NEW INSECTICIDES FOR CONTROL OF SILVERLEAF WHITEFLY: AN EFFICACY EVALUATION

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Abstract

A study was conducted in Imperial Valley, CA to evaluate insecticides for control of silverleaf whitefly in cotton. New insecticidal compounds, sucrose octanoate (AVA sugar ester), acetamiprid (EXP61486A)and acetamiprid plus fipronil (TADS1222) were compared to standard whitefly insecticides for efficacy of control of whitefly adults, eggs and nymphs. The whitefly egg and nymph means for the sugar ester treatment were not different from the untreated control. EXP61486A, TADS1222, and Danitol plus Orthene treatments provided the highest levels of control for silverleaf whitefly adults, eggs, and nymphs.

Introduction

The silverleaf whitefly, *Bemisia argentifolii* Bellows and Perring, (Bellows et al. 1994) caused severe economic losses to cotton and other crops in the United States in 1991 with conservative estimates of direct dollar losses exceeding $200 million and the direct dollar loss to cotton producers in the Lower Rio Grande Valley of Texas was more than $80 million (Henneberry 1993). Direct dollar losses to cotton in Arizona in 1992 exceeded $100 million (Henneberry 1993). Whitefly-induced economic losses to cotton occur as a result of reduced cotton yield (Mound 1965) and contamination of lint with honeydew and sooty molds (Davidson et al. 1994). The whitefly-transmitted cotton leaf crumple disease, caused by cotton leaf crumple geminivirus (CLCV), can also cause extensive reduction in yield (Dickson et al. 1954, Duffus and Flock 1982).

The silverleaf whitefly is a prolific pest with a broad host range that has resulted in year round infestations on commercial crops in Southern California. Although chemical applications only provide temporary control of this pest (e.g. Chu et al. 1993, Natwick 1993), and a long term solution that offers economical and environmental advantages is needed, the principal method of control of silverleaf whitefly in commercial crops, including cotton, has been the use of insecticides. Studies during the 1998 cotton season were conducted in the Imperial Valley, CA to evaluate registered insecticides and new insecticidal compounds for control of silverleaf whitefly in cotton.

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Material and Methods

A stand of cotton, var. DPL 5415, was established at UC Desert Research & Extension Center 25 March 1998, Imperial Valley, CA. Fourteen insecticide treatments and an untreated control were replicated four times in a randomized complete design. Each plots was 15 m long and 8 m wide. Insecticide treatments by registered trade name, or experimental number or name, are listed in Table 1. New insecticides (insecticides without a federal label for use on cotton) were AVA sugar ester (sucrose octanoate), EXP61486A 70 WP (acetamiprid), and TADS12222 1.67 EC (acetamiprid + fipronil). Helena Buffer PS at 1 pt/100 gal and Sylgard 309 at 4 fl oz/100 gal were used with all insecticide spray treatments.

Silverleaf whitefly adults were sampled using the leaf turn method (Naranjo & Flint 1995) from 10 plants at random in each plot. Silverleaf whitefly eggs and nymphs were counted on single leaf disks of 1.65 cm^2 from the lower left hand quadrant on the undersides of 5th node leaves extracted from 10 plants at random in each plot. Leaf samples were taken weekly from 10 June through 11 August 1998. On 28 August 1998, seed cotton was hand picked from 0.002 acre per plot, data were recorded, and yield as seed cotton per acre was calculated. Seed cotton samples were ginned and percentages of lint turnout and pounds of lint per acre were calculated.

Seasonal silverleaf whitefly adult, egg, and nymph densities, seed cotton and lint weights, and percentages of lint turnout were analyzed using ANOVA (MSTAT-C 1989). Student-Neuman-Keul's Multiple Range Test (SNKMRT) was employed for means separations.

Results and Discussion

Insecticide treatment seasonal means for silverleaf whitefly adults were lower than the untreated control, $P \leq 0.05$ (Table 2). Whitefly adult seasonal means for the Danitol 2.4 EC + Orthene 90S, EXP61486A 70 WP treatments and TADS12222 1.67 EC treatments were lower than other insecticide treatments. Applaud 70 WP + Phaser 3 EC had a lower adult seasonal mean than Applaud 70 WP and Applaud 70 WP + Decis 0.2 EC.

Insecticide treatment seasonal means for silverleaf whitefly eggs, except the sugar ester treatment, were lower than the untreated control, $P \leq 0.05$ (Table 3). Whitefly egg seasonal means for the Danitol 2.4 EC + Orthene 90S, EXP61486A 70 WP treatments and TADS12222 1.67 EC treatments were lower than other insecticide treatments. The whitefly egg seasonal mean for Applaud 70 WP + Phaser 3 EC was lower the Applaud 70 WP + Decis 0.2 EC seasonal mean.

Insecticide treatment seasonal means for silverleaf whitefly nymphs, except the sugar ester treatment, were lower than

the untreated control, $P \leq 0.05$ (Table 3). Whitefly nymph seasonal means for the EXP61486A 70 WP treatment at 0.075 lb ai/acre was lower than all Applaud 70 WP treatments, the Knack 0.086 EC treatment, the TADS12222 1.67 EC treatment at 0.044 lb ai/acre, and the sugar ester treatment. Applaud 70 WP + Decis 0.2 EC followed by Danitol 2.4 EC + Orthene 90S had a more ($p \leq 0.05$) whitefly nymphs than all insecticides treatments except the sugar ester treatment, Applaud 70 WP + Phaser 3 EC followed by Danitol 2.4 EC + Orthene 90S, Applaud 70 WP used alone and followed by Danitol 2.4 EC + Orthene 90S, and Knack 0.086 EC followed by Ovasyn 1.5 EC + Phaser 3 EC.

There were no differences in pounds of seed cotton per acre, percentages of lint turnout, or pounds of lint per acre among the treatments, $P \geq 0.05$ (Table 4). The untreated control had a numerically lower seed cotton yield and lint yield than the insecticide treatments. In general the highest numerical values for pounds of seed cotton per acre and pounds of lint per acre were from treatments which had the lowest numbers of silverleaf whitefly adults, eggs, and nymphs.

Whitefly egg and nymph means for AVA sugar ester were not different from the untreated control and adult control was poor. AVA sugar ester needs formulation refinement and patterns of use for whitefly control need to be investigated. EXP61486A, TADS1222, and Danitol plus Orthene provided the highest whitefly adult, egg, and nymph control levels. EXP61486A and TADS1222 look promising for whitefly control in cotton.

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Table 1. Cotton Insecticide Treatments, Rates and Application Dates, 1998.

Treatment	lb ai/acre	Treatment dates
Untreated Control	--------	----------
Applaud 70 WP followed by Danitol 2.4EC + Orthene 90S	0.35 0.20 + 0.50	7, 21 Jul 4 Aug
Applaud 70 WP + Phaser 3 EC followed by Danitol 2.4EC + Orthene 90S	0.35 + 0.75 0.20 + 0.50	7, 21 Jul 4 Aug
Ovasyn 1.5 EC + Phaser 3EC	0.25 + 0.75	7, 14, 21, 28 Jul, 4 Aug
Knack 0.86 EC followed by Ovasyn 1.5 EC + Phaser 3EC	0.05 0.25 + 0.75	7 Jul 21, 28 Jul, 4 Aug
Applaud 70 WP + Decis 0.2 EC followed by Danitol 2.4EC + Orthene 90S	0.35 + 0.02 0.20 + 0.50	7, 21 Jul 4 Aug
Danitol 2.4EC + Orthene 90S	0.20 + 0.50	7, 21, 28 Jul, 4 Aug
EXP61486A 70 WP	0.022	7, 21 Jul, 4 Aug
EXP61486A 70 WP	0.044	7, 21 Jul, 4 Aug
EXP61486A 70 WP	0.075	7, 21 Jul, 4 Aug
EXP61486A 70 WP	0.10	7, 21 Jul, 4 Aug
TADS12222 1.67 EC	0.044	7, 21 Jul, 4 Aug
TADS12222 1.67 EC	0.088	7, 21 Jul, 4 Aug
Sugar ester	0.3%	7, 14, 21, 28 Jul, 4 Aug

Table 2. Seasonal means of whitefly adults per leaf, Holtville, CA, 1998.

Treatment	lb ai/acre	Adults
Danitol 2.4 EC + Orthene 90S	0.20 + 0.50	5.51 e
EXP61486A 70 WP	0.10	5.92 e
EXP61486A 70 WP	0.075	6.91 de
EXP61486A 70 WP	0.044	7.06 de
EXP61486A 70 WP	0.022	8.11 de
TADS12222 1.67 EC	0.088	7.60 de
TADS12222 1.67 EC	0.044	9.89 d
Applaud 70 WP + Phaser 3 EC followed by Danitol 2.4 EC + Orthene 90S	0.35 + 0.75 0.20 + 0.50	12.60 c
Knack 0.86 EC followed by Ovasyn 1.5 EC + Phaser 3 EC	0.05 0.25 + 0.75	13.11 bc
Applaud 70 WP followed by Danitol 2.4 EC + Orthene 90S	0.35 0.20 + 0.50	15.24 b
Sugar ester	0.3%	15.58 b
Ovasyn 1.5 EC + Phaser 3 EC	0.25 + 0.75	15.68 b
Applaud 70 WP + Decis 0.2 EC followed by Danitol 2.4 EC + Orthene 90S	0.35 + 0.02 0.20 + 0.50	15.87 b
Untreated Control	----------	24.34 a

Mean separations within columns by Student-Newman-Keul's Multiple Range Test, P≤0.05.

Table 3. Silverleaf whitefly seasonal means as eggs and nymphs per cm^2, Holtville, CA, 1998.

Treatment	lb ai/a	Eggs[a]	Nymphs[a]
EXP61486A 70 WP	0.075	0.81 g	0.63 g
EXP61486A 70 WP	0.10	0.69 g	0.72 fg
Danitol 2.4 EC + Orthene 90S	0.20 + 0.50	0.97 g	0.80 efg
EXP61486A 70 WP	0.044	1.03 g	0.80 efg
EXP61486A 70 WP	0.022	1.08 g	0.89 defg
TADS12222 1.67 EC	0.088	1.05 g	0.92 defg
Ovasyn 1.5 EC + Phaser 3 EC	0.25 + 0.75	2.20 cde	1.09 cdefg
Knack 0.86 EC followed by Ovasyn 1.5 EC + Phaser 3 EC	0.05 0.25 + 0.75	2.80 bc	1.20 bcdef
TADS12222 1.67 EC	0.044	1.13 g	1.25 bcde
Applaud 70 WP + Phaser 3 EC followed by Danitol 2.4 EC + Orthene 90S	0.35 + 0.75 0.20 + 0.50	1.70 def	1.41 bcd
Applaud 70 WP followed by Danitol 2.4 EC + Orthene 90S	0.35 0.20 + 0.50	2.22 cd	1.52 bc
Applaud 70 WP + Decis 0.2 EC followed by Danitol 2.4 EC + Orthene 90S	0.35 + 0.02 0.20 + 0.50	2.61 c	1.71 b
Sugar ester	0.3%	3.37 ab	2.43 a
Untreated Control	--------	3.90 a	3.03 a

[a]Log transformed data used in analysis, reverse transformed means reported.
Mean separations within columns by Student-Newman-Keul's Multiple Range Test, P≤0.05.

Table 4. Pounds seed cotton per acre, percentages of lint turnout and pounds lint per acre, Holtville, CA, 1997.

Treatment	lb ai/a	lb seed cotton	% lint	lb lint
EXP61486A 70 WP	0.044	3656.3 a	39.6 a	1447.9 a
EXP61486A 70 WP	0.10	3667.3 a	39.3 a	1441.2 a
Ovasyn 1.5 EC + Phaser 3 EC	0.25 + 0.75	3547.2 a	40.3 a	1429.5 a
TADS12222 1.67 EC	0.088	3549.4 a	39.2 a	1391.4 a
Danitol 2.4 EC + Orthene 90S	0.20 + 0.50	3417.1 a	39.4 a	1346.3 a
EXP61486A 70 WP	0.022	3420.4 a	39.3 a	1344.2 a
Applaud 70 WP + Phaser 3 EC followed by Danitol 2.4 EC + Orthene 90S	0.35 + 0.75 0.20 + 0.50	3406.1 a	38.9 a	1325.0 a
TADS12222 1.67 EC	0.044	3235.2 a	39.4 a	1274.7 a
Knack 0.86 EC followed by Ovasyn 1.5 EC + Phaser 3 EC	0.05 0.25 + 0.75	3193.7 a	39.2 a	1251.9 a
Applaud 70 WP followed by Danitol 2.4 EC + Orthene 90S	0.35 0.20 + 0.50	3242.9 a	38.5 a	1248.5 a

Table 4. Continued

Treatment	lb ai/a	lb seed cotton	% lint	lb lint
Applaud 70 WP + Decis 0.2 EC followed by Danitol 2.4 EC + Orthene 90S	0.35 + 0.02 0.20 + 0.50	3180.1 a	39.2 a	1246.6 a
EXP61486A 70 WP	0.075	3103.0 a	39.2 a	1216.4 a
Sugar ester	0.3%	2866.0 a	38.5 a	1132.1 a
Untreated Control	--------	2728.2 a	39.1 a	1066.7 a

Mean separations within columns by Student-Newman-Keul's Multiple Range Test, $P \leq 0.05$.