PERFORMANCE OF LEVERAGE 2.7 SE IN THE MISSISSIPPI DELTA

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Abstract

LEVERAGE 2.7 SE™ Insecticide is a new broad-spectrum insecticide from Bayer Agriculture Division. LEVERAGE contains two proven active ingredients: cyfluthrin (1.1 lb. ai/gal.) and imidacloprid (1.6 lb. ai/gal.) with two distinctly different modes of action. Two modes of action not only broaden the insect control spectrum with LEVERAGE but also reduce the potential for insecticide resistance development. Therefore, LEVERAGE is a good choice for managing resistance of certain pests such as plant bug (*Lygus* species) which is susceptible to both active ingredients. LEVERAGE will be recommended at 3 to 3.75 oz./A on non-*Bt* cotton and 3.0 oz./A on *Bt* cotton. Research and demonstration trials conducted by university personnel, cotton consultants, and Bayer personnel indicated excellent performance of LEVERAGE against several important insect pests of cotton including thrips (several species including *Frankliniella fusca*), cotton aphid (*Aphis gossypii*), tarnished plant bug (*Lygus lineolaris*), bollworm (*Helicoverpa zea*), boll weevil (*Anthonomus grandis*) and bandedwinged whitefly (*Trialeurodes abutiloneus*). The potential of LEVERAGE for crop protection was also demonstrated by improved square retention and improved cotton yield compared to other insecticides and untreated plots.

Introduction

A wide variety of insect pests may infest cotton and result in economic loss (Williams 1999). According to Williams, arthropod pests reduced overall yield by 7.98% across the U.S. cotton-growing region in 1998. The five most damaging pests across the cotton belt were: 1) Heliothine complex (bollworm and tobacco budworm (Heliothis v*irescens*)) (of those, 70% were bollworm), 2) Boll weevil, 3) *Lygus* species, 4) Thrips and 5) cotton aphid. Closer examination of Williams' report reveals the same five pests are the most economically important in the Mid-South States of Arkansas, Louisiana, Mississippi, Missouri and Tennessee; however, thrips and cotton aphids are reversed in order of importance.

New technology such as *Bt* cotton and advancement of Boll Weevil Eradication Programs has altered insect control strategies in the Mid-South. Although *Bt* cotton is a very effective technology for control of tobacco budworm and other caterpillar pests, insect pests once considered secondary have increased in importance due to fewer sprays and less coincidental control of these pests on *Bt* cotton (Bell et. al. 1999, Meyer & Smith 1999). Yield increases have also been documented where pyrethroid insecticides have been used to supplement insect control on *Bt* cotton (Lambert et al. 1997, Mink et al. 1997, Hopkins et. al. 1998, Bell et. al. 1999, Capps et. al. 1999). Other pests such as aphids and whiteflies have also become more prevalent where intensive insecticide sprays are used for boll weevil eradication (Layton et. al. 1999).

In recent years, insecticides developed for use on cotton have been more specific for target pests. This may be helpful for preserving predatory insects (Holloway et. al. 1999) but limits a cotton grower's ability to control a complex of insect pests. Under practical conditions, insect management decisions must be made for a complex of insect pests. Therefore, there is a need for a broad-spectrum insecticide to control such a pest complex.

LEVERAGE 2.7 SE Insecticide is a new broad-spectrum insecticide from Bayer Agriculture Division. LEVERAGE is the only insecticide product currently recommended for control of all five of the most important insect pests on cotton. Because LEVERAGE combines the proven insecticidal activity of cyfluthrin and imidacloprid, with two distinctly different modes of action, it is an excellent choice for broad-spectrum insect control on cotton and may also be helpful for managing resistance of certain pests susceptible to both active ingredients.

Materials and Methods

Data presented in this manuscript are from university researchers and extension specialists, crop consultants and Bayer personnel in Arkansas, Louisiana, Mississippi, Missouri and Tennessee (Table 1). Most trials were conducted using standard insecticide evaluation techniques in randomized complete block designs; however a few large-plot demonstrations were also conducted in grower fields without replications. Results presented here represent data on the efficacy of LEVERAGE against the five most important insect pests of cotton in the Mid-South: bollworm, boll weevil, tarnished plant bug, cotton aphid, and thrips. Evaluation of LEVERAGE for control of bandedwinged whiteflies is also included.

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Results and Discussion

Bollworm Control

Bollworm is the most important insect pest in cotton (Williams 1999). Results from university testing in the Mid-South indicate excellent control of bollworm with LEVERAGE (Table 2). Data indicate other products such as pyrethroids provide effective control of bollworm. LEVERAGE offers an advantage when other pests such as plant bug and aphid are at economic levels in a complex with bollworm.

Boll Weevil Control

For areas of the Mid-South outside the eradication zones, the boll weevil remains an economically important pest of cotton. Boll weevil control with LEVERAGE was evaluated in Bayer trials in 1998 and University of Arkansas trials in 1998 and 1999. Results indicate good to excellent control of boll weevil with LEVERAGE (Table 3).

Tarnished Plant Bug Control

Excellent control of tarnished plant bug was observed for LEVERAGE compared to untreated plots (Table 4). Data also indicate LEVERAGE provides better plant bug control than either cyfluthrin or imidacloprid alone. Tarnished plant bugs feed on young squares and cause them to abscise from the plant (Pack and Tugwell 1976). Therefore, improved retention of small squares is a useful measure of plant bug control. Plant mapping data from one trial in 1998 and two trials in 1999 illustrate the efficacy of LEVERAGE for plant bug control. LEVERAGE improved retention of small squares in 1998 and 1999 trials conducted at the Bayer Research Station near Benoit, Mississippi (Table 5). Plant mapping data from Dr. Gary Lentz at the University of Tennessee also indicated excellent square retention following LEVERAGE compared to standards and untreated plots.

Cotton Aphid Control

LEVERAGE provided excellent control of cotton aphid in trials conducted in 1998 and 1999 (Table 6). The cotton aphid is an extremely important pest in Mid-South cotton. Significant yield losses have been documented from aphid infestations (Harris et. al. 1992) in cotton. Layton et. al. (1999) observed increased aphid populations following Malathion ULV sprays for boll weevil eradication. Therefore, growers in the first years of boll weevil eradication should be prepared to control aphids with insecticide sprays.

Thrips Control

Limited data are available for thrips control with LEVERAGE. However, good control was achieved where LEVERAGE was evaluated as a foliar treatment for thrips control (unpublished data). Soil- and seed-applied insecticides are more effective than foliar sprays as the primary means of protecting cotton seedlings from thrips damage. LEVERAGE may be useful for this pest if a grower neglects thrips control options at planting or if thrips populations persist longer than usual following the use of insecticides at planting.

Bandedwinged Whitefly Control

As observed for the cotton aphid, bandedwinged whitefly populations may also be induced by malathion sprays in the boll weevil eradication areas (Layton et. al. 1999). Limited data indicated good to excellent control of bandedwinged whitefly with LEVERAGE. Dr. Ralph Bagwell of Louisana State University observed good control in a large-plot demonstration compared to other standard insecticides (personal communication). Jeff North, North Ag. Consulting observed 93% and 70% control of bandedwinged whitefly at two locations in Mississippi, when LEVERAGE was used at 4 oz/A and 3.2 oz/A, respectively (personal communication).

Multiple Pest Complex

Consultants and other pest management advisors must make insect management decisions when several pests occur in a complex. In 1999, selected consultants demonstrated the performance of LEVERAGE against a multiple pest complex in the Mid-South. The most common pest complex reported by consultants included bollworm, boll weevil, plant bug, aphid and bandedwinged whitefly. Consultants reported excellent performance of LEVERAGE against these pests.

LEVERAGE on *Bt* Cotton

Although *Bt* cotton provides good control of several caterpillar pests and is important technology for managing insect pests in the Mid-South, control of bollworm may not be adequate under high infestations. Studies have shown a yield response when pyrethroids were used to supplement control of bollworm and other insect pests on *Bt* cotton (Lambert et al. 1997, Mink et al. 1997, Hopkins et. al. 1998, Bell et. al. 1999, Capps et. al. 1999). Mann and Mullins (1999) reported enhanced efficacy when pyrethroids were applied to bollworm larvae feeding on *Bt* cotton. Other important pests such as plant bugs, cotton aphids, and boll weevil are not controlled by this technology. Therefore, the need for insecticide sprays on *Bt* cotton is evident. LEVERAGE has an excellent fit for *Bt* cotton since it controls most major pests except pyrethroid-resistant tobacco budworm, which are readily controlled by the *Bt* toxin. In one study conducted in 1998, multiple applications of LEVERAGE were made to *Bt* cotton near Lonoke, Arkansas. Tarnished plant bugs, bollworm and boll weevil were the primary pests present during the mid- to late-season spray period. Yield results indicate excellent performance of LEVERAGE (Table 7). In 1999, a demonstration conducted by Bill Harris at the AgriCenter International in Memphis, Tennessee indicated a similar yield response to three applications of LEVERAGE on *Bt* cotton (Table 7). Boll weevils were not a factor at the AgriCenter experiment in 1999 since this location was in the boll weevil eradication program and eleven Malathion ULV

sprays were applied to the entire test area beginning June 21. Aphids were observed in the experiment. LEVERAGE provided excellent aphid control but BAYTHROID® was not effective. Tim Sumrow, a crop consultant in West Tennessee observed a similar trend when LEVERAGE was used on *Bt* cotton in a boll weevil eradication area.

Summary

Data from university trials, cotton consultants and Bayer personnel indicate excellent performance of LEVERAGE 2.7 SE Insecticide for control of the most important insect pests in Mid-South cotton.

LEVERAGE will help growers in the Mid-South manage cotton pests on both *Bt* and non-*Bt* cotton. LEVERAGE supplements bollworm control and provides control of many other cotton pests such as boll weevil, aphids and plant bugs not controlled by *Bt* cotton. LEVERAGE provides control of more insect pests than any other single cotton insecticide.

LEVERAGE will also be a valuable tool for growers participating in the Boll Weevil Eradication Program. Malathion sprays have been associated with a reduction in beneficial insects that may contribute to increased incidence of bollworm, aphids and whiteflies. LEVERAGE controls these and other important pests in the Mid-South.

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Table 1. Data contributors.

Name	Institution	Target Pest
Dr. Charles Allen	University of Arkansas	Tarnished Plant Bug, Cotton Aphid
Dr. Ralph Bagwell	Louisiana State University	Bandedwinged Whitefly
Dr. Michael Boyd	University of Missouri	Bollworm, Boll Weevil
Dr. Don Johnson	University of Arkansas	Bollworm, Boll Weevil, Plant Bug
Dr. Dick Hardee	USDA, ARS, Stoneville	Cotton Aphid
Dr. Aubry Harris	Mississippi State University	Tarnished Plant Bug
Mr. Bill Harris	AgriCenter International	Cotton Aphid, Bollworm
Dr. Gary Lentz	University of Tennessee	Tarnished Plant Bug
Dr. Roger Leonard	Louisiana State University	Bollworm, Cotton Aphid
Dr. William Scott	USDA, ARS, Stoneville	Tarnished Plant Bug
Dr. Brian Sweeden	Bayer	Tarnished Plant Bug
Dr. Tina Teague	Ark. State Univ.and Ark. Agricultural Exp. Stn.	Tarnished Plant Bug, Boll Weevil
Dr. Phil Tugwell	University of Arkansas	Tarnished Plant Bug, Boll Weevil

Table 2. Bollworm control with LEVERAGE 2.7 SE Insecticide.

Data Contributor	Untreated	Leverage (2.8–3.75 oz/A)
	% Damaged Bolls or Squares	
Boyd, U of Missouri (1999)	11.25	3.75
Johnson, U of Arkansas (1999)	34.6	11
Leonard, Louisiana State Univ. (1999)	6.7	2.2

Table 3. Boll weevil control with LEVERAGE 2.7 SE Insecticide.

Data Contributor	Untreated	Leverage (2.8–3.75 oz/A)
	% Weevil Damaged Squares (Seasonal Means)	
Hopkins, Bayer (1998)	52	22
Johnson, Univ. of Arkansas (1998)	39	29
Tugwell & Teague, Arkansas (1999)	16	5
Tugwell & Teague, Arkansas (1999)	79	16

Table 4. Tarnished plant bug control with LEVERAGE 2.7 SE Insecticide.

Data Contributor	Untreated	Leverage (3.75 oz/A)
	Plant Bugs / unit*	
Allen, University of Arkansas (1998)	10.7	2.7
Allen, University of Arkansas (1999)	3.8	0.6
Boyd, University of Missouri (1999)	4.0	0.5
Donaldson, Bayer (1998)	9.2	1.2
Harris, Mississippi State Univ. (1999)	2.3	1.0
Hopkins, Bayer (1999)	21.2	6.8
Johnson, University of Arkansas (1999)	17.6	2.1
Lentz, University of Tennessee (1999)	1.6	0.4
Scott, USDA, ARS, Stoneville, (1999)	7.9	1.2
Sweeden, Bayer (1998)	8.7	3.0
Sweeden, Bayer (1999)	2.8	0.9
Tugwell & Teague, Arkansas I (1999)	8	2.5
Tugwell & Teague, Arkansas II (1999)	34	2
Tugwell & Teague, Arkansas III (1999)	24	2.7

- Allen ’98 – counted number of plant bugs / 25 plants.
- Boyd – counted number of plant bugs / 20 sweeps.
- Lentz – counted number of plant bugs / 10 sweeps.
- Scott – data averaged from two counts following three applications.
- Sweeden ’98 & ’99 – counted number of plant bugs / 10 plants.
- Tugwell & Teague I – counted number of plant bugs / 25 sweeps.
- Allen ‘99, Donaldson, Johnson, Tugwell II & III, Harris, Hopkins, and Scott – counted number of plant bugs / x Row Feet. Data converted to number of plant bugs / 12 row feet.

Table 5. Square retention with LEVERAGE 2.7 SE Insecticide.

Data Contributor	Untreated	Leverage (3.75 oz/A)
	% Small Squares Retention	
Lentz, University of Tennessee (1999)	56	96
Sweeden, Bayer (1998)	66	83
Sweeden, Bayer (1999)	60	88

- Lentz – One evaluation of match-head-size squares three days after second application.
- Sweeden – Square retention on top four nodes. Average of five and four evaluations in 1998 and 1999, respectively.

Table 6. Cotton aphid control with LEVERAGE 2.7 SE Insecticide.

Data Contributor	Leverage (2.8 – 3.75 oz/A)
	Percent Control*
Allen I, University of Arkansas (1999)	92.4
Allen II, University of Arkansas (1999)	89.8
Andrews, Mississippi State University (1999)	81.4
Hardee, USDA, ARS, Stoneville (1999)	82.5
Hopkins, Bayer (1999)	88.3
Leonard, Louisiana State Univ. (1999)	87.4

- Data collected 3 to 6 days after application.

Table 7. Influence on *Bt* cotton yield with LEVERAGE 2.7 SE Insecticide.

Data Contributor	Untreated	Leverage (3.75 oz/A)
	Pounds Lint / Acre	
Hopkins, Bayer (1998)	511.5	746.6
Harris, Agricenter International (1999)	511.6	687.7
Sumrow, Covington, TN (1999)	602.6	671.3

- Hopkins – Seven applications in mid- to late-season targeting boll weevil, tarnished plant bug and bollworm.
- Harris – Three applications in mid- to late-season under low insect pressure. Experiment conducted in Boll Weevil Eradication Program area with eleven applications of Malathion ULV over the test area.
- Sumrow – Two applications in mid- to late-season under low insect pressure. Experiment conducted in Boll Weevil Eradication Program area with several applications of Malathion ULV over the test area.