2004 BELTWIDE COTTON CONFERENCES, SAN ANTONIO, TX – JANUARY 5-9

PERFORMANCE OF DIAMOND (NOVALURON) FOR CONTROL OF HELIOTHINES AND PLANT BUGS, 2003

P.R. Smith, G.M. Lorenz III, W.H. Robertson, D.Plunkett, and D.R. Johnson
University of Arkansas Cooperative Extension Service
Little Rock, AR
Richard Edmund[2]
DuPont Agricultural Products
Little Rock, AR

Abstract

Pyrethroid resistance in the lepidopteran insects has caused an influx of new non-pyrethroid based compounds. One such compound is Diamond® .83 EC (novaluron), an insect growth regulator. This compound is a newly available compound sold as Diamond. The purpose of this experiment was to test the effectiveness of Diamond with respect to a standard of spinosad (Tracer® 4 L) and cyhalothrin (Karate Z® 2.08 CS) for heliothine control. Significant differences were observed in the performance of Diamond® compared to the standard.

Aside from heliothine activity Diamond also exhibits control of Tarnished Plant Bugs (*Lygus lineolaris* (Pialisot de Benuvois)). Diamond was tested for efficacy against Tarnished Plant Bugs and was compared to two rates of Steward® 1.25 SC + Crop Oil 99SL, two rates of KN-128 1.25 EC + Crop Oil 99SL, Vydate® C-LV 3.77 SL + Asana® XL 0.66 EC, Bidrin® 8 EC, Curacron® 8EC, Karate® Z 2.08 CS, Intruder® 70WP + Vydate® 3.77SL + Crop Oil 99SL, Vydate® C-LV, two rates of Centric® 40WG + Surfactant 90SL, two rates of Intruder® 70WP + Crop Oil 99SL, and two untreated checks. Significant differences were observed in the performance of Diamond® in relation to the other treatments.

Introduction

Heliothine resistance to pyrethroid insecticides has been documented several times in the past few years (Reaper et. al 2001; Payne et. al 2001; Williams et. al 1999). Tank mixing pyrethroids with non-pyrethroids has shown to be effective in controlling the Heliothine complex (Reaper et. al, 2002). However, due to cost of mixing treatments producers are looking for more cost effective stand alone chemical applications that achieve effective control. The purpose of this study was to examine the feasibility of Diamond® as a non-tank mixed application, compared to a tank mixed application of Diamond® and Karate® Z, compared to a standard of spinosad and Karate® Z.

Tarnished Plant Bugs are becoming a major problem in the boll weevil eradication areas for Arkansas farmers and other states across the Mid-South (Kharboutli et. al 1998). However resistance to widely used classes of insecticides has been reported (Hollingsworth et. al 1995). Pyrethroid resistance has also been documented (Robbins et. al 1998). Because of this it has become necessary to look to new means of Tarnished Plant Bug control. One such method is the use of insect growth regulators to accomplish effective control. One such compound, novaluron (Diamond® 0.83EC) has shown to be effective for control of Tarnished Plant Bugs.

Materials and Methods

The Heliothine trial was conducted at Hooker Farms in Jefferson County, AR in 2003. Sure-Grow 521RR was planted on 23 May. The field was planted and afterwards subdivided into plots of 32 rows on 38 inch spacing and 250 feet in length. Plots were setup in a randomized complete block with three replications. Treatments were made according to statewide threshold recommendation. Treatments were applied with a John Deere Hi-Cycle 6000 using a compressed air delivery system 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 8.3 gallons per acre of volume. Treatments were foliar applied on 8 July, 23 July, and 4 August. Observations were conducted on 11 July, 15 July, 21 July, 28 July, 31 July, 7 August, 13 August. Plots were machine picked on October 31. Data were collected from random samples of 50 terminals, 50 squares, and 50 blooms. Insect sampling was conducted using a beat-sheet which was used to sample in 4 locations within each plot. Data were analyzed using Agricultural Research Manager version 6 using Analysis of Variance and LSD (P=0.10)

The Tarnished Plant Bug trial was conducted at Brantley Farms in Lonoke County, AR in 2003. Paymaster 1218 BG/RR was planted on 6 May. On 11 July field was mowed and an 100lbs/A of nitrogen was applied. The field was allowed to regrow and was subdivided into plots 12.67ft x 25ft. Plot were setup in a randomized complete block with four replications. Treatments were applied with a boom sprayer using a CO_2 delivery system and Tee-Jet TXVS-6 nozzles with a 19 inch spacing. Operating pressure was 45 pounds per square inch and 9 gallons per acre of volume. Treatments were applied on 10 September. Observations were conducted on 12 September and 16 September. Data were collected from two randomly selected loca-

tion within each plot using a beat-sheet for a total of 12 row feet. Data were analyzed using Agricultural Research Manager version 6 using Analysis of Variance and LSD (P=0.10)

Results and Discussion

Observing seasonal terminal damage (Fig. 1) the standard (Tracer® and Karate® Z) and the tank mix (Diamond® and Karate® Z) performed statistically better than all three rate of Diamond®. The 0.078 lb ai/a rate of Diamond® performed statistically better than the 0.058 lb ai/a of Diamond® and the 0.039 lb ai/a rate of Diamond®. The 0.058 lb ai/a rate of Diamond® performed better than the 0.039 lb ai/a rate of Diamond®. The seasonal observations of damaged squares (Table 1) showed no statistical difference between all 5 treatments. Observing seasonal damaged blooms (Tab. 1) the standard and the tank mixed showed no statistical difference between both treatments. Both treatments did perform statistically better than the Diamond® non-tank mixed treatments. The higher rate of Diamond® performed statistically better than the middle and low rates. The middle rate performed statistically similar to the low rate with respect to damage blooms. Observing seasonal damaged bolls (Tab. 1) the standard performed statistically better than the other treatments. The tank mix and the high rate of Diamond® performed statistically better the middle and low rates of Diamond®. The middle and low rate showed no statistical difference. Observing seasonal total live larvae located in the terminal, squares, and blooms (Tab. 2) both the standard and the tank-mix performed statistically similar but performed statistically better than all three rates of Diamond®. The high rate and the middle rate of Diamond® performed statistically better than the low rate but did not perform statistically different comparatively. Therefore the low rate had a higher instance of live larvae, statistically. All 5 treatments compared simmillarly with regard to beneficiail populations (Tab. 3). The only statistical significance of data occured with spiders (Tab. 3). All three rates of Diamond® had statistically more spiders than the two tank mixed chemicals. With regard to pest observed there was statistical variability. The highest rate of Diamond® faired statistically best when comparing Tarnished Plant Bug (*Lygus lineolaris* (Pialisot de Benuvois)) number. The middle, low rates of Diamond® and the tank mix of Diamond® and Karate® Z all performed statistically simmilar. The tank mix of Tracer® and Karate® Z had the highest incidence of Tarnished Plant Bugs (Tab. 3). The effictiveness of control of Saltmarsh catapillars (*Estigmene acrea* (Drury)) was statistically simmillar. Cotton Bollworm (*Heliothis zea* (Boddie)) control exhibited statistical significance (Tab. 3). The middle rate of Diamond® performed statistically worst, while the low rate and high rate performed statistically more effectively. The tank mixes of Diamond® and Karate® Z and the mix of Karate® Z and Tracer® performed statistically the most effectively. Yield of seed cotton (Tab. 4) also likewise showed significant statistical differences. The standard (Tracer® and Karate® Z) and the tank mix of Diamond® and Karate® Z n both yielded statistically higher than all other treatments. Both the middle and higher rate of Diamond® statistically significantly out yielded the low rate of Diamond®. Therefore an increased rate of Diamond® will significantly enhance yields. However when tank mixed with Karate® Z, the lower rate of Diamond® (0.039 lbs ai/a) out yielded all treatments of Diamond® alone. Additional information is needed in order to better compare Diamond® efficacy versus the Heliothine complex, and the efficacy versus traditional non-pyrethroids.

For Tarnished Plant Bug control data varied greatly from 3 DAT and 7 DAT (Table 5). Observing total live nymphs and adults data fell into six distinct statistical tiers at 3 DAT. The low rate (0.09 lb ai/a) of experimental compound KN-128 performed statistically best. The second tier consisted of Steward® at 0.09 lb ai/a, Steward® at 0.104 lb ai/a, the high rate of KN-128 at 0.104 lb ai/a, Bidrin® at 0.33 lb ai/a, Diamond® at 6 fl oz/a, and Diamond® at 9 fl oz/a. The next tier consisted of Vydate® tank mixed with Asana® (at .25 lb ai/a and 0.036 lb ai/a, respectively), Karate® Z at 0.03 lb ai/a, one of the untreated checks, Intruder® mixed with Vydate® (at 0.018 lb ai/a and 0.25 lb ai/a respectively), Vydate® at .25 lb ai/a, Centric® at 0.05 lb ai/a, Intruder® at 0.037 lb ai/a, and Centric® at 0.031 lb ai/a. The next tier consisted of only Centric® at 0.05 lb ai/a. The next tier consisted of only Curacron® at 0.25 lb ai/a. The last tier consisted of the other untreated check. At 7 DAT data fell into 8 distinct tiers. The top tier consisted of the 9 fl oz/a rate of Diamond®. The next tier consisted of the 6fl oz/a rate of Diamond®, 0.09 lb ai/a rate of indoxacarb, the 0.09 lb ai/a rate of KN-128, and the 0.104 lb ai/a rate of KN-128. The next tier consisted of the Vydate® and Asana® tank mix, and Centric® at 0.05 lb ai/a. The next tier consisted of Curacron® at 0.25 lb ai/a, and Vydate® at 0.25 lb ai/a. The next tier consisted of Intruder® at 0.05 lb ai/a. The next tier consisted of Intruder® at 0.018 lb ai/a tank mixed with Vydate® at 0.25 lb ai/a. The next tier consisted of Karate® Z at 0.03 lb ai/a, Intruder® at 0.037 lb ai/a, and Centric® at 0.031 lb ai/a. The last tier consisted of both untreated checks. Additional testing will be necessary to further confirm the effectiveness of Diamond® for control of plant bugs.

Acknowledgments

We would like the thank Mr. Chuck Hooker for allowing us to use his land, and Don Plunkett, Jefferson County Extension Agent for his help with observations. We would also like to thank the Brantley's for allowing us to use his field for our research. We would also like to thank Dickie Edmund for his help with observations and for application.

References

Hollingsworth, R.G., D.C. Steinkraus, and N.P. Tugwell. 1995. Insecticide resistance in Arkansas populations of Tarnished Plant Bugs (Heteroptera: Miridae) and tolerance differences between nymphs and adults. J. Econ. Entomol.

Kharboutli, M.S., C.T. Allen, C. Capps, and L. Earnest. 1998. Insecticides for Tarnished Plant Bug control in Southeast Arkansas. *IN* Proceedings Beltwide Cotton Conferences

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, J.D., J.D. Hopkins, D.R. Johnson, G.M. Lorenz, and A.M. Fisher. 2001. Heliothine control in cotton with new chemistry. *IN* Proceedings Beltwide Cotton Conferences. pp. 1122-1125

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

Robbins, J.T., F.A. Harris, R.E. Furr. 1998. Tarnished Plant Bug control in the Mississippi Delta. *IN* Proceedings Beltwide Cotton Conferences. pp. 1197-1998

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 Damaged Plant Structures.
Project Code: 0314
Application Dates: 8 July, 23 July, 4 August
Evaluation Date: 11 July (4DAT), 16 July (9DAT), 21 July (14DAT), 28 July (6DAT), 31 July (9DAT), 7 August (4DAT), 13 August (10DAT)
Evaluation Method: Randomly selected plant from 50 locations in each plot

Treatment and Rate	Damaged Terminals	Damaged Squares	Damaged Blooms	Damaged Bolls
Diamond @ 0.039 lb ai/a	37.67 a	22.67 a	7.33 a	13.67 a
Diamond @ 0.058 lb ai/a	35.33 a	25.67 a	7.67 a	13.67 a
Diamond @ 0.078 lb ai/a	22 ab	27 a	4.33 a	6.33 ab
Diamond @ 0.039 lb ai/a + Karate @ 0.018 lb ai/a	15.67 b	14.33 a	3.33 a	7.33 ab
Tracer @ 0.067 lb ai/a + Karate @ 0.03 lb ai/a	8.67 b	17 a	3.33 a	2.67 b

Means followed by same letter do not significantly differ (P=.10, Duncan's New MRT).
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Table 2. Heliothine Larvae Observed By Plant Location.
Project Code: 0314
Application Dates: 8 July, 23 July, 4 August
Evaluation Date: 11 July (4DAT), 16 July (9DAT), 21 July (14DAT), 28 July (6DAT), 31 July (9DAT), 7 August (4DAT), 13 August (10DAT)
Evaluation Method: Randomly selected plant from 50 locations in each plot

Treatment and Rate	Seasonal Larvae Terminal	Seasonal Larvae Squares	Seasonal Larvae Blooms	Seasonal Larvae Total
Novaluron @ 0.039 lb ai/a	10.00 a	3.33 a	5.00 a	18.33 a
Novaluron @ 0.058 lb ai/a	9.00 ab	4.00 a	2.67 ab	15.67 ab
Novaluron @ 0.078 lb ai/a	8.00 ab	4.33 a	2.00 b	14.33 ab
Novaluron @ 0.039 lb ai/a + Cyhalothrin @ 0.018 lb ai/a	4.33 b	3.00 a	1.33 b	8.67 b
Spinosad @ 0.067 lb ai/a + Cyhalothrin @ 0.03 lb ai/a	4.00 b	3.33 a	1.67 b	9.00 b

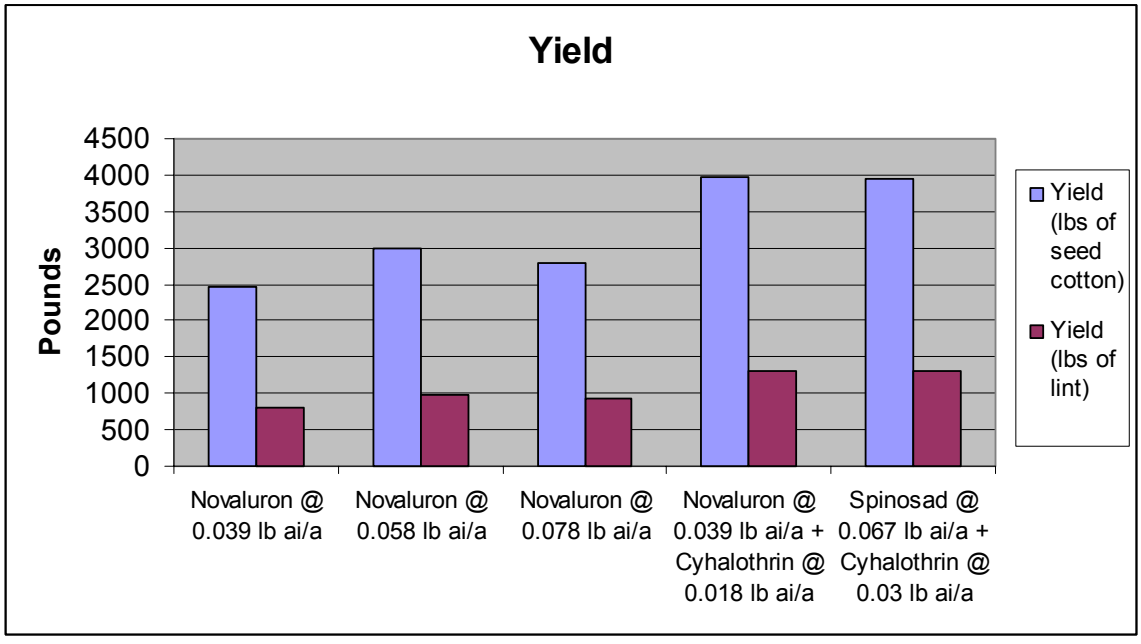
Means followed by same letter do not significantly differ (P=.10, Duncan's New MRT). Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Table 3.1 Beneficial Insects Observed.
Project Code: 0314
Application Dates: 8 July, 23 July, 4 August
Evaluation Date: 11 July (4DAT), 16 July (9DAT), 21 July (14DAT), 28 July (6DAT), 31 July (9DAT), 7 August (4DAT), 13 August (10DAT)
Evaluation Method: 24 row feet sampled

Treatment and Rate	Lacewing	Lady Beetle	Nabid	Spiders	Big Eyed Bug	Syrphid
Novaluron @ 0.039 lb ai/a	1.67 a	36.67 a	3.33 a	54.67 a	5.33 a	0.33 a
Novaluron @ 0.058 lb ai/a	3.67 a	29.67 a	5.67 a	52.67 a	3.67 a	2.33 a
Novaluron @ 0.078 lb ai/a	1.67 a	45.67 a	4.67 a	50.67 a	5.33 a	0.67 a
Novaluron @ 0.039 lb ai/a + Cyhalothrin @ 0.018 lb ai/a	1.33 a	24.67 a	2.33 a	26 b	3.00 a	0.33 a
Spinosad @ 0.067 lb ai/a + Cyhalothrin @ 0.03 lb ai/a	3.33 a	46.00 a	1.67 a	23.33 b	3.00 a	0.67 a

Table 3.2 Pest Insects Observed.
Project Code: 0314
Application Dates: 8 July, 23 July, 4 August
Evaluation Date: 11 July (4DAT), 16 July (9DAT), 21 July (14DAT), 28 July (6DAT), 31 July (9DAT), 7 August (4DAT), 13 August (10DAT)
Evaluation Method: 24 row feet sampled

Treatment and Rate	Tarnished Plant Bug	Saltmarsh	Bollworm
Novaluron @ 0.039 lb ai/a	18.67 ab	1.00 a	12.67 ab
Novaluron @ 0.058 lb ai/a	15.33 ab	.33 a	18.00 a
Novaluron @ 0.078 lb ai/a	11.67 b	1.00 a	11.00 ab
Novaluron @ 0.039 lb ai/a + Cyhalothrin @ 0.018 lb ai/a	12.67 ab	0.67 a	6.67 b
Spinosad @ 0.067 lb ai/a + Cyhalothrin @ 0.03 lb ai/a	23.00 a	0.00 a	2.67 b



Project Code: 0314
Application Dates:
Evaluation Date: 11/3/03
Evaluation Method: Machine picked and weighed

Chart 4. Yield.

Table 5. Efficacy of Various Insecticide for Control of Tarnished Plant Bugs.
Project Code:
Application Dates: 9-10-03
Evaluation Date: 9-12-03 (3DAT) and 9-16-03 (7DAT)
Evaluation Method: Tarnished Plant Bugs counted per two samples of beat sheet per plot for a total of 12 row feet

Treament/Form	Rate lb (AI/acre)	Plant Bug nymphs (3DAT)	Plant Bug adults (3DAT)	Plant Bug TOTALS (3DAT)	Plant Bug nymphs (7DAT)	Plant Bug adults (7DAT)	Plant Bug TOTALS (7DAT)
Steward 1.25SC + Crop Oil Concentrate 99SL	0.09 + 1.00 PT/A	12.6 c	2.4 b	14.96 cd	13.5 ef	3.5 a	16.91 de
Steward 1.25SC + Crop Oil Concentrate 99SL	0.104 + 1.00 PT/A	16.3 c	4.8 ab	21 cd	19.8 def	3.0 a	22.75 cde
KN-128 1.25EC + Crop Oil Concentrate 99SL	0.09 + 1.00 PT/A	11.8 c	2.5 b	14.25 d	9.8 f	4.3 a	14 de
KN-128 1.25SC + Crop Oil Concentrate 99SL	0.104 + 1.00 PT/A	16.8 c	3.3 ab	20 cd	16.8 ef	3.5 a	20.25 de
Vydate C-LV 3.77SL + Asana XL 0.66EC	0.25 + 0.036	31 bc	6.8 ab	37.8 bcd	23 def	4.3 a	27.25 cde
Bidrin 8EC	0.33	14.3 c	5.8 ab	20 cd	13.8 ef	3.0 a	16.75 de
Diamond 0.83EC	6 FL OZ/A	23.5 bc	2.3 b	25.75 cd	11.3 ef	3.3 a	14.5 de
Diamond 0.83EC	9 FL OZ/A	24 bc	2.3 b	26.25 cd	7.3 f	2.8 a	10 e
Curacron 8EC	0.25	63.8 b	7.3 ab	71 b	40.8 c-f	3.0 a	43.75 b-e
Karate Z 2.08CS	0.03	42.3 bc	7.8 a	50 bcd	73 abc	4.8 a	77.75 ab
UTC		51 bc	6.5 ab	57.5 bcd	93.3 a	5.0 a	98.25 a
Intruder 70WP + Vydate 3.77SL + Crop Oil Concentrate 99SL	0.018 + 0.25 + 1.00 PT/A	50.5 bc	6.3 ab	56.8 bcd	56.3 bcd	4.8 a	61 abc
Vydate 3.77SL	0.25	40.3 bc	6.8 ab	47 bcd	43 c-f	4.3 a	47.25 b-e
Centric 40 WG + Surfactant 90SL	0.05 + 0.25	23.8 bc	7.3 ab	31 bcd	22 def	4.5 a	26.5 cde
Intruder 70WP + Crop Oil Concentrate 99SL	0.037 + 1.00 PT/A	48.3 bc	6.3 ab	54.5 bcd	68.8 abc	4.0 a	72.75 ab
Intruder 70WP + Crop Oil Concentrate	0.05 + 1.00 PT/A	51.5 bc	7 ab	58.5 bc	49.3 b-e	3.5 a	52.75 bcd
Centric 40WG + Surfactant 90 SL	0.031 + 0.25	44.8 bc	6.3 ab	51 bcd	71.3 abc	5.8 a	77 ab
UTC		100.5 a	7.3 ab	107.75 a	85.8 ab	5.5 a	91.25 a

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)