treated areas at a 14.00 average (Table 2). The individual application of esfenvalerate (0.036 lbs. ai / A) showed the highest amount of damage terminals and bolls at 4.25 average for each plant location (Table 1). A yield increase of 24.7 % for the indoxacarb (0.06 lbs. ai / A) and esfenvalerate (0.036 lbs. ai / A) treated area indicates that esfenvalerate is more effective when combined with a non-pyrethroid, such as indoxacarb, than when it is applied individually. The esfenvalerate (0.036 lbs. ai / A) treated area only showed a 17.1 % yield increase (Table 4).

The highest amount of boll damage occurred in both the individual applications of spinosad (0.067 lbs. ai / A) and esfenvalerate (0.036 lbs. ai / A) at an average of 4.25 (Table 1). Esfenvalerate is a pyrethroid and spinosad is a non-pyrethroid. The combination application of these two chemicals (spinosad at 0.067 lbs. ai / A and esfenvalerate at 0.036 lbs. ai / A) contained less damaged terminals, blooms, and bolls than the individual applications of both these chemicals at the same rates (Table 1). This indicates the possibility that a pyrethroid and non-pyrethroid combination application has the potential to provide more effective Heliothine control than either a pyrethroid or non-pyrethroid individual application.

Gamma cyhalothrin (0.017 lbs. ai / A), a pyrethroid, was applied individually for this test. On average, the rate of damaged squares for the gamma cyhalothrin treated areas was 7.75 (Table 1). This rate also provided only 31.5 % control of Heliothine larvae. This rate of control is equal to the individual application of novaluron (0.078 lbs. ai / A). These two individual chemical applications provided the second lowest rate of control for Heliothine larvae for the treated areas (Table 4). These lower percentages of control support the theory that applications of both pyrethroids and non-pyrethroids have the potential for more effective Heliothine control than individual applications of either pyrethroids or non-pyrethroids. However, more data should be gathered to help support this theory.

An individual application of novaluron (0.078 lbs. ai / A), a non-pyrethoid, provided only 31.5 % control of the Heliothine larvae and a 54.5 % reduction in the number of Heliothine eggs. A combination application of novaluron (0.039 lbs. ai / A) with the pyrethroid lamda cyhalothrin (0.03 lbs. ai / A) provided 65.8 % control of Heliothine larvae 65.5 % reduction in the number of Heliothine eggs (Table 4). This supports the theory that combination applications of pyrethroid and non-pyrethroid chemicals provide a higher degree of control than applications of non-pyrethroids alone.

As stated previously, the combination application of bifenthrin (0.067 lbs. ai / A) and spinosad (0.059 lbs. ai / A) provided the highest cotton lint yield of the test area at 1061.85 lbs. of lint / A (Table 2). These two chemicals were applied together at two different rates each. The high and low combination rates of bifenthrin and spinosad (0.067 lbs. ai / A and 0.059 lbs. ai / A, 0.05 lbs. ai / A and 0.044 lbs. ai / A) had the highest percent increase of cotton lint yield (52.8 % and 42.6 %) of all the treated areas (Table 4). The bifenthrin, a pyrethroid, and spinosad, a non-pyrethroid, combination provided the highest percent yield increase of all the treated areas.

Summary

This study was conducted to evaluate the benefits of combination applications of pyrethroids and non-pyrethroids over individual applications of each. The highest yield for treated areas was from the two combination applications of bifenthrin, a pyrethroid, and spinosad, a non-pyrethroid, at 1061.85 lbs. of lint per acre for the higher rates, and 990.89 lbs. of lint per acre for the lower rates (Table 2). This supports the theory that combination applications of pyrethroids and non-pyrethroids provide a more effective means of Heliothine control than individual applications of each. The highest degree of Heliothine larvae control was provided by the single application of indoxacarb (0.104 lbs. ai / A) with an average of 4.50 across all four evaluation dates (Table 2). This same individual application of indoxacarb (0.104 lbs. ai. / A) all contained the lowest amount of damaged squares with an average of 3.00 across the four evaluation dates (Table 1).

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References

Greene, J. K. (ed.) 2003. pp. 51-52. In MP144 2002 - 2003 Insecticide Recommendations for Arkansas, Little Rock, AR.

Payne, G.T., J.S. Bacheler, J.W. Van Duyn, R.D. Bagwell, B.R. Leonard, M.L. Boyd, B.L. Freeman, N. Liu, J.R. Weeks, A. Herbert, G.A. Herzog, D.R. Johnson, M.B. Layton, G. Lentz, R. Seward, S.H. Martin, P.V. Pietrantonio, M.E. Roof, M.J. Sullivan, and R.K. Sprenkel. 2001. U.S. cottonbelt survey: testing the susceptibility of the bollworm, *Heliocoverpa zea* (Boddie) to pyrethroid insecticides. *IN* Proceedings Beltwide Cotton Conferences

Reaper III, J., J.D. Hopkins, D.R. Johnson, G.M. Lorenz III, 2002. Efficacy of Asana XL tank mixed with new chemistry for heliothine control in cotton. *IN* Proceedings Beltwide Cotton Conferences

Williams, K.R. 1999. Five years of vial testing on a county-wide basis for bollworm and budworm resistance to Tracer, pyrethroids, and Curacron in Ashley County, Arkansas. *IN* Proceedings Beltwide Cotton Conferences. pp. 775-777

Table 1. Heliothine Damage Assessment following treatment of cotton with insecticides, Jefferson County AR, 2003

Treatment	(lbs. ai / A)	25 Squares Average	25 Terminals Average	25 Blooms Average	25 Bolls Average
Diamond (novaluron)	(0.078)	8.00 ab	3.50 b	4.00 ab	3.00 b
Diamond (novaluron) Karate Z (lamda cyhalothrin)	(0.039) (0.03)	4.75 b	3.00 b	2.00 b	2.25 b
Steward (indoxacarb)	(0.104)	3.00 b	2.75 b	3.00 b	3.50 b
Steward (indoxacarb) Asana XL (esfenvalerate)	(0.09) (0.036)	4.25 b	2.00 b	2.50 b	1.75 b
Double Threat (bifenthrin & spinosad)	(0.067) (0.059)	3.75 b	2.25 b	2.00 b	2.50 b
Double Threat (bifenthrin & spinosad)	(0.05) (0.044)	6.50 ab	1.50 b	1.00 b	1.25 b
Tracer (spinosad)	(0.067)	5.25 ab	3.25 b	1.75 b	4.25 b
Tracer (spinosad) Asana XL (esfenvalerate)	(0.067) (0.036)	6.00 ab	3.00 b	1.00 b	2.00 b
DE-225 (gamma cyhalothrin)	(0.017)	7.75 ab	3.00 b	4.00 ab	2.50 b
Asana XL (esfenvalerate)	(0.036)	8.25 ab	4.25 b	3.75 ab	4.25 b
Steward (indoxacarb) Asana XL (esfenvalerate)	(0.06) (0.036)	8.75 ab	3.25 b	1.25 b	2.75 b
UTC		11.25 a	12.75 a	6.25 a	10.00 a

Means followed by same letter not significantly different P value = 0.05

Table 2. Effect of various insectcides on Heliothine control and cotton yield in Jefferson

Treatment	(lbs. ai / A)	Larvae Average	Eggs Average	Harvest (lbs. / A) Avg. (37% Turnout)
Diamond (novaluron)	(0.078)	12.50 abc	6.25 b	900.92 bc
Diamond (novaluron) Karate Z (lamda cyhalothrin)	(0.039) (0.03)	6.25 bc	4.75 b	942.74 abc
Steward (indoxacarb)	(0.104)	4.50 c	5.75 b	929.34 abc
Steward (indoxacarb) Asana XL (esfenvalerate)	(0.09) (0.036)	5.75 bc	5.00 b	839.47 c
Double Threat (bifenthrin & spinosad)	(0.067) (0.059)	6.00 bc	5.25 b	1061.85 a
Double Threat (bifenthrin & spinosad)	(0.05) (0.044)	7.25 bc	7.75 b	990.89 ab
Tracer (spinosad)	(0.067)	8.25 bc	5.50 b	904.12 bc
Tracer (spinosad) Asana XL (esfenvalerate)	(0.067) (0.036)	9.50 bc	3.75 b	873.05 bc
DE-225 (gamma cyhalothrin)	(0.017)	12.50 abc	7.75 b	883.19 bc
Asana XL (esfenvalerate)	(0.036)	12.00 abc	6.75 b	814.13 cd
Steward (indoxacarb) Asana XL (esfenvalerate)	(0.06) (0.036)	14.00 abc	5.25 b	866.71 bc
UTC		18.25 a	13.75 a	695.02 d

Means followed by same letter not significantly different P value = 0.05

Table 3. Effect of insecticides on Helithine control in cotton, Jefferson County AR, 2003

Treatment	(lbs. ai / A)	25 Squares % Damage Reduction	25 Terminals % Damage Reduction	25 Blooms % Damage Reduction	25 Bolls % Damage Reduction
Diamond (novaluron)	(0.078)	28.9%	72.5%	36.0%	70.0%
Diamond (novaluron) Karate Z (lamda cyhalothrin)	(0.039) (0.03)	57.8%	76.5%	68.0%	77.5%
Steward (indoxacarb)	(0.104)	73.3%	78.4%	52.0%	65.0%
Steward (indoxacarb) Asana XL (esfenvalerate)	(0.09) (0.036)	62.2%	84.3%	60.0%	82.5%
Double Threat (bifenthrin & spinosad)	(0.067) (0.059)	66.7%	82.4%	68.0%	75.0%
Double Threat (bifenthrin & spinosad)	(0.05) (0.044)	42.2%	88.2%	84.0%	87.5%
Tracer (spinosad)	(0.067)	53.3%	74.5%	72.0%	57.5%
Tracer (spinosad) Asana XL (esfenvalerate)	(0.067) (0.036)	46.7%	76.5%	84.0%	80.0%
DE-225 (gamma cyhalothrin)	(0.017)	31.1%	76.5%	36.0%	75.0%
Asana XL (esfenvalerate)	(0.036)	26.7%	66.7%	40.0%	57.5%
Steward (indoxacarb) Asana XL (esfenvalerate)	(0.06) (0.036)	22.2%	74.5%	80.0%	72.5%
UTC		0.0%	0.0%	0.0%	0.0%

All percentages are based on the damage assessment numbers in the UTC (Table 1)

Table 4. Effect of various insectcides on Heliothine control in Jefferson County AR, 2003

Treatment	(lbs. ai / A)	Larvae % Control	Eggs % Reduction	Harvest % Lint Increase
Diamond (novaluron)	(0.078)	31.5%	54.5%	29.6%
Diamond (novaluron) Karate Z (lamda cyhalothrin)	(0.039) (0.03)	65.8%	65.5%	35.6%
Steward (indoxacarb)	(0.104)	75.3%	58.2%	33.7%
Steward (indoxacarb) Asana XL (esfenvalerate)	(0.09) (0.036)	68.5%	63.6%	20.8%
Double Threat (bifenthrin & spinosad)	(0.067) (0.059)	67.1%	61.8%	52.8%
Double Threat (bifenthrin & spinosad)	(0.05) (0.044)	60.3%	43.6%	42.6%
Tracer (spinosad)	(0.067)	54.8%	60.0%	30.1%
Tracer (spinosad) Asana XL (esfenvalerate)	(0.067) (0.036)	47.9%	72.7%	25.6%
DE-225 (gamma cyhalothrin)	(0.017)	31.5%	43.6%	27.1%
Asana XL (esfenvalerate)	(0.036)	34.2%	50.9%	17.1%
Steward (indoxacarb) Asana XL (esfenvalerate)	(0.06) (0.036)	23.3%	61.8%	24.7%
UTC		0.0%	0.0%	0.0%

All percentages are based on the damage assessment numbers in the UTC (Table 2)