Efficacy of the Insect Growth Regulator, Buprofezin and the Insecticide, Amitraz Against the Sweetpotato Whitefly on Cotton at Maricopa, AZ, 1991

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Abstract

Reduction of populations of the B strain (poinsettia) of sweetpotato whitefly (SPWF), Bemisia tabaci Gennadius, resulted from applications of buprofezin or amitraz to cotton in central Arizona (Maricopa, AZ). Control was fair to good control for this insect. However, yields of seed cotton in treated plots were not increased significantly compared to untreated plots, following three applications of these insecticides during the season. Similar results on percentage sugar on lint and lint stickiness from honeydew of SPWF in both treated and untreated plots were obtained.

Introduction

The sweetpotato whitefly (SPWF), *Bemisia tabaci*, has become a serious cotton pest in the arid southwest. Control measures are difficult because the immatures develop on the undersides of the leaves and aerial applications are usually ineffective in delivering control agents to the leaf undersides and lower leaf surfaces. Also, there are several generations of SPWF in a season and SPWF populations appear to build resistance to conventional pesticides quickly (Akey, unpublished data, 1988). Control measures are needed that overcome these problems.

This research was conducted to determine the efficacy of three foliar sprays of buprofezin (Applaud^{R}) and amitraz (Ovasyn^{R}) against infestations of the B strain of SPWF in cotton in the last quarter of the season. Earlier, Akey et al. (1991) reported on the effects of two sprays of buprofezin applied for control of SPWF in Arizona cotton in 1990.

Materials and Methods

Research was conducted at the University of Arizona Maricopa Agricultural center (MAC) in the 1991 cotton season. Plots were arranged in a random block design with 10 treatments (five of those treatments are being reported here) in each of 10 replicates. Cotton "DPL 90" was planted in 40 in (1-meter) rows, 4 rows per plot, and 34 ft (10.36 m) length per plot. Plots were isolated from each other by corridors of 3 unplanted rows between each 4 plot rows and by 20 ft (6.1 m) clear alleys that separated replicates. Cotton was pre-irrigated 2-21-91 and planted 3-20-91. Buprofezin (Applaud^{R}) and Amitraz (Ovasyn^{R}) were formulated as suspendable and emulsifiable concentrate, respectively.

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Buprofezin was applied at 0.38 lb/ac (0.426Kg/ha) with or without 1% Comate^{TM} adjuvant, V/V (S. Helffrich and Associates, Phoenix, AZ) and 1% Comate^{TM} was used as a check. Amitraz was applied at 0.25 lb/ac (0.28Kg/ha). Control plots received water spray only. Sprays were applied 3 times on days 222-224, 234-238 (both of the first two applications required 2 days to complete application), and 259.

Sprays were applied at 70 psi and 60 gallons/acre (561 l/ha) through 14 nozzles/row. Two nozzles were overhead of the row and sprayed straight down, while the others were on swivel heads adjusted upwards from pairs of three horizontal extensions extending from 3 ft (0.91 m) drops resulting in six nozzles per each side of each row (see Akey et al. 1992).

Plots were sampled for SPWF adults with 6 X 6 in (15 X 15 cm) yellow sticky cards, 1/plot (10 plots/treatment) for ca 24 hr. Cards were centered in each plot and positioned slightly above canopy heights, perpendicular to the rows. Cards were ruled into six 1-in sectors/side and SPWF adults were counted on sectors 3-5 on both sides of each card (this eliminated "top and bottom" edge effects).

For samples of immatures, five leaves were picked from each plot (10 plots/treatment). Leaves were chosen from the third to fifth main leaf from the terminal leaf. Immatures were sampled by whole leaf counts early in the season and throughout the season by four 10 mm diam. leaf disk samples, 1 disk/leaf quadrant/each leaf. Based on previous experience with counts of eggs, all instar stages, and determinations of "live or dead" status (Akey et al. 1991), only large 3rd instars, young 4th instars, and"red-eye" 4th (pupae) were counted. Data presented here include these instars as a single group of "large" immature SPWF. Sampling was conducted from day 222 (8-10) through 274 (10-1). The leaves were harvested, stored in coolers, brought back to back to the laboratory, put in cool storage, and examined by microscope (6-12X).

Seed cotton was hand harvested on day 274 (10-1) from 13.1 ft (4 meters) of an inner row of each plot, weighted, and saw ginned. Then seed and lint were weighted, and lint Kg/ha was calculated for each plot. A 50-g sample of the lint from each plot was analyzed for stickiness by minicard and for reducing sugars (Perkins 1986). Two surveys were also made ranking the plant leaves for stickiness. The first ranking, day 252 (9-26), was done as a binomial test - 25 plants in each plot were graded as sticky or not sticky. The second ranking, day 282 (10-9), ranked 25 plants/plot as "not sticky"(touch by fingers did not indicate stickiness), moderately sticky (touch by fingers indicated stickiness present) or "very sticky" (leaves were so sticky that when touch by fingers, the leaf did not release from the fingers but continued to stick to them).

Data for populations, yields, lint stickiness, and sugars were analyzed by analysis of variance (ANOVA) for sampling dates and means were separated (given significant F value by ANOVA) by Duncan's New Multiple Range Test and/or Student-Neuman-Keul's Multiple Range Test ($P \leq 0.05$). Leaf stickiness data were analyzed by Chi Square tests for the first ranking test (binomial data) and as described above for the second ranking test.

Results and Discussion

Populations of the SPWF adults ranged from 1.9 to 1346 on cards in the center of the untreated plot from day 222 (8-10) to day 274 (10-1) (Table 1). Counts of immatures rose to a maximum of 21 and then fell to 2.7 during the test period.

Percentage reductions of adults and large immature SPWF by buprofezin ranged from 0 to 41 and 0 to 89, respectively (Table 2). Percentage reductions of large SPWF larvae were 0 to 89 and 46 to 68 after 1-2 days and 8 to 25 days following sprays, respectively. Akey et al. (1991) showed similar control with buprofezin in 1990.

Percentage reductions by amitraz of adults and large immature SPWF ranged from 0 to 50 and 0 to 89, respectively (Table 3). Percentage reductions of large immature SPWF were significantly greater 8 to 25 days after application than on days 1 and 2, following applications.

Seed cotton yields, and degree of stickiness and sugar content of treated cotton were not significantly different from untreated cotton (Table 4). Yields were only increased 8 and 2% in plots treated with amitraz and buprofezin, respectively (Table 4). Also, we show that the number of sticky plants were significantly less in buprofezin than amitraz plots and amitraz was significantly less than untreated plots using either method of evaluation (Table 5).

Here we show that amitraz and buprofezin reduced populations of immatures of the B strain (poinsettia) of SPWF but reductions were extremely variable as were the populations on which they were based. However, quantities of lint were increased by the sprays of both compounds at both locations, even though the differences are not significant.

Stickiness ratings of lint from both treated and untreated plots were equal. Also, percentage reducing sugars were not reduced in treated and untreated plots below 0.3% (Elsner et al. 1983). Elsner et al. (1983) used this percentage as a threshold level for maximum sugar content to be present on lint. They also indicate that reducing sugar content on lint, "sooty" mold and stickiness of lint is complex.

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Table 1. Populations of sweetpotato whitefly in untreated cotton (received water spray only). Maricopa, AZ 1991.

Calendar Day (date)	Application	Adults[1]	Large Immatures[2]
222 (8-10)	[3]	100.000	0
224 (8-12)	[cont. from 222]		
225 (8-13)		5.333	0.040
233 (8-21)		100.300	1.040
234 (8-22)	[3]		
235 (8-23)		1.9	0.222
259 (9-16)	[3]	nd[4]	19.4
261 (9-18)		nd	11.4
267 (9-24)		nd	21.00
268 (9-25)		1346.000	
274(10-1)		1139.000	2.700

[1] Mean of counts from yellow sticky cards, both sides counted, 1/plot (10 cards). Card size 6 x 6 in. Three inches of card counted between inch 3 - 5 (18 sq. in./side).
[2] Large 3rd, early 4th, and "red eye" (pupae) instars. Mean of 5 whole leaf counts/plot (50 leaves) for days 222 - 235. Mean of four 10-mm leaf disks per leaf for 5 leaves per plot (200 disks) for days 235 -274.
[3] Application date.
[4] Not done.

Table 2. Control (%) of sweetpotato whitefly by Buprofezin (Applaud^{R}) 0.38 lb/ac (0.426Kg/ha) and a cottonseed oil (Comate^{TM}) (1% V/V, a surfactant) applied three times during season. Maricopa, AZ 1991.

Calendar Day (date)	Days After Application	Control %	
		Adults[1]	Large Immatures[2]
224 (8-12)[3]			
225 (8-13)	1	94.7	[1.5x increase]
233 (8-21)	9	30.8	80.8
234 (8-22)[3]			
235 (8-23)	1	99.0	30.0
259 (9-16)[3]	25	nd[4]	68.6*
261 (9-18)	2	nd	75.3
267 (9-24)	8	nd	85.7
268 (9-25)	9	45.5	nd
274(10-1)	15	14.0	66.7

[1] Mean of counts from yellow sticky cards, both sides counted, 1/plot (10 cards). Card size 6 x 6 in. Three inches of card counted between inch 2 - 5 (18 sq. in./side).
[2] Large 3rd, early 4th, and "red eye" (pupae) instars. Mean of 5 whole leaf counts/plot (50 leaves) for days 222 - 235. Mean of four 10-mm leaf disks per leaf for 5 leaves per plot (200 disks) for days 235 -274.
[3] Application date.
[4] nd = Not done.
* = Significantly different from check at $P \leq 0.05$.

Table 3. Control (%) of sweetpotato whitefly by Amitraz (Ovasyn^R), 0.25 lb/ac (0.28Kg/ha) applied three times during season. Maricopa, AZ 1991.

Calendar Day (date)	Days After Application	Control % Adults[1]	Control % Large Immatures[2]
224 (8-12)[3]			
225 (8-13)	1	94.6	[3x increase]
233 (8-21)	9	11.2	62.5
234 (8-22)[3]			
235 (8-23)	1	98.0	[1.4x increase]
259 (9-16)[3]	25	nd[4]	80.4*
261 (9-18)	2	nd	[1.5x increase]
267 (9-24)	8	nd	71.0
268 (9-25)	9	50.0	nd
274(10-1)	15	12.7	88.9

[1] Mean of counts from yellow sticky cards, both sides counted, 1/plot (10 cards). Card size 6 x 6 in. Three inches of card counted between inch 2 - 5 (18 sq. in./side).
[2] Large 3rd, early 4th, and "red eye" (pupae) instars. Mean of 5 whole leaf counts/plot (50 leaves) for days 222 - 235. Mean of four 10-mm leaf disks per leaf for 5 leaves per plot (200 disks) for days 235 -274.
[3] Application date.
[4] nd = Not done.
* = Significantly different from check at $P \leq 0.05$.

Table 4. Lint Kg/ha, stickiness of lint, concentrations of sugar on lint of treated and untreated cotton following insecticide application to cotton for control of sweetpotato whitefly, Maricopa, AZ 1991. Applications made on days 224, 234, and 259. Cotton was hand harvested on day 274.

Insecticide	Application Conc. lb/ac	Lint lb/ac	% Yield increase	Lint Stickiness rating [1]	Lint % Sugar content[2]
Ovasyn	0.25	983.6	6.8	.5	.418
Buprofezin	0.38	943.5	2.8	.0	.419
Buprofezin + Comate	0.38 + 1% V/V	983.6	6.8	.1	.404
Comate	1% V/V	1010.4	9.3	.7	.472
Control	Water	916.7	- -	.2	.528

[1] Based on rating 0 = no stickiness, 1 = light stickiness, 2 = moderate stickiness, and 3 = heavy stickiness by minicard rating.
[2] % sugar content of reducing sugars.

Table 5. Stickiness of cotton leaves of treated and untreated cotton following insecticide application to cotton for control of sweetpotato whitefly, Maricopa, AZ., 1991.

Insecticide	Application Conc. lb/ac	Sticky plants, 25 plants/plot, 10 plots/treatment	
		Mean no.sticky plants (yes/no)	Mean stickiness, ranked 1-3
Ovasyn	0.25	11.8 a	1.68a
Buprofezin	0.38	6.5 b	1.34b
Buprofezin + Comate	0.38 + 1% V/V	2.0 c	1.34b
Comate	1% V/V	19.9 d	2.27c
Control	Water	20.0 d	2.30c

Different letters by column means indicate significant difference at $P \leq 0.05$