STICKY COTTON AND REDUCTION OF LINT STICKINESS

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Abstract

Sticky cotton has been an increasing problem in some cotton growing areas of Arizona and California associated with high *Bemisia argentifolii* Bellows and Perring populations. A study was conducted in the Imperial Valley, CA in 1995 to determine the effect of Solvay Enzyme B on lint stickiness. Results showed that enzyme applications of 2 to 10% by volume did not reduce lint stickiness under field conditions. This was likely due to the small increase in seed cotton moisture after these applications. Moisture of seed cotton was increased less than 1% when 50 gal/acre of water was applied to open bolls daily for 7 days. On the average, seed cotton moisture varied from 3.5% in the afternoon to 5.1% early in the morning. Lint stickiness was reduced when moisture was increased to 10% and lint samples were incu-bated at 96°F for 72 hours. The reduction was significant for thermodetector ratings of 42 to 34 for untreated cotton compared to a thermodetector rating of 27 following 10% enzyme application.

Introduction

The newly described whitefly species, *Bemisia argentifolii* Bellows and Perring (1994) has a wide host range and has been a particularly serious pest of cotton in Arizona and California since 1990. In addition to yield loss, the new species reduces lint quality because of stickiness and associated sooty-mold development (Henneberry et al. 1995) . In an action threshold study in the Imperial Valley, CA, we demonstrated 3.5 bale per acre yields with effective chemical control, but lint was sticky due to honeydew contamination (Chu et al. 1994). Commercial cotton producers in the Imperial Valley, CA averaged 2.5 bales per acre on about 6000 acres. Sticky cotton occurred where whiteflies control was inadequate (personal communication, Robert Bedwell, Planters Ginning Co., Brawley, CA, 1995). Under laboratory con-ditions lint stickiness has been reduced with enzyme treatment (Hendrix and Perkins 1995). We conducted studies in 1995 to determine the potential of treating open cotton on plants in field with an enzyme to reduce cotton lint stickiness.

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Materials and Methods

The study was conducted at the USDA-ARS Irrigated Research Station at Brawley, CA. The cotton c.v. Deltapine 5461 was planted and watered for germination on 20 March. Seed emergence reached ≈90% by 7 April. Cultural practices were conventional. No pesticides were applied during the season.

The experimental design was a factorial with four blocks. Each plot was 40 ft long by four rows wide. Rows were spaced 40 inches apart. There were four unplanted rows between plots and 30 ft alleys that separated blocks. Plots were defoliated on 29 August. The two factors studied were lint mois-ture content and amount of enzyme applied. In the dry treatment no water was applied following the initial enzyme treatment. In the wet treatment plots, 50 gal/ac of water was applied daily for six days following the initial enzyme treatment. The enzyme was applied in 50 gal/ac of water, at concentrations of 2% or 4% by volume. Controls were (1) no water applied or (2) plots treated one time with 50 gal/ac of water on the day of enzyme application. Additionally, four plots were treated with 10% enzyme solution and sprayed daily for six days with 50 gal/ac of water. A surfactant Silwet (0.04% by volume) was included in all spray treatments.

Treatments were initiated at 9:30 a.m. on 6 September. Thereafter, the wet treat-ment plots were sprayed with water daily for six days at 7:00 a.m. All sprays were applied with a High-boy sprayer equipped with three hollow cone nozzles (#7 disc with #25 core) and operated at 80 psi and 2.4 mph. The sprayer delivered 50 gal/of spray acre.

Before and after enzyme application and water treatments each day, seed cotton from 50 open bolls were picked from each plot for total reducing sugars analyses and thermodetector rating of lint stickiness. Seed cotton of ≈ 100 gm from each plot was immediately sealed in three brass cans for moisture determination. Samples were picked four times a day (0600 and 0700), 1800, and 2400 and placed in plastic baskets, weighed and dried at 212° F for 5 hours or more and re-weighed to determine moisture contents (ASTM 1987).

Also, 10 gm of lint from each plot of the two controls and the 10% enzyme treatment were moistened to 10% moisture content, sealed in a plastic bag and incubated at 96° F for 72 hours. For comparison, a similar set of lint samples were held at room temperature 74° F (range 72-76° F) on a laboratory bench for 72 hours.

Lint samples picked on 12 September from the two controls, and from plots treated with 2 and 4% enzyme solutions on 6 September were analyzed for reducing sugars and lint stickiness on 3 and 30 October to determine possible changes occurring during storage.

Weather information was collected from a weather station half a mile away from the field at 9:00 a.m. daylight saving time. Data for each sampling day were combined and analyzed according to the experimental design using a MSTAT-C statistical program (1988).

Results and Discussion

Weather conditions during the study from 6 to 12 September are shown in Table 1. Maximum and minimum air temperatures were $\geq$ 100° F and 70° F, respec-tively. No rain was recorded and relative humidity ranged from 33 to 68%. Daily evaporation ranged from 0.27 to 0.57 inches per day.

Seed cotton moisture content was the highest (5.1%) at 0600, decreasing to ≈5.0% at 0700 and to ≈3.6% at 1800 (Table 2). Seed cotton moisture content increased to ≈ 4.2% at 2400. Application of 50 gal/ac water after seed cotton sampling at 0600 increased the moisture content from 4.87 to 5.19% in samples taken at 0700. The seed cotton yield in this field was estimated at 2200 lb/acres. The 0.32% weight increase equates to about 7.04 pounds of water and enzyme added to the seed cotton on the plants. The weight of 50 gallons of water is 415.8 pounds. Thus, the interception of the applied water by open bolls on the plants was calculated to be 1.7%. Evaporation from the seed cotton surface probably occurred, but in the author's opinion, would not significantly increase the amount of water actually deposited on the seed cotton in the bolls. Increased water interception may be possible by increasing droplet size and use of flat fan nozzles (personal communication, John Norman, Texas A&M University, Weslaco, TX, 1995). However, under the high evaporation rate condition in Imperial Valley, the added water to seed cotton would likely be rapidly lost. Results in Table 2 showed that the average increase of seed cotton moisture for untreated cotton was from 3.59 at 1800 hours to 5.15% at 0600 hours. The increase in water due to atmospheric moisture of 0.56% far exceeded the 0.32% increase following 50 gal/acre water treatment. The results suggest that water applied using conventional spray equipment did not significantly contribute to seed cotton moisture increase.

Percentages of total reducing sugars in cotton lint increased from 6 to 12 September (Table 3), probably because of microbial breakdown of large to small sugar molecules. Thermodetector stickiness ratings were variable between sampling days. All values were $\geq$ 24, which is highly sticky (Perkins and Brushwood 1955). No significant differences in thermodetector lint stickiness ratings were found between cotton treated with enzyme and untreated samples. The moisture content of ≈4-5% suggests that the enzyme was not activated. When the moisture content of non-enzyme treated-lint was increased to 10% and incubated for 72 hours at a constant temperature of 96° F, the thermodetector rating was decreased from 42 to 34 compared with untreated cotton (Table 4). Results indicate that high moisture levels alone may reduce stickiness, probably due to microbial activity. The average thermodetector rating for lint from plots treated with 10% enzyme with added water to 10% moisture (96° F incubation) was 27, probably due to reducing stickiness with enzyme activity.

The seed cotton used in this study was very sticky resulting from uncontrolled whitefly populations. Under lower lint stickiness conditions, enzyme application may be useful for reducing stickiness to an acceptable level if lint moisture levels can be increased to at least 10%. Lint stickiness was not reduced in dry samples from enzyme treated plots stored over a period of one to two months (Table 5).

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Table 1. Meteorological observations during the field study with Solvay Enzyme B applied to cotton plots in Brawley, CA in 1995.

Date	Air temperature (°F) Max	Min	Mean	Percent relative humidity	Evaporation (in)
September					
6	104	80	92	68	0.30
7	106	81	94	48	0.46
8	106	84	95	64	0.50
9	107	73	90	33	0.57
10	100	70	85	37	0.41
11	106	67	87	34	0.49
12	106	67	87	33	0.27

Table 2. Average seed cotton moisture in enzyme-treated, water-treated and untreated cotton plots in Brawley, CA in 1995.

Variable	% Moisture content at[a] 2400	0600	0700	1800
Dry or wet[b]				
Dry (untreated)	4.19 a	5.15 a[d]	4.87 b	3.59 a
Wet	4.15 a	5.12 a	5.19 a	3.55 a
% Enzyme				
0	4.16 a	5.09 a	4.79 b	3.49 a
0[bc]	4.12 a	5.20 a	5.09 a	3.63 a
2	4.16 a	5.07 a	5.13 a	3.58 a
4	4.24 a	5.18 a	5.10 a	3.56 a
Interaction				
Dry, 0%	4.21 a	5.13 a	4.87 cd	3.57 a
Dry, 0%[c]	4.10 a	5.28 a	5.05 bcd	3.62 a
Dry, 2%	4.19 a	5.04 a	4.73 d	3.60 a
Dry, 4%	4.27 a	5.15 a	4.83 cd	3.55 a
Wet, 0%	4.12 a	5.05 a	4.72 d	3.41 a
Wet, 0%[bc] 4.14 a	5.13 a	5.13 bc	3.64 a	
Wet, 2%	4.12 a	5.11 a	5.54 a	3.56 a
Wet, 4%	4.20 a	5.21 a	5.36 ab	3.58 a

[a] Determined at 212 F °C for 5 or more hours.
[b] Sprayed with 50 gal/acre of water daily for six days after the day enzyme was applied.
[c] Sprayed with 50 gal/acre of water only at the day enzyme was applied.
[d] Means of a variable in a column with different letters differ significantly (Student-Neuman-Keul's Test, $p \leq 0.05$).

Table 3. Effect of Solvay Enzyme B application on total reducing sugars and lint stickiness in Brawley, CA in 1995.

Variable	%Sugar	Thermo-detector reading
Samples taken in September		
6	1.77 cd[c]	76 b
7	1.59 d	24 d
8	1.77 cd	24 d
9	1.95 bcd	95 a
10	2.03 bc	24 d
11	2.20 b	27 d
12	2.56 a	44 c
Before/after water treatment		
Before	2.02 a	45 a
After	1.95 a	46 a
Dry or wet[a]		
Dry	1.98 a	44 a
Wet	1.99 a	46 a
% Enzyme		
0	1.87 a	44 a
0[b]	1.99 a	45 a
2	2.05 a	45 a
4	2.01 a	46 a

[a] Sprayed with 50 gal/acre of water daily for six days after the day enzyme was applied.
[b] Sprayed with 50 gal/acre of water only at the day enzyme was applied.
[c] Means of a variable in a column with different letters differ significantly (Student-Neuman-Keul's Test, $p \leq 0.05$).

Table 4. Percent total reducing sugars and lint stickiness with Solvay Enzyme B treated cotton after moisture was increased to 10% in Brawley, CA in 1995.

Variable	% Sugar	Thermo-detector ratings
Incubation temperature (°F)		
74	1.44 a[a]	33 a
96	1.53 a	36 a
Water and enzyme		
Untreated	1.53 a	42 a
Water alone	1.52 a	34 b
Water plus 10% enzyme	1.39 a	27 c

[a] Means of a variable in a column with different letters differ significantly (Student-Neuman-Keul'Test, $p \leq 0.05$).

Table 5. Percent total reducing sugars content and lint stickiness ratings of cotton lint after storage of 27 and 54 days following Solvay Enzyme B application in the field in Brawley, CA in 1995.

Variable	% Reducing sugar	Thermo-detector rating
Date		
3 Oct.	2.61 a[b]	40 a
30 Oct.	2.67 a	43 a
% Enzyme		
Dry, 0	2.35 a	39 a
Dry, 0[a]	2.21 a	45 a
Dry, 2	3.01 a	38 a
Dry, 4	3.00 a	42 a

[a] Sprayed with 50 gal/ac of water at the day enzyme (in 50 gal/ac of water) was applied on 6 September.
[b] Means of a variable in column with different letters differ significantly (Student-Neuman-Keul's, $p \leq 0.05$).