EARLY-SEASON INSECT CONTROL WITH PROVADO IN THE MISSISSIPPI DELTA Alan Hopkins and Fred Donaldson Field Development Representatives Bayer, Agriculture Division Conway, AR Pineville, LA

Abstract

Provado 1.6 F was registered for use in cotton for the 1995 growing season. University research and extension personnel, consultants and Bayer development and sales representatives were involved in testing and demonstrating the product during its first use season. Low tarnished plant bug infestations in the Mississippi Delta limited extensive testing for that pest. However, some experiments and demonstrations did indicate good to excellent control of tarnished plant bug. Cotton aphid infestations were unusually high during 1995. Several experiments initiated for plant bug control provided excellent insight into the control of cotton aphid with Provado, as these treatments delayed or prevented severe aphid infestations. Provado also provided good to excellent control of cotton aphid when used after the population was established (81% control averaged over 22 trials). In four Delta Region experiments where yield data were collected, multiple applications of Provado provided a 13.8% yield increase over the check or standard. Over 70 Consultant demonstrations were conducted. Consultant observations were overwhelmingly positive with 80% satisfied or very satisfied with Provado for aphid and plant bug control. Most consultants reported Provado as easier on beneficial insects than standard treatments. University personnel, consultants and Bayer personnel documented improved square retention where Provado was used as an early-season treatment.

Introduction

Provado 1.6 F was developed by Bayer under the number NTN-33893 with the common name: imidacloprid. The compound represents the first registra-tion of a new chemistry group known as chloronicotinyl. Imidacloprid acts on the nicotinergic acetylcholine receptor site in the post-synaptic region of the insect nerve and gives excellent control of a broad spectrum of insect pests.

Provado 1.6 F was registered for foliar uses in cotton and other crops in time for use during the 1995 growing season. Initial registration in cotton was for control of cotton aphid (*Aphis gossyppii* (Glover)), *Lygus* spp. including tarnished plant bug (*Lygus lineolaris* (Palisot de Beauvois)) and whitefly species. The labelled rate for Provado 1.6 F is 0.047 lb ai/A (3.75 fl. oz/A).

The benefits of early-season insect control are well documented. Burris, Pavloff, Church and Leonard (1994) recently published results of a three-year study to evaluate several insecticide strategies and found that presquare and prebloom applications of organophosphate and pyrethroid insecticides contributed to early crop maturity and significantly reduced the need for late-season pesticide use. Other conclusions from their work include: prebloom applications significantly reduced plant bug/fleahopper numbers in a year with higher plant bug populations; presquare and prebloom applications consistently increased cotton yields; there was no significant reduction in beneficial arthropods following several applications of insecticides in June. One negative conclusion was that prebloom applications flared aphid counts in July and August. Melville et al. (1982) reported from a 21-year study that earliness (early crop maturity) can be attributed to plant bug control and that full-season insect control (including early-season control) resulted in cotton yield increases 15 of 21 years. Regarding the cotton aphid, Harris (1995, Miss. State Univ., Delta Res. and Ext. Ctr., Stoneville, Ms, personal communication) observed a marked delay in crop development when severe aphid infestations developed in early June (prebloom) in conjunction with drought stress. Harris noted that delay in cotton maturity may subject the crop to greater risk of Heliothine spp. damage later in the season. A delay in maturity may also complicate resistance management of H. virescens. One may also conclude from research published by Andrews and Kitten (1989) that insecticide applications should be initiated at the beginning of aphid infestations to minimize yield losses, although their studies were conducted during boll set.

Experiments and demonstrations were established in 1995 by university personnel, consultants and Bayer personnel to evaluate Provado and provide experience with Provado for control of tarnished plant bug and cotton aphid. Data collected and experience gained in 1995 demonstrate the potential for Provado as an effective tool for early-season insect control in cotton.

Materials and Methods

Provado Programs for Plant Bug Control

A large, non-replicated field experiment was conducted by Bagwell, Burris and Leonard in 1995 at the Panola Plantation near Newellton, LA. Insecti-cide treatment strategies for control of tarnished plant bug were compared. Data on other insects were also collected. Strategy one (Early Control) consisted of 5 applications of Provado 1.6F at 0.044 lb ai/A initiated May 23 at the 4- to 5-leaf stage of cotton development. Sequential applications were made on May 29, June 6, June 16 and July 7. Strategy two (Mid Control) consisted of Vydate 3.77 C-LV + Orthene 90S, (0.25 + 0.25 lb ai/A) applied June 6, Vydate 3.77 C-LV

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(0.25 lb ai/A) applied June 16 and Bidrin 8E + Ovasyn 1.5 E (0.4 + 0.25 lb ai/A) applied July 6. Strategy three (Late Control) was not treated until July 6 when Bidrin 8E at 0.4 lb ai/A was applied. Sweep net samples were taken starting May 25 and continuing weekly until July 11. Data were converted to percent infestation. Thrips (species not defined) and cotton aphids in terminals were counted on June 20. Whole-plant washing procedures were employed on June 20 and July 11. Plant mapping was also conducted on June 20 and July 11.

In other experiments (replicated) by university and Bayer personnel, Provado was evaluated in a program for tarnished plant bug control with two to three applications initiated at the 5th- to 7th-node of cotton development with sequential applications made on a 7- to 10-day interval.

Provado in Established Aphid Populations

Replicated experiments and large field demonstrations were conducted to evaluate Provado for control of established populations of aphids. Twenty -two trials were available with percent control values compared to either the untreated or the standard. Trials were conducted in Arkansas (3), Louisiana (4), Mississippi (8), Tennessee (1), Texas (1), and Oklahoma (5).

Cage and Laboratory Studies

Field cage studies and laboratory data are also mentioned in this report which include plant bug mortality, sub-lethal effects of imidacloprid and *Heliothine* spp. ovicidal activity.

In some instances data are summarized in this report and fully discussed by the original researcher in other manuscripts of these proceedings.

Results and Discussion

Provado Programs for Plant Bug Control

In the study conducted by Bagwell and associates at the Panola Plantation, five applications of Provado (Early Strategy) resulted in fewer thrips, aphids and tarnished plant bugs compared to applications of traditional treatments initiated later (Mid Control) (Table 1). They also observed improved square and boll retention with the Early Control Strategy compared to the Mid Control Strategy (Table 2). Seed cotton yield was slightly higher for the Early Control Strategy compared to the Mid Control Strategy but surprisingly similar to the Late Control Strategy which was only treated once with Bidrin. The Early and Mid Strategies were harvested in mid October while the Late Strategy was harvested over a one-week period in mid September. Different harvest dates as well as lower-than-normal yields and drought may have contributed to a lack of correlation between insect control and yield.

Other experiments where multiple applications of Provado were made for early-season insect control include Luttrell and Parker near Morgan City, MS (3 applications); Johnson and Klein near Coy, AR (3 appl.); Almand, Benoit, MS (3 appl.); Parker, Corpus Christie, TX (2 appl.); and Cleary, Tifton, GA (3 appl.). In each of these trials, plant bugs or fleahoppers (Psallus seriatus) (TX) were the intended pests but populations did not develop except in Texas where fleahoppers and aphids were at treatment level. Early infestations of cotton aphid became severe in the untreated plots of most experiments and were delayed or prevented in the Provado treatments. Improved cotton square retention was reported in treatments with multiple applications of Provado. Yield increases of 10.3% to 39.5% were reported for Provado treatments compared to the untreated (Table 3).

Provado in Established Aphid Populations

Provado was tested for aphid control by universities, consultants and Bayer personnel. Provado provided good to excellent control in 19 of 22 trials where percent control data were available. In two of the three trials with poor results, Provado performed equal to or better than any other treatment in the test. Figure 1 illustrates the frequency distribution for percent aphid control with Provado. Data averaged over 22 trials produced a mean of 81.4% control. As shown in figure 1, the majority of trials (16/22) resulted in greater than 80% aphid control.

Cage and Laboratory Studies

Tugwell and Teague (1995, Univ. of Ark. and Ark. Agri. Expt. Sta., personal communication) reported 72 and 76% mortality of tarnished plant bug after 72 hours exposure to Provado at 0.047 lb ai/A on caged plants (Table 4). In 1994 Tugwell observed similar mortality in a cage study. However, percent control data based on drop cloth counts in the same experiment indicated slightly higher plant bug control than cage study mortality would indicate. Perhaps the most interesting observation was increased square retention in Provado-treated plots compared to Fipronil and Curacron (Fig. 2). Therefore, Provado may be sub-lethally affecting plant bugs and contributing to plant protection more than mortality data indicate.

Sub-lethal effects of imidacloprid have been documented in cotton aphid (Nauen and Elbert, 1994) and green peach aphid (*Myzus persicae*) (Nauen, 1995). Nauen postulated two different and dose-dependent modes of action: one which produces irreversible symptoms at field rates and another revers-ible starvation response as an antifeedant effect at sub-lethal concentrations. His data indicate that the dose resulting in only 15% mortality will at the same time result in a 95% reduction in honeydew production. This effect is reversible if the aphids are removed from exposure and provided an untreated food source.

Dr. Tina Teague (1995, Ark. Agric. Experiment Station / Ark. State Univ., personal communication) conducted

laboratory experiments in 1995 to evaluate sub-lethal effects of imidacloprid on tarnished plant bug. She observed similar effects as Nauen reported with green peach aphid. Tarnished plant bugs were allowed to feed on imidacloprid (.5 ppm). Plant bug survival was reported as 55% and 25% at 4 and 8 days, respectively. Of the surviving plant bugs, less than 15% produced high fecal specks (>5 / individual) 4 days after exposure to imidacloprid was discontinued. Surviving individuals returned to normal after feeding on an untreated food source for 8 days indicating a reversible response to sub-lethal dosages.

Observations which warrant further evaluation include the effects of Provado as an ovicide against *Heliothine* spp. Dr. Gary Elzen (USDA-ARS, Stoneville, MS, personal communication) conducted two experiments to evaluate Provado and other insecticides for ovicidal activity (Table 5). In both trials Provado provided good contact ovicidal control of *Heliothis virescens* compared to the untreated and standard ovicides. Others observed field control of boll weevil with Provado. This will be investigated more fully in future research.

Consultant Demonstrations and Effect on Beneficial Insects

Over 70 consultant demonstrations were conducted in grower fields in the Mississippi Delta. Data collected by consultants and general observations were overwhelmingly positive. The majority of consultants commented in their reports that Provado was easier on beneficial insects than standard treatments. In trials where beneficials data were taken, post-treatment counts were greater or equal to pretreatment counts 7 out of 8 times (Table 6). University trials provided mixed results for effect on beneficial insects. In general, university data indicate an impact on beneficial insects, especially *Geocrus* spp. and *Orius* spp. comparable to Vydate C-LV. Consultant observations of fast resurgence of beneficial insects following Provado should be investigated more fully in future research.

Over 80% of consultants were either satisfied or very satisfied with aphid and plant bug control. Several consultants collected square retention data with 5 to 15% increase in square retention observed. Where yield data were collected by consultants, increases of 88 to 109 lb lint/A were reported. This yield increase is consistent with data reported in Table 3 for multiple applications of Provado.

In several instances, Provado-treated fields were observed to have a much lower incidence of *Heliothine* spp. infestations. However, methyl parathion + Provado resulted in increased *Heliothine* spp. in a demonstration in Mississippi. In light of ovicidal activity previously mentioned and the observation by several consultants indicating lower *Heliothine* spp. infestations following Provado, future studies should be conducted to investigate the potential for Provado to affect *Heliothine* spp.

Summary

Based on previous years research and experience gained in 1995, Bayer will recommend Provado at 3.75 fl. oz/A for control of tarnished plant bug and aphids in the Mississippi Delta. Treatment is recommended when the pest population is at or near threshold. Applications should continue on a 7- to 10- day interval as long as pests or damage persists. For resistance management purposes, no more than three applications should be used.

Future research should provide further documentation of insect control, cotton response to Provado treatments, sublethal effects of Provado and effects on beneficial insects.

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Table 1. Effect of control strategies on early-season pests.

	Thrips			Tarnished Plant Bug		
Treatment	Adult	Immature	Aphids	Adults	Nymphs	
	(N	umber / Five	Plants)	(Percent	Infestation)	
Early Control	2.0	5.9	49.1	1.6	0.2	
Mid Control	7.2	12.5	238.2	2.6	0.5	
Late Control	4.6	16.8	188.1	5.1	2.1	
Bagwell Burris and Leonard LSU Newellton LA - 1995						

All data are seasonal means across all sample dates.

Table 2. Effect of control strategies on square and boll retention and yield.

	Percent Retention 1st Position	Percent Retention 1st Position	Percent Retention 2nd Position	Percent Retention 2nd Position	Seed Cotton Yield/
Treatment	Squares	Squares	Bolls	Bolls	Acre
Early Control	79.5	75.3	42.6	21.9	871.8
Mid Control	52.2	58.6	23.8	17.6	820.6
Late Control	48.9	61.5	25.8	10.9	874.7

Bagwell, Burris and Leonard, LSU, Newellton, LA - 1995.

Square Retention: June 20.

Boll Retention: July 11.

Table 3. Effect of early-season insect control on cotton yield - 1995.

Location	Untreated (Cotton)	Treated Yields -	%Increase	
	Pounds Lint/Acre)			
Morgan City, MS	828.8	913.8	10.3%	
Coy, AR	669.4	743.0	11.0%	
Benoit, MS	768.5	978.5	27.3%	
Tifton, GA	585.9	686.7	17.2%	
Corpus Christie, TX	559.0	780.0	39.5%	

Two to three applications made between 6th node and early bloom.

Table 4. Tarnished plant bug mortality after 72 hrs exposure to Provado 1.6F.

	Rate	Marianna, AR	Jonesboro, AR	
Treatment	(lb ai/A)	(% mortality after 72 hours)		
Control	-	16	15	
Provado	0.047	72	76	
Orthene	0.50	100	100	

Tugwell and Teague, Univ. of Arkansas and Ark. Ag. Expt. Sta. - 1995.

Table 5. Provado Ovicidal Activity - G.W.Elzen, USDA, Stoneville, MS.

	Percent Total Mortality			
	Test 1	Test 2		
Check	31	27		
Provado	78	64		
Baythroid	96	88		
Ovasyn	77	90		
Larvin	93	90		

Total mortality = Egg plus emerging larvae mortality

Test 1 - Pyrethroid susceptible H. virescens.

Test 2 - Pyrethroid resistant H. virescens.

Table 6. Effect of Provado on beneficial insects in consultant demonstrations.

Pre-treatment	Post-treatme	nt				
(Beneficial Insects	s per 100 Sweeps)	DAT	Acres			
8	38	3	30			
6	19	3	25			
6	13	3	15			
12	17	3	15			
11	19	1	17			
17	25	3	15			
7	6	6	78			
6	6	3	50			

Summary of Consultant data from several locations in the Mississippi Delta.



Figure 1. Frequency distribution of percent aphid control in 22 trials across the Southern United States. Data indicate that Provado provided excellent aphid control in a majority of trials. In 2 of 3 trials with poor performance, Provado was equal to or better than the standard.



Figure 2. Tarnished plant bug control and effects on cotton square retention with Provado - Tugwell, 1994 (Data unpublished).