SUMMARY OF RESEARCH RESULTS WITH FIPRONIL FOR CONTROL OF PLANT BUGS ON COTTON

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Abstract

In trials conducted since 1989, foliar sprays of fipronil at rates of 0.038 to 0.05 lbs active ingredient per acre has provided control of *Lygus hesperus* and *L. lineolaris* equal to or better than commercial standards.. Research results summarized confirm activity equal to or superior to commercial standards in both initial and residual control of *Lygus spp*..

Introduction

Plant bugs and Lygus bugs *(Lygus spp.)* are recognized as major pests of cotton throughout the western and mid-south production areas of the United States. The Insect Loss Estimate Committee of the National Cotton Council estimates that in each of the last 7 years, an average of over 3.3 million acres have been treated for these pests (Table 1). In 1995 it was estimated a total of 4,493,424 acres were treated and the total loss in production to these pests was 240,134 bales.

The development of insecticide resistance in populations of *Lygus hesperus* in the Western U. S.(Dennehy. and Russell. 1996) and *Lygus lineolaris* in the Mid-south-(Snodgrass. and Scott. 1988, Snodgrass. 1994, Snodgrass and Elzen. 1995, Pankey et. al. 1995, Snodgrass 1996, Snodgrass and Scott. 1996 and Pankey et. al. 1996) has increased interest in finding new tools for plant bug management in cotton.

In 1996 in parts of the Mississippi Delta, control failures of standard treatments for *L. lineolaris* were common. In some areas farmers have reported higher than normal rates of acephate and bidrin were required to provide any measurable control. Additional reports from areas of early season pyrethroid use were that these compounds bacame ineffective in controlling plant bugs during mid-season. Increased tolerance of plant bugs to this class of chemical insecticides as the season progresses has been demonstrated by Snodgrass and Scott (1996). *Lygus spp*. will likely continue to be a serious problem in US cotton production and the evident widespread presence of insecticide resistance in this pest has created considerable appreciation by growers of the need for new chemistry effective against it.

Discussion

Fipronil has been in development on cotton in the U. S, since 1989. It is currently commercially available for use on cotton in several countries outside the U. S. and commercial introduction in the United States is planned by 1999 under the tradename REGENT7. Previous data reviews by Burris et. al. (1994) Shaw (1995) and Shaw and Yang (1996). have demonstrated fipronil=s activity against *Lygus spp*. on cotton. Tables 2 through 4 present an overview of the data on *Lygus spp*. control from these previous summaries. Scott et. al. (1996) presented data demonstrating the performance of fipronil against a field population of *Lygus lineolaris* which had been confirmed to be resistant to synthetic pyrethroids. (Figure 1)

From 1994-1995, extensive tests were conducted to confirm the effective use rates and to further define the residual performance of fipronil compared to standard treatments for *Lygus spp*. on cotton. These data also allow more complete assessment of fipronil=s specific potential for control of each of the two major species of *Lygus* on cotton. Previous summaries had combined results for *L. hesperus* and *L. lineolaris.* Tables 5 and 6 represent summaries of the data from 1994-1995 on the control of *Lygus lineolaris* and *L hesperus* respectively.

Data in table 5 are the summary of 3 trials in 1994 and 7 trials in 1995. Data in table 6 are the summary of 2 trials in 1994 and 4 trials in 1995. Where sufficient numbers of tests were available, only data on nymphal control was used since this is generally viewed as more representative of the effectiveness of the control for small plot trials on these highly mobile pests. In the case of *L. lineolaris*, combined adult and nymphal counts were used to generate sufficient data points to plot performance over time of the insecticide treatments. Figures 2, 3, 4, and 5 represent the comparative control of *L. lineolaris* following applications of different rates or applications of fipronil compared to standard insecticides. Results presented in tables 5, 6 and 7 and figures 2, 3, 4 and 5 confirmed that fipronil is a highly effective insecticide for the consistent initial and residual control of *Lygus spp*. on cotton.and is equal to or better than the best of the current standard treatments.

1996 data presented here represents trials conducted by Rhone Poulenc in Arizona and Mississippi. Table 7 presents results from two Arizona locations where fipronil was compared with acephate and oxamyl for control of *L. hesperus*. Control was based on sweep net samples

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compared to the untreated plot. Both an EC and WG formulation of fipronil were tested. Both formulations provided control equal to or superior to both standards.

Table 8 presents data from Leland, MS on adult and nymphal control of *Lygus lineolaris* 2 days after each of two applications of fipronil, cypermethrin and methyl parathion. Adult and nymphal numbers were determined by sampling 6 row ft. with a standard 3 ft. beat cloth. After two applications, only fipronil at 0.038 resulted in statistically significant reductions in nymphal numbers.

Table 9 presents data from two caged studies on *Lygus lineolaris* conducted at Leland, MS. Field collected *L. lineolaris* adults were caged on treated plants on the day of application in test 96I39. In test 96I25, insects were caged on the plant 24 hrs. after the first application and on the day of the second application after spray deposits had dried. In both trials, fipronil at both rates tested was superior to the standard oxamyl treatment. Placing insects on the plants the day after application resulted in lower mortality for all treatments.

Summary

Field and laboratory trials since 1989 have demonstrated excellent efficacy of fipronil for control of *Lygus spp*. in cotton. As a new class of chemistry, fipronil could play an important role in cotton insecticide resistance management. Current early season and mid-season use of organophosphate and synthetic pyrethroid insecticides for boll weevil, thrips, whitefly and plant bug control frequently results in diminished performance of these classes of insecticides in mid and late season for control of aphids, tobacco budworm and plant bugs. Availability of a different class of chemistry for control of thrips, plant bugs and boll weevil would allow much greater flexibility in implementing recommended insecticide resistance management programs for *Lygus spp*, bollworm, tobacco budworm, whitefly and aphids in most parts of the cotton belt. Availability of a new class of insecticide for control of plant bugs would result in fewer applications of insecticides for these pests.

Acknowledgments

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Orthene7 is a registered trademark of Monsanto Company for acephate insecticide.

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Guthion7 is a registered trademark of the Parent Company of Furbenfabriken Bayer GmbH,Leverkusen for azinphosmethyl insecticide.

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Curacron7 is a trademark of Ciba-Geigy Corporation for profenofos insecticide.

REGENT7 is a registered trademark of Rhone Poulenc for fipronil insecticide.

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Table 1. Insecticide use estimates for control of *Lygus spp*. on cotton, 1989-1995.

YEAR	ACRES TREATED (Lygus spp)
1995	4,493,424
1994	6,776,785
1993	1,816,323
1992	2,468,280
1991	4,319,455
1990	1,974,846
1989	1,748,618
7 yr. mean	3,371,104

Table 2. Percent control of *Lygus sp*. with fipronil in caged studies 1989-1994. Shaw and Yang (1996).

Treatment*	Rate*	Number of Trials	Mean % Control
Fipronil	0.025	1	87
Fipronil	0.038	6	84
Fipronil	0.05	1	94
Curacron®	0.25	1	57
Vydate®	0.25	3	52
M-Parathion	0.25	1	36
Dimethoate	0.2	4	100
Imidacloprid	0.044	1	81

*Treatments were applied as foliar sprays using standard spray table practices. Rates are in lbs. active per acre.

Table 3. Percent control of *Lygus sp*. with fipronil at 0.038 lbs. ai./a. compared with standard treatments in field studies 1989-1994. Shaw and Yang (1996).

Treatment	Rate	% Control					
Fipronil	0.038	67	91	68	84	84	84
Orthene	0.25	55					
Curacro	0.25		74				
Capture®	0.060			86			
Admire®	0.022				81		
Admire®	0.044					86	
Vydate®	0.250						76
# of trials		1	1	1	1	1	1

*Treatments were applied as foliar sprays using standard application practices. Rates are in lbs. ai./a.

Table 4. Percent control of *Lygus sp*. with fipronil at 0.05 lbs. ai./a. compared with standard treatments in field studies 1989-1994. Shaw and Yang (1996).

Treatment	Rate	% Control					
Fipronil	0.050	58	91	81	89	88	88
Orthene®	1.000	81					
Curacron®	0.250		49				
Capture®	0.060			86			
Admire®	0.022				81		
Admire®	0.044					51	
M. Para. 4E	0.250						44
# of trials		1	2	1	1	2	2

*Treatments were applied as foliar sprays using standard application practices. Rates are in lbs. ai./a.

Table 5: Percent control of adult and immature *L. lineolaris* at indicated days following application of fipronil and standard insecticides. 1994-1995.

	Days after treatment						
TREATMENT	2	3	4	5	6	7	8
fipronil 0.05 lbs. ai/A	81	69	54	58	22	51	30
fipronil 0.038 lbs. ai./A.	67	*	75	41	17	30	*
acephate 0.05 lbs ai./A.	*	76	55	64	22	47	21
imid. 0.047 lbs. ai./A.**	*	*	50	*	*	*	28
No. OF DATA POINTS							
fipronil 0.05 lbs. ai/A	3	2	5	1	1	2	3
fipronil 0.038 lbs. ai./A.	1	*	2	1	1	2	*
acephate 0.05 lbs ai./A.	*	1	3	1	1	1	3
imid. 0.047 lbs. ai./A**	*	*	3	*	*	*	3

*No data reported for treatment at that interval.
**imidacloprid

Table 6: Percent control of immature *L. hesperus* at indicated days following application of fipronil and standard insecticides. 1994-1995.

	Days after treatment									
TRT.	2	5	6	7	11	12	14	15	16	21
bif. 0.06**	92	100	*	84	*	*	95	100	85	74
fip. 0.038***	86	100	97	83	94	94	77	100	100	34
fip. 0.05****	88	100	97	89	100	100	72	100	100	92
# DATA POINTS										
bif. 0.06**	1	1	*	1	*	*	2	1	1	1
fip. 0.038***	3	1	4	3	2	1	3	1	1	1
fip. 0.05****	3	1	4	3	2	1	3	1	1	1

*No data reported for treatment at that interval.
**bifenthrin = CAPTURE® 2 EC 0.06 lb ai/A
***fipronil 0.038 lb ai/A
****fipronil 0.05 lb ai/A

Table 7: Percent Control of *Lygus hesperus* nymphs at indicated days after treatment at two Arizona locations. Deeter, Yuma and Harquahala, AZ 1996.

TREATMENT	Harq. 2 DAT*	Harq. 5 DAT*	Yuma 2 DAT*
REGENT® 2.5 EC 0.05 LBS ai./A.	94.8	94.3	92
REGENT® 80 WDG 0.05 lbs. ai./A.	91.4	96.2	80
acephate(Orthene®) 1.0 lbs. ai/A	87.9	98.1	95
oxamyl (Vydate® 8EC) 0.125 lbs. ai./A.	81.1	86.8	85

*DAT= days after application.

Table 8: Number of *Lygus lineolaris* adults and nymphs per 6 row ft. at indicated days after treatment , R. A. Shaw; Leland, MS 1996.

	3 DAT 1		3 DAT 2	
Treatment	adults	nymphs	adults	nymphs
UTC	0.3a	3.5a	1.0a	6.5a
cypermethrin 0.055 lbs. ai./A.	0.8a	3.5a	1.3a	4.0ab
methyl parathion 0.5 lbs. ai./A.	0.5a	2.8a	0.8a	3.8ab
fipronil 0.038 lbs. ai./A.	0.3a	4.3a	1.0a	2.0b

Means followed by the same letter do not differ significantly (P=.05, Duncan's MRT)
*DAT= days after application.

Table 9: Percent Control of *Lygus lineolaris* adults at indicated days after treatment , B.K. Rowe; Leland, MS 1996.

	Test 96I39	Test 96I25	
Treatment	3 DAT	3 DAT 1	3 DAT 2
fipronil 0.022 lbs. ai./A.	82a	13c	82a
fipronil 0.044 lbs. ai./A.	79a	54a	100a
oxamyl 0.026 lbs. ai./A.	38c	21bc	34cd

Means followed by the same letter do not differ significantly (P=.05, Duncan's MRT)
*DAT= days after application.

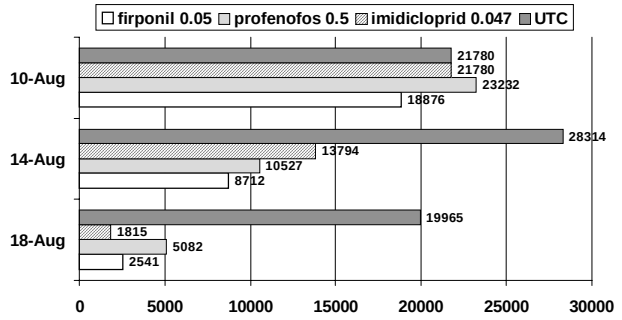

Figure 1. Number of plant bugs per acre following insecticide treatments applied Aug. 8, 11 and 15. Scott et. al (1996)

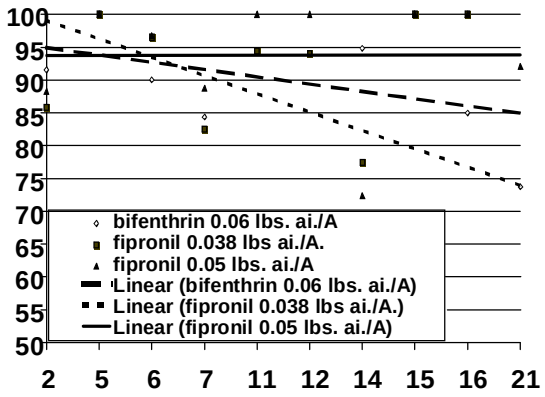

Figure 2. Percent control of immature *L. hesperus* at indicated days following application of fipronil and standard insecticides

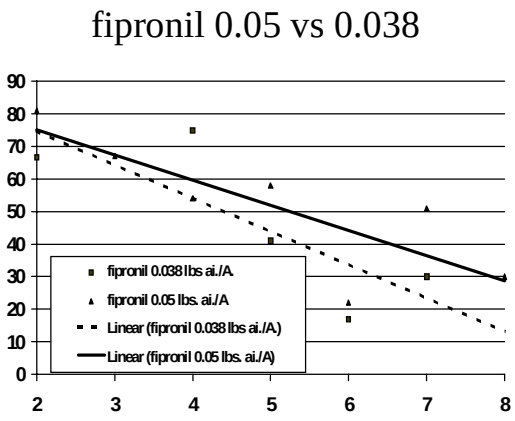

Figure 3. Percent control of iadult and immature *L. lineolaris* at indicated days following application of fipronil and different rates.

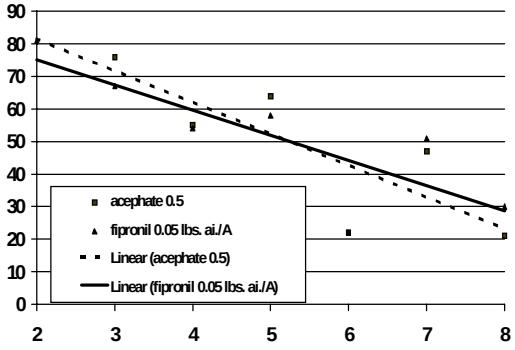

Figure 4. Percent control of adult and immature *L. lineolaris* at indicated days following application of fipronil and acephate.

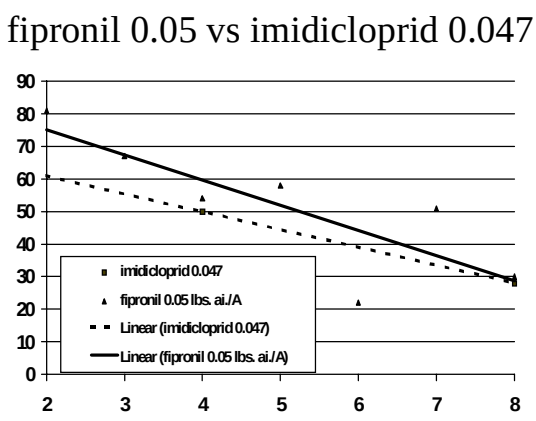

Figure 5. Percent control of adult and immature *L. lineolaris* at indicated days following application of fipronil and imidicloprid.