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DOUBLETHREAT™ : A NEW INSECTICIDE PRE-MIX FOR BROADSPECTRUM COTTON INSECT PEST CONTROL

J.P. Reed
Technical Development
FMC Corporation
North Little Rock, AR
H.R. Mitchell
Technical Development
FMC Corporation
Louisville, MS

Abstract

DOUBLETHREAT™ is an insecticide product composed of the two active ingredients, bifenthrin and spinosad. This concept of use of these two active ingredients was born out from the cotton consultant community and the advent of Cry 1Ab Bt cotton. As Bt Cotton is efficacious only against Cotton Budworm (Heliothes virescens), Cotton Bollworm (Helicoverpa zea) control is not as effective. Bt cotton does not control the other cotton insect pests, where as Capture applied at 0.06 lb ai/A provided commercially acceptable control of Heliothis virescens (F.), Helicoverpa zea (Boddie), Anthonomus grandis Boheman, Lygus spp., Aphis gossypii Glover and phytophagous Pentatomidae equal to or better than that of of other pyrethroids. Capture at 0.06 lb ai/A also provided Tetranychus urticae control equal to that of the standard miticides. Spinosad is a new class of insecticide that has broadspectrum lepidopterous activity, including pyrethroid resistant Cotton Budworms. The combination of these two insecticides, bifenthrin and spinosad, has resulted in a broad spectrum cotton insecticide that has made conventional (Non-Bt) cotton economically viable. In a set of trials conducted by consultants across the Cotton Belt, DOUBLETHREAT ™ treated conventional cotton was more profitable to grow than Bt cotton by approximately $37/acre. This profitability comparison took into account all input costs of pesticides , GMO royalties, fertilizer, seed and tillage.

Introduction

DOUBLETHREAT™ is a pre-mixed insecticide that has been used effectively across the Cotton Belt in 2002. DOUBLETHREAT™ strength is in its broad-spectrum of control and its ability to handle not only the numerious insect pests of cotton but the spider mite complex as well, an ability unique in the pyrethroid class of chemistry (Mitchell and Hatfield 1999). In addition, Capture has demonstrated effectiveness on the Hemipteras pest of cotton, specifically tarnished plant bugs, Lygus lineolaris (Palisot de Beauvious) and cotton fleahopper, Pseudatomoscelis seriatus (Reuter). (Knabbe and Kukas 1986, Gage and Knabke 1987, Kukas 1987, Mitchell et al. 1987, Mitchell and Hatfield 1988, Mitchell and Hatfield 1999, Hatfield and Mitchell 2000). In past years, Capture has shown to be very effective for control of cotton aphid (Mitchell and Hatfield 1990). Although the level of aphid control with all pyrethroids has fluctuated over the years, Capture has consistently provided the greatest level of aphid control of the pyrethroid class of chemistry (Mitchell and Hatfield 1999).

Tarnished plant bugs have been shown to destroy meristematic tissue in developing plant terminals (Leigh et al. 1988). Tarnished plant bug and cotton fleahopper, Pseudatomoscelis seriatus (Reuter), occur primarily during early season. An accumulation of feeding periods from tarnished plant bug can lead to damaged plant terminals and subsequently lead to aborted square positions and/or low square retention during early cotton development (Ruscoe et al. 1998). Turnipseed et al. (1995) noted a one-week delay in harvest maturity when mechanical square removal was conducted for four weeks but no reduction in yield. Phelps et a. (1996) noted a delay in harvest maturity when mechanical square removal was conducted for 2 through 4 week resulting in delayed maturity from 2-14 days, respectively. Thus, effective and timely early season insecticide applications are essential to prevent insect damage in cotton and early fruit retention is essential for high production yields.

For later season Heliothine cotton insect pest complex, Spinosad has proven itself season after season controlling Cotton Bollworm (Helicoverpa zea) and Cotton Budworm (Heliothes virescens). For the past several years, Spinosad has been evaluated in University/Extension efficacy studies under a broad range of environmental conditions, cotton lepidopterous insect pests and infestation levels across the Cotton Belt (Leonard et al. 1988, and Leonard et al. 1996).

Reported herein, are summary results of these studies with regard to the efficacy of DOUBLETHREAT™ for control of the Heliothine complex, Helicoverpa zea (Boddie) and Heliothis virescens (F.), tarnished plant bug, Brwon and Green stink bug (Pentatomidae), two spotted spider mite, Tetranychus urticae (Koch) and Aphids. Summary results of Consultant questionnaires to evaluate the early season applications of Capture for early and late season cotton insect control, as well as yield are also presented.

Materials and Methods

In 2002, a survey was conducted of consultants throughout the states of AL, AR, GA, LA, MO, MS, NC, SC and TX. Field efficacy results presented herein were obtained from large plot trials that ranged from 10 up to 80 acres that may or may not have be replicated. These larger plot trials were applied via various ground or aerial application machinery and application rates ranged from 3 to 22 gallons per acre. Other small plot trials conducted by university/extension personnel across the Cotton Belt utilizing similar test procedures where test plot size generally ranged from 4 to 8 rows wide by 45 to 100 feet in length, replicated 4 times in a randomized complete block design. Applications were typically made with compressed air or CO2 charged small plot sprayers using water as the carrier. Total spray volume ranged from 9 to 12 gallons/acre. Cotton varieties, planting dates and production practices were typical of each geographic area regardless of whether the plots were performed in a large scale fashion or small plot.

DOUBLETHREAT™ was applied at the recommended rates of either 3.2 or 4.2 ounces of product per acre (0.05 to 0.067 lbs ai/A bifenthrin plus 0.044 to 0.059 lbs ai/A Spinosad) to a Non-Bt (conventional) cotton variety, preferably the isoline of a Bt variety. This single treatment was compared to a Bt cotton line and its associated insecticide program. Data was collected for percent control of various cotton insect pests warranting treatment including the Heliothine complex, as well as subsequent yield. Trials were initiated and subsequent treatments made in accordance with insect pest control recommendations for the region. All associated insecticide input costs as well any royalty fees were collected for each treatment program.

Tarnished plant bug / cotton fleahopper infestations were determined using the standard sweep net technique. Numbers of adults and nymphs were obtained from a sample size of no less than 25 sweeps per plot taken at various intervals following application. Data were summarized using a combined total of both adult and nymph stages. Cotton aphid, Aphis gossypii Glover, spider mite and whitefly populations were assessed by counting the number of pests per leaf taken from a designated location on 5–10 randomly selected plants per plot at various post treatment intervals.

Insect infestation levels were determined by standard evaluation procedures that varied by species. Heliothian infestations were determined by examination of a set number of cotton terminals, squares and/or bolls per plot prior to and following subsequent applications. Data were then compiled and analyzed based on a seasonal mean percent live larvae (terminal + square larvae) and square damage over multiple applications and evaluations. DOUBLETHREAT™ in conventional Non-Bt cotton was analyzed against the specific Bt competitive cotton and competitive insecticide regime only in those replicated trials where both treatments occurred and there were at least 3 trials conducted in similar fashion. On average for the insecticides evaluated and compared to DOUBLETHREAT™ there were11 trials for analysis. By analyzing the data in this manner, variability due to pest infestation levels, application methods and environmental conditions could be eliminated.

Results and Discussion

Results of the efficacy of DOUBLETHREAT™ for control of boll weevil, plant bugs, brown and green stinkbugs, mites, aphids and the Heliothine complex a is shown in Tables 1, 2, and 3. Table 4 shows the results of the economic summary comparing the DOUBLETHREAT™ ,conventional, Non-Bt program to Cry1 Ab Bt cotton program. It should be noted that Heliothine insect pressure in 2002 was on average higher than in previous years where these trials were initiated, while plant bug pressure was consistent throughout the season.

In Table 1, DOUBLETHREAT™ provided numerically superior control of boll weevil than Fury in Table 1. DOUBLETHREAT™ was the only insecticide to provide commercially acceptable control of Heliothine larvae and comparable control of Heliothine larval damage was observed between DOUBLETHREAT™ and Fury (Table 1).

In another set of trials, results denoted in Table 2, DOUBLETHREAT™ provided superior control of plants bugs and larvae than Curacron, Steward and Denim. However, Steward provided Heliothine larval damage control that was comparable to DOUBLETHREAT™.

In Table 3, Baythroid provided better control of brown stinkbug while DOUBLETHREAT™ provided superior control of green stinkbug. DOUBLETHREAT™ provided superior mite and control when compared to Fury, Karate and Baythroid.

The economic analysis of the two programs, DOUBLETHREAT™ in conventional Non-Bt cotton was analyzed against the specific Bt competitive cotton and competitive insecticide regime is presented in Table 4. The were 1-6 applications of DOUBLETHREAT™ in the Non-Bt DOUBLETHREAT™ ,where as there were 1-4 insecticide applications in the Bt program. The yield and quality were significantly greater in the DOUBLETHREAT™

Non-Bt cotton treatments than the Bt cotton program. Only fiber color was comparable between the two programs. As a result, the average loan value of the Non-Bt Value was $0.54/lb while the Bt cotton loan value was $0.51/lb. With an average

value of the Non-Bt, DOUBLETHREAT™, equaling $635.21 was greater income that the Bt cotton program. After subtracting the input costs of the respective programs, DOUBLETHREAT™ at $291.63 and Bt cotton program at $ 276.18; the greater net profit per acre was the DOUBLETHREAT™ program on average at $341.00/A; less profit per acre was the Bt cotton program at $307.25/A.

Since the 5 year inception of Bt cotton, both yield and quality of transgenic Bt cotton has been suspect. In an effort to remain competitive, cotton breeders have shifted cotton breeding programs into introgression of transgenic lines which has added crucial time on to development of commercial cotton varieties. This added time has resulted in the delayed introduction of transgenic lines while isolines might already be commercially available. As these commercially available isoline cotton varieties come to market, protection against Heliothine complex and other cotton insect pests is warranted. Attention paid to other insect pests of cotton as well as the Heliothine complex has necessitated development of such an insecticide as DOUBLETHREAT™. Hence the economic viability of DOUBLETHREAT™ in conventional cotton varieties and isolines of Bt cotton.

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Table 1. Efficacy of Doublethreat vs various insecticides for control of boll weevil, bollworm/budworm eggs, larvae and larval square damage. (2002)

		Seasonal Mean Percent Control		
Treatment	Rate (oz pr/A)	Boll Weevil Damage	Hel. Larvae Damage	Hel. Square Damage
Doublethreat [n=26]	3.2 to 4.2	75	77	49
Fury [n=9]	3.2	73	65	49
Karate [n=3]	1.8 to2.5	- -	65	27
Baythroid [n=3]	1.8	- -	66	28

Table 2. Efficacy of Doublethreat vs various insecticides for control of plant bug, bollworm/budworm eggs, larvae and larval square damage. (2002)

		Seasonal Mean Percent Control		
Treatment	Rate (oz pr/A)	Plant Bug Damage	Hel. Larvae Damage	Hel. Square Damage
Doublethreat [n=14]	3.2 –4.2	75	77	49
Curacron [n=3]	16	43	43	25
Steward [n=6]	11	- -	59	50
Denim [n=3]	8	33	50	25

Table 3. Efficacy of Doublethreat vs various insecticides for control of boll weevil, bollworm/budworm eggs, larvae and larval square damage. (2002)

		Seasonal Mean Percent Control			
Treatment	Rate (oz pr/A)	Brown Stinkbug	Green Stinkbug	Mites	Aphids
Doublethreat [n=6]	3.2 to 4.2	85	100	88	90
Fury [n=3]	3.2	67	- -	0	66
Karate [n=3]	1.8 to 2.5	- -	46	0	66
Baythroid [n=3]	1.8	88	50	0	0

Table 4. Economic Analysis of Doublethreat conventional, Non-Bt cotton insecticide program versus Bt cotton program using insecticides. (2002)_[n=14]

Doublethreat insecticide Non-Bt Conventional Cotton.	**Cry 1Ab Cotton + insecticides Bt Cotton with various insecticides**
	Bt Cry 1Ab Program Royalty Fee
1-6 Applications	1-4 Applications
Average Yield = 1139 lbs/A	Average = 1104 lbs/A
Fiber Length 35.2	Fiber Length 33.8
Fiber Strength 30.02	Fiber Strength 27.7
Micronaire 4.48	Micronaire 4.74
Fiber Color 41	Fiber Color 41
Ave Non-Bt Loan Value = $ 0. 557 / lbs	Ave Bt Loan Value = $ 0. 510 /lbs
Ave Non-Bt Value/A = $ 635.21 / A	Ave Bt Value = $ 608.38 / A
Ave Non-Bt Input Costs = $ 291.63/A	Ave Bt Input Costs = $ 276.18/A
Ave Non-Bt Profit/A = $ 341.00	Ave Bt Profit/A = $ 307.25/A