### EFFICACY OF SELECTED INSECTICIDES FOR CONTROL OF HELIOTHINES IN CONVENTIONAL NON-BT COTTON 2004-2005 Jarrod T. Hardke, Gus M. Lorenz, Kyle Colwell Univ. of Arkansas CES Little Rock, AR Craig Shelton Univ. of Arkansas CES Jonesboro, AR

#### <u>Abstract</u>

Field experiments were conducted in 2004-2005 in Jefferson County, Arkansas to evaluate efficacy of selected insecticides to control bollworm, Helicoverpa zea, and tobacco budworm, Heliothis virescens. The insecticides selected for these studies were both traditional and experimental. In the 2004 study, the selected insecticides were Steward (indoxacarb), a Steward (indoxacarb) and Asana XL (esfenvalerate) tank mix, S-1812, V-10132, Tracer (spinosad), a Tracer (spinosad) and Capture (bifenthrin) tank mix, Denim (emamectin benzoate), Diamond (novaluron) and bifenthrin tank mix, Karate Z (lambda-cyhalothrin), Leverage (imidachloprid + cyfluthrin), and a Karate Z (lambda-cyhalothrin) and Steward (indoxacarb) tank mix. In the 2005 study, the selected insecticides were Steward (indoxacarb), KN-128 tank mixed with Penetrator Plus (nonionic oil concentrate), KN-128, Tracer (spinosad), Bidrin (dicrotophos) tank mixed with Discipline (bifenthrin), Experimental 1, and Double Threat (bifenthrin and spinosad). In both studies, significant differences were observed among treatments in regard to heliothine damage and heliothines found.

#### **Introduction**

The bollworm *Helicoverpa zea*, and tobacco budworm, *Heliothis virescens*, are major pests of cotton. Resistance to insecticides by heliothines has led to the need for new chemistry to control the heliothine complex (Johnson, 2004). During the 2003 growing season, it was estimated that all 950,000 acres in the state of Arkansas were infested with bollworm/budworm populations, with an estimated 870,000 acres treated. An estimated 58,073 bales were lost due to bollworm/budworm infestation. This accounts for 44% of the bales lost due to insect infestation. At an estimated bale size of 480 pounds at \$0.65 per pound, bollworm/budworm infestation accounted for a total monetary loss of \$16,956,918. Taking into account the estimated yield per acre of 874 pounds, with 8,423 treatment applications, the total cost + loss due to insect infestations was \$161,487,050 which comes to \$169.99 lost per acre. Bollworm/budworm alone, accounting for 44% of the insect infestations, accounted for \$71,054,302 of the cost + loss, accounting for \$74.80 of the cost + loss per acre (Williams, 2003).

### **Research Problem**

Resistance to pyrethroids has led to the need for conclusive data on the effectiveness of compounds recommended for use to control heliothines (Johnson, 2004). It is important to develop effective strategies for controlling the bollworm/budworm complex in addition to other pests. In the 2004 study, selected rates of various insecticides currently recommended for heliothine control were utilized, as well as several experimental compounds and tank mixes. Among those currently recommended are Steward (indoxacarb), Tracer (spinosad), Capture (bifenthrin), Denim (emamectin benzoate), and Karate Z (lambda-cyhalothrin). The experimental compounds and the tank mixes used are as follows: Steward (indoxacarb) + Asana XL (esfenvalerate), S-1812, V-10132, Tracer (spinosad) + Capture (bifenthrin), Diamond (novaluron) + bifenthrin, Leverage (imidachloprid + cyfluthrin), and Karate Z (lambda-cyhalothrin) + Steward (indoxacarb). Currently recommended compounds in the 2005 study were Steward (indoxacarb), Tracer (spinosad), Discipline (bifenthrin), Denim (emamectin benzoate), and Double Threat (bifenthrin + spinosad). The experimental compounds and the tank mixes used are as follows: KN 128 + Pentrator Plus (nonionic oil concentrate), KN 128 alone, Bidrin (dicrotophos) + Discipline (bifenthrin), and Experimental 1.

### Materials And Methods

The 2004 test was conducted at Jefferson County, AR. Stoneville RR 4793 was planted on 6 May. The field was planted and afterwards subdivided into plots of 8 rows on 38 inch spacing and 50 feet in length. Plots were set up in a randomized complete block with four replications. Treatments were made according to statewide threshold recommendations. Treatments were applied with a John Deere 6500 Hi-Cycle using an 8-row boom with 19 inch nozzle spacing. The nozzles used for application were Tee-Jet TXVS 6. Operating pressure was 45 pounds per square inch and 9.17 gallons per acre of volume. Treatments were made on 6 July, 13 July, 20 July, and 29 July. Treatments included: an untreated check, Steward (indoxacarb) at 0.104 lb ai/a, Steward (indoxacarb) at 0.09 lb ai/a + Asana XL (esfenvalerate) at 0.036 lb ai/a, S-1812 at 0.15 lb ai/a, V-10132 at 6 fl oz/a, Tracer (spinosad) at 0.063 lb ai/a, Tracer (spinosad) at 0.044 lb ai/a + Capture (bifenthrin) at 0.067 lb ai/a, Denim (emamectin benzoate) at 0.01 lb ai/a, Diamond (novaluron) at 0.058 lb ai/a + bifenthrin at 0.067 lb ai/a, Karate Z (lambda-cyhalothrin) at 0.033 lb ai/a, Leverage (imidachloprid + cvfluthrin) at 0.07 lb ai/a, and Karate Z (lambda-cyhalothrin) at 0.033 lb ai/a + Steward (indoxacarb) at 0.06 lb ai/a. Observations were conducted on 9 July (3 DAT), 12 July (6 DAT), 16 July (3 DAT), 19 July (6 DAT), 23 July (3 DAT), 26 July (6 DAT), 2 August (4 DAT), and 5 August (7 DAT). In each plot, data was collected from random samples of 25 terminals, 25 squares, 10 blooms, and 10 bolls. Data were analyzed using Agricultural Research Manager Version 7 using Analysis of Variance and LSD (P=0.10).

The 2005 test was also conducted in Jefferson County, AR. Delta Pine 434 was planted on 6 May. The field was planted and afterwards subdivided into plots of 8 rows on 38 inch spacing and 50 feet in length. Plots were set up in a randomized complete block with four replications. Treatments were made according to statewide threshold recommendations. Treatments were applied with a John Deere 6500 Hi-Cycle using an 8 row boom with 19 inch nozzle spacing. The nozzles used for application were Tee-Jet TXVS 6. Operating pressure was 45 pounds per square inch and 9.69 gallons per acre of volume. Treatments were made on 8 July, 15 July, and 25 July. Treatments included: an untreated check, Steward (indoxacarb) at 0.09 lb ai/a, Steward (indoxacarb) at 0.104 lb ai/a, KN 128 at 0.09 lb ai/a + Penetrator Plus (nonionic oil concentrate) at 0.5% volume/volume, KN 128 at 0.09 lb ai/a, KN 128 at 0.104 lb ai/a, Tracer (spinosad) at 0.067 lb ai/a, Bidrin (dicrotophos) at 0.33 lb ai/a + Discipline (bifenthrin) at 0.0625 lb ai/a, Discipline (bifenthrin) at 0.08 lb ai/a, Discipline (bifenthrin) at 0.08 lb ai/a + Bidrin (dicrotophos) at 0.25 lb ai/a, Denim (emamectin benzoate) at 0.01 lb ai/a, Experimental 1 at 0.25 lb ai/a, and Double Threat with bifenthrin at 0.08 lb ai/a + spinosad at 0.07 lb ai/a. Observations were conducted on 12 July (4 DAT), 15 July (7 DAT), 19 July (4 DAT), 22 July (7 DAT), 29 July (4 DAT), and 1 August (7 DAT). In each plot, data was collected from random samples of 25 terminals, 25 squares, 25 blooms, and 25 bolls. Data were analyzed using Agricultural Research Manager Version 7 using analysis of Variance and LSD (P=0.10).

### **Results And Discussion**

In the 2004 study, in regard to seasonal totals, all treatments significantly differed from the untreated check concerning damaged fruit (damaged fruit consists of all damage found in squares, blooms, and bolls). All treatments significantly differed from the untreated check, but V-10132 at 6 fl oz/a and Tracer (spinosad) at 0.044 lb ai/a + Capture (bifenthrin) at 0.067 lb ai/a were statistically the best in regard to damaged terminals, although they only differed from the untreated check, Steward (indoxacarb) at 0.104 lb ai/a, S-1812 at 0.15 lb ai/a, and Denim (emamectin benzoate) at 0.01 lb ai/a. Tracer (spinosad) at 0.044 lb ai/a + Capture (bifenthrin) at 0.067 lb ai/a was also statistically the best treatment in relation to damaged squares, although it only significantly differed from the untreated check and Steward (indoxacarb) at 0.104 lb ai/a. All treatments performed significantly better than the untreated check in regard to damaged blooms and damaged bolls. Tracer (spinosad) at 0.044 lb ai/a + Capture (bifenthrin) at 0.067 and Karate Z (lambda-cyhalothrin) at 0.033 lb ai/a + Steward (indoxacarb) at 0.06 lb ai/a performed statistically the best in relation to heliothines found in terminals, though they only significantly differed from the untreated check, Steward (indoxacarb) at 0.104 lb ai/a, and Denim (emamectin benzoate) at 0.01 lb ai/a. Tracer (spinosad) at 0.044 lb ai/a + Capture (bifenthrin) at 0.067 lb ai/a was again statistically the best in regard to heliothines found in squares, though it only significantly differed from the untreated check and Denim (emamectin benzoate) at 0.01 lb ai/a. All treatments were statistically better than both the untreated check and Steward (indoxacarb) at .104 lb ai/a in relation to heliothines found in blooms. All treatments significantly differed from the untreated check in regard to heliothines found in bolls. In regard to yield in the 2004 study, the untreated check performed statistically worse than all other treatments with a yield of 671 lint lbs/acre. The highest yields observed were Steward (indoxacarb) at 0.09 lb ai/a + Asana XL (esfenvalerate) at 0.036 lb ai/a [1605 lint lbs/acre], V-10132 at 6 fl oz/a [1593 lint lbs/acre], Tracer (spinosad) at 0.044 lb ai/a + Capture (bifenthrin) at 0.067 lb ai/a [1610 lint lbs/acre], Diamond (novaluron) at 0.058 lb ai/a + Bifenthrin at 0.067 lb ai/a [1594 lint lbs/acre], and the highest yield was Karate Z (lambda-cyhalothrin) at 0.033 lb ai/a + Steward (indoxacarb) at 0.06 lb ai/a [1624 lint lbs/acre]. These treatments were numerically the best in regard to yield and statistically better than the untreated check [671 lint lbs/acre] and Karate Z (lambda-cyhalothrin) at 0.033 lb ai/a to 0.033 lb ai/a = 1305 lint lbs/acre].

In the 2005 study, in regard to seasonal totals, all treatments significantly differed from the untreated check concerning damaged fruit. Double Threat (bifenthrin at 0.08 lb ai/a + spinosad at 0.07 lb ai/a) was statistically the best treatment in regard to seasonal damaged fruit, as it was statistically better than Tracer (spinosad) at 0.067 lb ai/a, Bidrin (dicrotophos) at 0.33 lb ai/a + Discipline (bifenthrin) at 0.0625 lb ai/a, Discipline (bifenthrin) at 0.08 lb ai/a, Denim (emamectin benzoate) at 0.01 lb ai/a, and Experimental 1. Double Threat (bifenthrin at 0.08 lb ai/a + spinosad at 0.07 lb ai/a) was numerically better than all other treatments in regard to seasonal damaged fruit. In regard to damaged terminals, all treatments significantly differed from the untreated check, but Steward (indoxacarb) at 0.104 lb ai/a, KN 128 at 0.104 lb ai/a, Discipline (bifenthrin) at 0.08 lb ai/a, Denim (emamectin benzoate) at 0.01 lb ai/a, and Double Threat (bifenthrin at 0.08 lb ai/a + spinosad at 0.07 lb ai/a) were numerically the best treatments and statistically better than the untreated check, Bidrin (dicrotophos) at 0.33 lb ai/a + Discipline (bifenthrin) at 0.0625 lb ai/a, and Experimental 1. All treatments significantly differed from the untreated check in regard to damaged squares, with both rates of Steward (indoxacarb), and the single rate of Double Threat (bifenthrin at 0.08 lb ai/a + spinosad at 0.07 lb ai/a) being numerically the best. In regard to damaged blooms, all treatments significantly differed from the untreated check with Double Threat (bifenthrin at 0.08 lb ai/a + spinosad at 0.07 lb ai/a) also being statistically better than Denim (emamectin benzoate) at 0.01 lb ai/a and Experimental 1, as well as being numerically better than all other treatments. All treatments significantly differed from the untreated check in regard to damaged bolls. In regard to the seasonal total heliothines found in terminals, all treatments significantly differed from the untreated check, with Steward (indoxacarb) at 0.104 lb ai/a and Double Threat (bifenthrin at 0.08 lb ai/a + spinosad at 0.07 lb ai/a) being statistically better than Discipline (bifenthrin) at 0.08 lb ai/a + Bidrin (dicrotophos) at 0.25 lb ai/a, and Experimental 1, and numerically better than all other treatments. In regard to the seasonal total heliothines found in squares, all treatments significantly differed from the untreated check. In regard to the seasonal total heliothines found in blooms, all treatments significantly differed from the untreated check, with Experimental 1 being significantly worse than all treatments except the untreated check and Denim (emamectin benzoate). All treatments significantly differed from the untreated check in regard to the seasonal total heliothines found in bolls.

### **Ackowledgements**

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#### **References**

Johnson, D.R., et al. 2004. Efficacy of Selected Insecticides for Control of Heliothines in Arkansas, 2003. *IN* Proceedings Beltwide Cotton Conferences 2004. pp. 1782-1787.

Williams, Michael R. 2004. Cotton Insect Loss Estimates – 2003. <u>IN</u> Proceedings Beltwide Cotton Conferences 2004. pp. 1258-1312.

# Table 1. Seasonal Damage 2004

Application Dates: July 6, July 13, July 20, July 29, 2004 Evaluation Date: July 9 (3DAT), July 12 (6DAT), July 16 (3DAT), July 19 (6DAT), July 23 (3DAT), July 26 (6DAT), August 2 (4 DAT), August 5 (7DAT)

Treatment		Rate	Dam	aged	Dam	aged	Dam	aged	Dam	aged
Name	Rate	Unit	Tern	ninal	Squ	lare	Blo	om	B	oll
Untreated Check			106.5	а	85.75	а	23.5	а	19	а
STEWARD (indoxacarb)	0.104	lb ai/a	33.25	bc	15.75	b	4.25	b	2	b
STEWARD (indoxacarb)	0.09	lb ai/a	26.5	cd	11	bc	2	b	1.25	b
ASANA XL (esfenvalerate)	0.036	lb ai/a								
S-1812	0.15	lb ai/a	33	bc	13.5	bc	3.25	b	1.5	b
V-10132	6	fl oz/a	16.25	d	9	bc	1.5	b	0.75	b
TRACER (spinosad)	0.063	lb ai/a	27.25	cd	13.75	bc	3.75	b	2	b
TRACER (spinosad)	0.044	lb ai/a	19	d	6.5	С	1.5	b	0	b
CAPTURE (bifenthrin)	0.067	lb ai/a								
DENIM (emamectin	0.04		00.75		4.5				0.5	
benzoate)	0.01	id ai/a	38.75	D	15	DC	3	D	3.5	D
DIAMOND (novaluron)	0.058	lb ai/a	23	cd	7.25	bc	1.25	b	1	b
BIFENTHRIN	0.067	lb ai/a								
KARATE Z (lambda-										
cyhalothrin)	0.033	lb ai/a	22.25	cd	10.75	bc	2.75	b	1	b
LEVERAGE										
(imidachloprid + cyfluthrin)	0.07	lb ai/a	23.25	cd	10.25	bc	1	b	0.5	b
KARATE Z (lambda-										
cyhalothrin)	0.033	lb ai/a	23	cd	8.75	bc	1.5	b	1.25	b
STEWARD (indoxacarb)	0.06	lb ai/a								

Means followed by same letter do not significantly differ (P=.10, Duncan's New MRT)



# Table 2. Seasonal Helothine Found 2004

Project code: N/A Application Dates: July 6, July 13, July 20, July 29, 2004 Evaluation Date: 9 (3DAT), July 12 (6DAT), July 16 (3DAT), July 19 (6DAT), July 23 (3DAT), July 26 (6DAT), August 2 (4 DAT), August 5 (7DAT)

Treatment		Rate	Heli	othis	Heli	othis	Heli	othis	Helio	othis
Name	Rate	Unit	Tern	ninal	Squ	uare	Blo	oom	В	oll
Untreated Check			12.75	а	27.5	а	14.75	а	9	а
STEWARD (indoxacarb)	0.104	lb ai/a	5.25	bc	3.25	bc	4.75	b	1.5	b
STEWARD (indoxacarb) ASANA XL (esfeny/alerate)	0.09	lb ai/a	3.25	bcd	1.75	bc	0.75	С	0	b
S-1812	0.15	lb ai/a	3.75	bcd	3.75	bc	1.75	С	0	b
V-10132	6	fl oz/a	1.75	cd	2.75	bc	0.25	с	1	b
TRACER (spinosad)	0.063	lb ai/a	4	bcd	4	bc	1	с	0.25	b
TRACER (spinosad)	0.044	lb ai/a	1.5	d	1.5	с	0.25	с	0	b
CAPTURE (bifenthrin)	0.067	lb ai/a								
DENIM (emamectin benzoate)	0.01	lb ai/a	6.25	b	6.25	b	1.25	С	1	b
DIAMOND (novaluron)	0.058	lb ai/a	2.5	cd	2	bc	1.5	с	0.25	b
BIFENTHRIN	0.067	lb ai/a								
KARATE Z (lambda- cyhalothrin)	0.033	lb ai/a	2.5	cd	3.75	bc	2.5	С	0.25	b
LEVERAGE										
(imidachloprid + cyfluthrin)	0.07	lb ai/a	3	bcd	2.25	bc	0.5	с	0	b
KARATE Z (lambda- cyhalothrin) STEWARD (indoxacarb)	0.033	lb ai/a lb ai/a	0.75	d	4	bc	0.75	С	1	b

Means followed by same letter do not significantly differ (P=.10, Duncan's New MRT)



## Table 3. Harvest Data

Application Dates: July 6, July 13, July 20, July 29, 2004 Harvest Date: October 7, 2004

Treatment	Rate	Rate Unit	Lint lbs/	A
Untreated Check			670.95	с
STEWARD				
(indoxacarb)	0.104	lb ai/a	1532.68	ab
STEWARD	0.00	15 -:/a	1005.0	_
	0.09	ib ai/a	1605.∠	а
(esfenvalerate)	0.036	lb ai/a		
S-1812	0.15	lb ai/a	1548.36	ab
V-10132	6	fl oz/a	1593.44	а
TRACER (spinosad)	0.063	lb ai/a	1452.32	ab
TRACER (spinosad)	0.044	lb ai/a	1609.77	а
CAPTURE (bifenthrin)	0.067	lb ai/a		
DENIM (emamectin				
benzoate)	0.01	lb ai/a	1508.5	ab
DIAMOND (novaluron)	0.058	lb ai/a	1594.09	а
BIFENTHRIN	0.067	lb ai/a		
KARATE Z (lambda-				
cyhalothrin)	0.033	lb ai/a	1304.67	b
LEVERAGE				
(imidachloprid +				
cyfluthrin)	0.07	lb ai/a	1465.39	ab
KARATE Z (lambda-	a	,	100444	
cyhalothrin)	0.033	lb ai/a	1624.14	а
SIEVVARD (indovacarb)	0.06	lh ai/a		

Means followed by same letter do not significantly differ (P=.10, Duncan's New MRT)



# Table 4.Seasonal Damage 2005

Application Dates: July 8, July 15, and July 25 Evaluation Dates: 12 July (4 DAT), 15 July (7 DAT), 19 July (4 DAT), 22 July (7 DAT), 29 July (4 DAT), and 1 August (7 DAT)

Treatment		Rate	Damaged	Damaged	Damaged	Damaged
Name	Rate	Unit	Terminal	Square	Bloom	Boll
Untreated Check			29 a	28 a	30 a	24 a
STEWARD (indoxacarb)	0.09	LB A/A	6 cd	5 c	7 cd	5 b
STEWARD (indoxacarb)	0.104	LB A/A	4 d	5 c	8 cd	6 b
KN 128	0.09	LB A/A	7 cd	6 bc	7 cd	4 b
Penetrator Plus	0.5	% V/V				
KN 128	0.09	LB A/A	4 d	6 bc	6 cd	4 b
KN 128	0.104	LB A/A	6 cd	9 bc	8 cd	4 b
TRACER (spinosad)	0.067	LB A/A	6 cd	6 bc	9 cd	10 b
BIDRIN (dicrotophos)	0.33	LB A/A	12 bc	8 bc	6 cd	9 b
DISCIPLINE (bifenthrin)	0.0625	LB A/A				
DISCIPLINE (bifenthrin)	0.08	LB A/A	5 d	8 bc	10 cd	6 b
DISCIPLINE (bifenthrin)	0.08	LB A/A	7 cd	7 bc	8 cd	5 b
BIDRIN (dicrotophos)	0.25	LB A/A				
DENIM (emamectin benzoate)	0.01	LB A/A	5 d	8 bc	12 c	7 b
Experimental 1			13 b	13b	16 b	9 b
Double Threat -Bifenthrin	0.08	LB A/A	4 d	2 c	5 d	2 b
Double Threat -Spinosad	0.07	LB A/A				

Means followed by same letter do not significantly differ (P=.10, Student-Newman-Keuls)



# **Table 5. Seasonal Heliothines Found**

Application Dates: July 8, July 15, and July 25 Evaluation Dates: 12 July (4 DAT), 15 July (7 DAT), 19 July (4 DAT), 22 July (7 DAT), 29 July (4 DAT), and 1 August (7 DAT)

Treatment		Rate	Heliothis	Heliothis	Heliothis	Heliothis
Name	Rate	Unit	Terminal	Square	Bloom	Boll
Untreated Check			6a	5a	19a	10 a
STEWARD (indoxacarb)	0.09	LB A/A	1 bc	0 b	Зc	2 b
STEWARD (indoxacarb)	0.104	LB A/A	0 c	1 b	4 c	2 b
KN 128	0.09	LB A/A	1 bc	1 b	Зc	1 b
Penetrator Plus	0.5	% V/V				
KN 128	0.09	LB A/A	1 bc	0 b	4 c	2 b
KN 128	0.104	LB A/A	1 bc	1 b	5 c	1 b
TRACER (spinosad)	0.067	LB A/A	1 bc	2 b	Зc	3 b
BIDRIN (dicrotophos)	0.33	LB A/A	1 bc	1 b	4 c	2 b
DISCIPLINE (bifenthrin)	0.0625	LB A/A				
DISCIPLINE (bifenthrin)	0.08	LB A/A	1 bc	0 b	7 c	2 b
DISCIPLINE (bifenthrin)	0.08	LB A/A	3 b	1 b	4 c	2 b
BIDRIN (dicrotophos)	0.25	LB A/A				
DENIM (emamectin benzoate)	0.01	LB A/A	1 bc	0 b	8 bc	2 b
Experimental 1			3b	1 b	12 b	4 b
Double Threat -Bifenthrin	0.08	LB A/A	0 c	1 b	2 c	1 b
Double Threat -Spinosad	0.07	LB A/A				

Means followed by same letter do not significantly differ (P=.10, Student-Newman-Keuls)



### Table 6. Harvest Data

Application Dates: July 8, July 15, July 25, 2005

Treatment	Rate	Rate Unit	Lint lbs/A
Untreated Check			1064 b
STEWARD (indoxacarb)	0.09	LB A/A	1378 a
STEWARD (indoxacarb)	0.104	LB A/A	1471 a
KN 128	0.09	LB A/A	1461 a
Penetrator Plus	0.5	% V/V	
KN 128	0.09	LB A/A	1466 a
KN 128	0.104	LB A/A	1452 a
TRACER (spinosad)	0.067	LB A/A	1440 a
BIDRIN (dicrotophos)	0.33	LB A/A	1484 a
DISCIPLINE (bifenthrin)	0.0625	LB A/A	
DISCIPLINE (bifenthrin)	0.08	LB A/A	1529 a
DISCIPLINE (bifenthrin)	0.08	LB A/A	1505 a
BIDRIN (dicrotophos)	0.25	LB A/A	
DENIM (emamectin benzoate)	0.01	LB A/A	1465 a
Experimental 1			1304 a
Double Threat -Bifenthrin	0.08	LB A/A	
Double Threat -Spinosad	0.07	LB A/A	1567 a

