PERFORMANCE SUMMARY OF FIPRONIL INSECTICIDE ON COTTON

Richard Shaw, Senior Field Development Scientist
H. S. Yang, Technical Development Manager
Rhone Poulenc Ag. Company
Madison, MS
Research Triangle Park, NC

Abstract

In trials conducted since 1989, foliar sprays of fipronil have provided control equal to or better than commercial standards for thrips, boll weevils and plant bugs at rates as low as 10 times less than the commercial standards. The spectrum of pests controlled by fipronil offers potential for fipronil to replace mixtures of more than one insecticide when combinations of these species reach damaging numbers at the same time..

Introduction

Fipronil insecticide belongs to the novel chemistry class, phenylpyrazoles, discovered by Rhone-Poulenc. The insecticide has been in development since 1989. Fipronil is unique among cotton insecticides in its mode of action in that it affects the GABA neurotransmission system in the insect. Mode of entry of the insecticide into the insect is either by contact or ingestion depending upon the insect species.

Fipronil has been evaluated on cotton in the United States since 1989. Sufficient data has been developed to identify 4 important uses for the product on cotton;

1. As an in-furrow at-planting spray for thrips control.
2. As an early season foliar spray for control of thrips.
3. As a foliar spray for control of plant bugs (*Lygus sp.*)
4. As a foliar spray for boll weevil control.

These 4 uses represent important pest control challenges for U. S. Cotton Producers. Table 1 presents estimates by The National Cotton Council's Insect Loss Committee of the annual cumulative treated acres for these pests over the last 6 years. Availability of more effective insecticides, broader selection of insecticides and insecticides with multiple pest activity could help reduce the total cumulative treated acres as well as the cost per acre for treatment.

Product Characteristics

Fipronil possesses unique characteristics and advantages when compared to many commercial cotton insecticides. For several reasons, fipronil use could result in a significant reduction in the total amount of active ingredients (ai) applied to cotton in the United States. Fipronil will be applied at much lower rates than the commonly used standard insecticides for the pests controlled by fipronil. (approximately 0.1 lbs. ai/A vs 0.9 lbs. ai./A for in-furrow treatments of Orthene® and 0.025 to 0.05 lbs. ai./A vs .25 to .5 lbs. ai./A for foliar sprays of Guthion®, Methyl Parathion or Orthene). The pest control spectrum of fipronil offers the opportunity to utilize a single product to control multiple pest species that often reach damaging numbers at the same time but which presently require tank mixing two insecticides to obtain acceptable control of both. (thrips & plant bugs early season, plant bugs and boll weevil mid-season).

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 and plant bug control frequently results in diminished performance of these classes of insecticides in mid and late season for control of aphids, bollworms and tobacco budworms. Availability of a different class of chemistry for control of thrips, plant bugs and boll weevils would allow much greater flexibility in implementing recommended insecticide resistance management pro-grams for bollworms, tobacco budworms and aphids in most parts of the cotton belt.

Material and Methods

Data supporting the use of fipronil on thrips, plant bugs and boll weevils presented in this summary were abstracted from 49 documents generated since 1989 by Rhone Poulenc, university researchers and contract research entomologists. In the following performance tables where results from individual tests are presented, trials are referenced by the State and year the trial was conducted.

Thrips control from at-planting treatments was evaluated by counts of the number of immature thrips per plant during the first 4 to 5 weeks after emergence. Table 2 presents results from tests with fipronil applied in-furrow on cotton. Only trials where thrips numbers reached more than 1 per plant in untreated plots are presented. Trials to determine the activity of fipronil as a foliar spray for thrips (table 3) were generally conducted on cotton 2 to 6 weeks after emergence when thrips had reached economically damaging levels. Trials where insect numbers did not reach damaging numbers in untreated plots were not included in this summary. When multiple evaluation dates were reported the percent control was determined utilizing the mean of all evaluation dates compared to the untreated.

Fipronil has been evaluated for control of plant bug (*Lygus sp.*) in caged studies, Table 4, and in small plot field studies, Tables 5 and 6. In caged studies, plants were treated in the field or in the laboratory on a spray table then immature plant bugs (Table 4) or lab reared adult boll

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:x-x (1996)
National Cotton Council, Memphis TN

weevils (Table 7) were confined on the treated plants. Most of the percent control numbers in Tables 4 and 7 represent the mean of 24 and 48 hour mortality observations. Data from field studies on plant bugs (Tables 5 and 6) and boll weevils (Table 8) is divided into individual comparisons with specific commercial standards and data from plant bug studies is further divided by fipronil rate in tables 5 and 6. Data presented in Table 8 represents several field studies evaluating multiple application, season-long control programs under heavy boll weevil pressure.. These trials utilized 4 to 5 applications beginning at early square formation and continuing through mid-season. Data reported is the seasonal mean percent reduction in square damage by boll weevil..

Results and Discussion

Thrips

Fipronil at 0.1 to 0.15 lbs ai./A in-furrow has consistently provided acceptable reductions in thrips numbers compared to untreated plots and has been comparable in performance to the standard treatment of 0.9 lbs. ai./A Orthene. (Table 2). Data in Table 3 supports that 0.025 to 0.038 lbs. ai./A Fipronil provides thrips control comparable to standards of 0.20 lbs. ai./A Orthene or 0.20 lbs. ai./A Bidrin and in a single trial was superior to the recently registered product Admire®.

Plant Bugs

The available caged study data presented in table 4, indicate fipronil is highly effective for control of plant bugs at rates as low as 0.038 lbs ai./A. Small plot field studies with fipronil for plant bug control (Tables 5 and 6) have generally confirmed results from caged studies. These data suggest that the 0.038 lbs. ai./a. is slightly less effective than the 0.05 lbs. ai./a. rate. With the exception of a single trial where Orthene at 0.1 lbs. ai./a. was the standard, Fipronil at 0.05 lbs. ai./a. provided control of plantbugs equal to or superior to the standards.

Boll Weevil

Cage studies with fipronil for boll weevil control, Table 7, have indicated potential for control of this pest at rates as low as 0.025 lbs. ai./A.

Several field studies evaluating multiple applications, season-long control programs under heavy boll weevil pressure have been conducted with fip-ronil (Table 7). Results support that 0.05 lbs. ai./A fipronil is highly efficacious against boll weevil and is equal to or superior to standard treatments.

Summary

Research conducted by university, USDA and Rhone Poulenc investigators since 1989 has demonstrated excellent fipronil efficacy against thrips, plant bugs and boll weevils on cotton. These three pests have resulted in cumulative insecticide treated acres in excess of 23,000,000 per year over the last 6 years. In-furrow and foliar sprays of fipronil have provided control equal to commercial standards for these pests at rates as low 10 times less than the commercial standards. The spectrum of pests controlled by fipronil offers potential for fipronil to replace mixtures of more than one insecticide when combinations of these species reach damaging numbers at the same time. In areas where plant bugs and boll weevil or thrips and plant bugs occur at damaging levels at the same time, fipronil offers the opportunity to eliminate at least one insecticide application. In most instances several applications of one or more insecticides would be eliminated thus reducing total production costs, applicator exposure and environmental exposure.

In addition, fipronil can play an important role in insecticide resistance management programs. By offering an alternative chemical class for use in early or mid-season, availability of fipronil would allow IPM specialists to alternate away from chemical classes for which resistance potential is present. Current use of pyrethroids for plant bugs has reduced late season performance of these compounds for control of *Heliothis*. Early season use of organophosphates has reduced efficacy of these compounds for control of mid and late season plant bug infestations. In cases where the insecticide resistance has not caused total insecticide failures, reduced efficacy has resulted in increased crop damage, increased numbers of insecticide applications and increased application rates for adequate control.

The combination of fipronil's excellent insecticidal efficacy, flexibility of application, low use rate, unique chemical class, and pest spectrum offers a valuable new tool to future pest management programs on cotton.

Acknowledgments

Orthene® is a registered trademark of Monsanto Company for acephate insecticide.

Capture® is a registered trademark of FMC Agri Chemical Group for bifenthrin insecticide.

Vydate® is a registered trademark of DuPont.

Guthion® is a registered trademark of the Parent Company of Furbenfabriken Bayer GmbH,Leverkusen.

Admire® is a registered trademarks of Miles Corp.

Curacron® is a trademark of Ciba-Geigy Corporation.

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Table 1. Insecticide use estimates for major cotton pests controlled by fipronil.

YEAR	*BOLL WEEVIL*	*LYGUS*	*THRIPS*	*TOTAL*
1994	19,318,839	6,776,785	1,306,682	27,402,306
1993	21,767,889	1,816,323	3,186,164	26,770,376
1992	16,300,892	2,468,280	5,664,613	24,433,785
1991	7,082,644	4,319,455	14,775,624	26,177,723
1990	4,541,949	1,974,846	2,821,445	9,338,240
1989	23,160,445	1,748,618	3,594,618	28,503,681
6 YR MEAN	15,362,110	3,184,051	5,224,858	23,771,019

Table 2. Number of thrips per plant 0-4 weeks. after in-furrow applications of fipronil vs. Orthene.

		1991-1993				
Treatment	Rate*	LA91	LA93	LA93	MS93	NC93
Fipronil	0.1	0.38	4.75	0.99	1.97	3
Fipronil	0.15	0.13			1.53	
Orthene®	0.90	0.28	5.19	0.8	1.73	0.25
UTC		2.25	9.38	2.5	8.3	5.3

		1994			
Treatment	Rate*	TN94	MS94	LA94	AL94
Fipronil	0.1	0.42	0.41	1.06	1.03
Fipronil	0.15			1.3	
Orthene®	0.90	0.62	0.85		1.26
UTC		3.68	1.54	5.9	4.41

*Treatments were applied as in-furrow sprays using standard application practices. Rates are in lbs. active per acre.

Table 3. Percent control of thrips following foliar insecticide applications.

Treatment*	Rate*	Number of Trials	Mean % Control
Fipronil	0.025	7	75
Fipronil	0.038	9	78
Orthene®	0.20	7	82
Dicrotophos	0.20	4	79
Admire® 2F	0.022	1	56

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

Table 4. Percent control of *Lygus sp*. with fipronil in caged studies.

Treatment*	Rate*	Number of Trials	Mean % Control
Fipronil	0.025	1	86.5
Fipronil	0.038	6	84.3
Fipronil	0.05	1	94
Curacron®	0.25	1	57
Vydate®	0.25	3	51.83
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 5. Percent control of *Lygus sp*. with fipronil at 0.038 lbs. ai./a. compared with standard treatments in field studies.

Treatment	Rate	% Control					
Fipronil	0.038	67.0	91.0	68.0	84.0	84.0	84.0
Orthene®	0.250	55.0					
Curacron®	0.250		74.0				
Capture®	0.060			86.0			
Admire®	0.022				81.0		
Admire®	0.044					86.0	
Vydate®	0.250						76.0
# of trials		1	1	1	1	1	1
# Fipronil = OR +		1	1	0	1	0	1

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

Table 6. Percent control of *Lygus sp*. with fipronil at 0.05 lbs. ai./a. compared with standard treatments in field studies.

Treatment	Rate	% Control					
Fipronil	0.05	58.0	91.0	81.0	89.0	87.5	87.5
Orthene®	1.00	81.0					
Curacron®	0.25		48.5				
Capture®	0.06			86.0			
Admire®	0.02				81.0		
Admire®	0.04					50.5	
M. Para. 4E	0.25						43.5
Vydate®	0.25						
# of trials		1	2	1	1	2	2
# Fipronil = OR		0	2	0	1	2	2

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

Table 7. Percent control of boll weevil with fipronil in caged studies.

Treatment*	Rate*	MS92	MS92	MS94
Untreated		0	18.35	0
Fipronil	0.025	90	61.65	96.5
Fipronil	0.038	100	75	98.5
Fipronil	0.05	96.65	71.65	
Vydate®	0.25	100	56.65	95

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

Table 8. Percent reduction in square damage by boll weevil following treatments with fipronil at 0.05 lbs. ai./a. compared with standard treatments in field studies.

Treatment	Rate	% Reduction in damage					
Fipronil	0.050	54.8	55.9	54.2	62.8	54.8	54.5
Vydate®	0.125	4.8					
Vydate®	0.250		49.2				
Methyl Parathion	0.250			41.1			
Methyl Parathion	0.500				47.2		
Guthion®	0.125					15.5	
Guthion®	0.250						42.9
# OF TRIAL		2	4	4	3	2	7
# FIPRONIL = OR +		2	3	4	3	1	6

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