2005 Beltwide Cotton Conferences, New Orleans, Louisiana - January 4 - 7, 2005

DIAMOND: EFFICACY OVERVIEW ON TARNISHED PLANT BUGS AND OTHER COTTON PESTS DURING 2004

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Abstract

Diamond™, common name novaluron, is an insecticide in the benzoylphenyl urea class of chemistry. It was recently registered in the U.S.A after acceptance as an Organophosphate Replacement product for cotton. Field-tests during 2004 confirmed earlier results demonstrating activity on immature stages of *Lygus* spp., Lepidoptera (e.g. *Pseudoplusia includens*) and stink bugs (spp.). Activity has been confirmed on *Pseudatomoscelis seriatus* nymphs and will be labeled for the 2005 use season. Research continues across the cottonbelt to further define insect spectrum and best use recommendations.

Introduction

Novaluron is a new generation Insect Growth Regulator (IGR) in the benzoylphenyl urea chemical class. It has broad-spectrum activity against numerous insect species of the orders Lepidoptera, Coleoptera, Hemiptera and Diptera (Ishaaya et al., 1996). The basic manufacturer of novaluron is Makhteshim Agan of North America (Makhteshim Chemical Works). Crompton Corporation is a Development and Marketing Partner. Early in 2002 U.S.E.P.A. granted novaluron Organophosphate Replacement registration status for cotton and pome fruit. These crops, including potatoes, were registered May 21, 2004. Novaluron has very low acute and chronic toxicities to mammals, low toxicities to birds and fish, low impact on beneficial organisms and it quickly degrades in water. Additionally, it can be used as a replacement for carbamates and pyrethroids.

Novaluron acts on immature stages of numerous insect species by inhibiting chitin biosynthesis causing interference with cuticle formation (Ishaaya et al., 1996). In many species novaluron works by ingestion, however contact activity has been observed. High mortality of early instar larvae occurs when treated foliage is ingested or the chemical is absorbed into the immatures through contact. Novaluron also acts as an ovicide. Weiland (2004) showed that nymph mortality of *Lygus hesperus* in a laboratory study can occur with a few days of contact to residues of Diamond. Activity on cotton pests, including the Lepidopteran heliothines, foliage feeding Lepitopterans, plant bugs and stink bugs, has been published and shown to be equivalent to current standard products (Capps and Greene, 2004; Dalrymple and Hinkle, 2004; Greene and Capps, 2003; Johnson et al., 2004; Lorenz et al., 2004; Smith et al., 2004; Weiland, 2004; Weiland and Whitehead, 2002, 2003). Ruberson and Fairbanks (2003) have determined Diamond has little effect on the predatory bug, *Orius insidiosus*. No cross-resistance has been determined with related benzoylphenyl compounds, pyriproxyfen and neonicotinoids (Ishaaya et al., 2003). Usage rates will depend on target species and ranges from 0.039 to 0.09 lbs ai (6 to 14 oz) per acre.

This paper presents additional results from trials conducted in 2004.

Materials and Methods

Senatobia, MS 2004

Diamond 0.83EC at 9 oz/acre and Orthene 90S at 9 oz/acre were evaluated on cotton for tarnished plant bug control. Stoneville 4793 RR cotton was planted and test plots were 13 feet wide by 200 feet long. Treatments were arranged in a randomized complete block design (RCB) with 4 replications. The insecticides were applied on August 6 and 13. First application was made at threshold (≥ 3 bugs/6 row-feet). Infestations at 7 days after each application were determined using a drop cloth and reported as either number of nymphs or adults per 12 row-feet of cotton.

Macon Ridge, LA 2004

In this study, the effects of Diamond at 9 oz/A, Diamond at 9 and 12 oz/A with COC at 1 pt/A, Diamond at 6 oz/A with either Karate Z at 1.6 oz/A plus COC at 1 pt/A or Orthene 90S at 0.28 lb/A plus COC at 1 pt/A, and Orthene 90S at 0.56 lb/A were investigated. Stoneville 4793R cotton was planted and test plots were 26.7 feet wide by 50 feet long. Treatments were arranged in an RCB design with 4 replications. Insecticides were applied on July 6 and

14 using a boom sprayer delivering 6 gallons of water per minute. Total number of nymphs shaken into a drop cloth at 4 random locations in each plot was recorded at various timings after the applications.

Norman Park, GA 2004
Treatments to control stink bugs (a mixture of Southern green, and brown stink bugs) included Diamond at 9 oz/A, Diamond at 12 oz/A plus Bidrin at 6 oz/A, and Bidrin at 8 oz/A. The variety was DPL 444 with plot sizes ranging from 0.6 to 0.8 acres. There were 3 replications for each treatment; the untreated control was not replicated. Treatments were applied on August 9 and 23 at 9 gallons application volume per acre. Number of bolls damaged per 25 assessed was determined at 9 days after the first application and 11 days after the second application. Monitoring was terminated as a consequence of damage inflicted by Hurricane Francis on September 6.

Colquitt County, GA 2004
Diamond at 9 oz/A with COC at 1% (v/v) was evaluated for soybean looper control. The cotton variety, FM 960BR, was planted and plots were 4 rows by 40' in length. Results were taken from 3 replications. Applications were made on July 9 and 20 with a self-propelled high clearance sprayer applying 10 gallons of solution per acre. Larvae in two 6-ft drop cloths were determined in each plot 6 days after the second application.

Corpus Christi, TX, 2004
In this trial Diamond at 6 oz/A, Centric 40WG at 2 oz/A and Intruder 70WP at 0.6 and 0.9 oz/A were evaluated for cotton fleahopper control. Stoneville 5303R variety cotton was planted and plots were 4 rows by 40' in length. Treatments were replicated 4 times in a randomized complete block design. The center 2 rows of a plot were treated on June 9 and 17 in 5.5 gallons per acre application volume. Nymphs of the cotton fleahopper, plus the beneficial insect *Orius insidiosus* (pirate bug), were assessed by counting the number per 20 plant terminals per plot at various timings.

Results

Senatobia, MS 2004 (Table 1)
Diamond reduced the tarnish plant bug nymph population equal to the Orthene standard treatment in this trial. Adult populations were similarly reduced at both sampling times.

Macon Ridge, LA 2004 (Table 2)
At 2 days after the first application, only Orthene sprayed alone had statistically reduced the tarnished plant bug nymph population. However by 6 days, Diamond alone, both Diamond treatments with oil and Diamond plus Karate Z reduced populations significantly to the untreated control. All treatments maintained levels below the control at 8 days after the first application and 6 days after the second application. Neither the higher rate of Diamond nor addition of oil increased performance in this trial. The combination treatments with Diamond at 6 oz/A performed equally to the higher Diamond rates starting at 8 days after treatment.

Norman Park, GA 2004 (Table 3)
Diamond alone and in combination with a low rate of Bidrin, equally controlled the mixed stink bug infestation to the standard, Bidrin. Nine oz/A of Diamond maximized controlled of stink bugs in this experiment.

Colquitt County, GA 2004 (Table 4)
Diamond reduced the soybean looper population to 0.67 larvae per 12 row-feet of cotton 6 days after the last application. The untreated control exhibited 3.33 larvae per 12 row-feet at this time.

Corpus Christi, TX, 2004 (Table 5)
Diamond, Centric and both rates of Intruder effectively controlled cotton fleahopper nymphs at 3 and 6 days after the second application. There were no statistical treatment differences prior to the second application. Both Intruder and Centric lessened pirate bug numbers versus both Diamond and the untreated control at 3 days after the second application (data not shown).

Concluding Remarks

Diamond exhibits a broad spectrum of activity on cotton pests, which includes plant bugs, stink bugs, the heliothine complex, and foliage feeding Lepidopterans. The activity is equal to or more effective than standard control products. Since it affects chitin formation/deposition, only immature stages of these pests are controlled, i.e. nymphs/larvae and eggs. The effective rate range for control of cotton fleahopper will need to be researched during 2005. Research will continue across the cottonbelt to further define insect spectrum and best use recommendations.

Acknowledgments

The authors thank those institutes and consultant organizations that helped establish, monitor and provide results presented here.

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Table 1. Mean number of *Lygus lineolaris* nymphs and adults per 12 row-feet at 7 days after each of 2 applications. (Senatobia, MS 2004).

Treatment	Rate oz/A	Number per 12 row-feet			
		7 DAT1	7 DAT2	7 DAT1	7 DAT2
		Nymphs		Adults	
Untreated		1.6a	5.0a	2.6a	0.6a
Diamond 0.83EC	9	0.6a	0.0b	0.0b	0.0b
Orthene 90S + 0.5% Kinetic @ 0.5% (v/v)	9	0.6a	0.0b	0.0b	0.0b

Means within a column followed by the same letter do not significantly differ (P=0.05, Student - Newman - Keuls).
Treatments below labeled rates are not shown.
Application dates: 6 and 13 August.

Table 2. Mean number of *Lygus lineolaris* nymphs per 4 shake cloths at several sampling times during a 2-application period. (Macon Ridge 2004).

Treatment	Rate oz/A	Number per 4 shake cloths			
		2 DAT1	6 DAT1	8 DAT1	6 DAT2
Untreated		6.8a	3.2a	3.2a	2.2a
Diamond 0.83EC	9	4.0ab	0.8bc	1.0b	0.2b
Diamond 0.83EC + COC @ 1 pt/A	9	3.8ab	0.8bc	1.0b	0.0b
Diamond 0.83EC + COC @ 1 pt/A	12	3.5ab	0.2c	0.8b	0.0b
Diamond 0.83EC + Karate Z + COC @ 1 pt/A	6 + 1.6	3.5ab	0.5c	0.8b	0.2b
Diamond 0.83EC + Orthene 90S + COC @ 1 pt/A	6 + 0.28 (lb)	4.0ab	2.5ab	1.0b	0.5b
Orthene 90S	0.56 (lb)	2.5b	2.0abc	0.3b	0.0b

Means within a column followed by the same letter do not significantly differ (P=0.05,Tukey's HSD).
Treatments below labeled rates are not shown.
Application dates: 6 and 14 July.

Table 3. Mean number of damaged bolls by a mixture of *Nezara vividula* and *Euschistus servus* stink bugs after each of 2 applications. (Norman Park, GA 2004).

Treatment	Rate oz/A	Damaged bolls/25	
		9 DAT1	11 DAT2
Untreated		12.0	13.0
Diamond 0.83EC	9	5.0	3.0
Diamond 0.83EC + Bidrin 8	12 + 6	4.7	2.7
Bidrin 8	8	5.3	4.0

Application dates: 9 and 23 August.

Table 4. Mean number of *Pseudoplusia includens* at 6 days after the 2nd application (Colquitt County, GA 2004).

Treatment	Rate (oz/A)	No. of Larvae/12 row-feet
Untreated		3.33a
Diamond 0.83EC + COC @ 1% (v/v)	9	0.67b

Means within a column followed by the same letter do not significantly differ (P=0.05, LSD).
Unregistered chemicals/treatments are omitted from above.
Application dates: 9 and 20 July.

Table 5. Mean number of *Pseudatomoscelis* seriatus nymphs at 2 assessments after the last of 2 applications. (Corpus Christi 2004).

Treatment	Rate oz/A	Number/100 plants	
		3 DAT2	6 DAT2
Untreated		10.0a	15.0a
Diamond 0.83EC	6	0.0b	0.0b
Centric 40WG	2	0.0b	0.0b
Intruder 70WP	0.6	0.0b	1.3b
Intruder 70WP	0.9	0.0b	0.0b

Means in a column followed by the same letter are not significantly different by ANOVA.
Some treatments and sampling dates omitted for brevity.
Application dates: 9 and 17 June.

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