Evaluation of Commercial Harvest Aid Products in Arizona Upland Cotton Production Systems

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Abstract

A defoliation experiment was conducted during the 2005 growing season in an effort to evaluate effectiveness of the Ginstar™ defoliant alone and in combination with Cotton Quick™. This study was conducted at the University of Arizona Safford Agricultural Center on Upland (cultivar DP655BR). Plots were planted on 22 April. Treatments were arranged in a randomized complete block design with four replications and treatments that included Ginstar™ at 6 and 8 oz./acre rates and Ginstar™ at the 6 and 8 oz./acre rates in combination with various rates of Cotton Quick™ (1.5, 2, 3, and 4 pts/acre). A control, not receiving any harvest prep material was also included for a total of eleven treatments. Treatments were imposed on 3 October and evaluations were made on 14 October and 26 October. Estimations on percent leaf drop, regrowth control, and open boll were made. Lint yield was estimated by harvesting the center two rows of each plot and sub-samples were collected for fiber quality analysis. Plots were harvested on 26 October in an attempt to evaluate the boll opening effectiveness of the Cotton Quick™ material. Results indicated increased leaf drop in lower Ginstar™ rates with the addition of Cotton Quick™. Measurements of open boll percentages did not indicate any increase with the addition of Cotton Quick™ however, lint yield and fiber quality parameters would demonstrate otherwise. Lint yield slightly increased in all treatments receiving Cotton Quick™ while fiber micronaire decreased in Cotton Quick™ treatments. This would indicate a blending of less mature bolls opened with the addition of Cotton Quick™ with those already opened. Percent lint also increased in all treatments receiving Cotton Quick™.

Introduction

Proper defoliation is oftentimes a difficult task to accomplish in an economical and efficient fashion. Many factors influence the effectiveness of any defoliation treatment such as weather, vigor of the crop, and water status of the crop. Mitigating factors can result in the need for more than one application of a chemical defoliant.

Chemical defoliation is an attempt to enhance a natural physiological process that occurs in the plant as it matures. As the cotton plant matures and begins to desiccate, an abscission layer begins to form at the base of the petiole where the leaf is attached to the stem. The formation of this abscission layer is driven by hormonal relationships within the plant (Cathey, 1986). As this layer forms the weight of the leaf will break the abscission layer and shear off the plant.

Chemical treatments are designed to enhance this process in preparing the crop for a clean, efficient harvest. Proper timing of defoliant applications is critical to achieving an effective defoliation. The crop must be physiologically active in order for this abscission layer to be formed. If the crop is stressed, a proper abscission layer will not be formed and a chemical defoliant may cause the leaves to 'freeze' on the plant and result in an increased level of trash in the lint. A crop that is growing very vigorously may require several applications of chemical defoliants to 'slow the crop down' in order for defoliation to effectively occur.

Another important component of harvest preparation separate from defoliation is boll opening. Several products on the market are designed to enhance boll opening and improve the ability to efficiently harvest

all available lint in one picking event. This can dramatically increase picking efficiency and reduce costs if all harvestable bolls are open at the time of picking. Most boll opening products are ethephon based. The product evaluated in this study is manufactured by DuPont namely Cotton Quick™.

The main objective of this study was to evaluate the effect of Ginstar™, a standard defoliation material, alone and in combination with a boll opening enhancer Cotton Quick™ on the yield and fiber quality of cotton grown in Arizona in an attempt to refine University recommendations on defoliation materials.

Materials and Methods

Plots were arranged in a randomized complete block design with eleven treatments and four replications. Plots consisted of four, 36-inch rows in width and extending 40 feet in length. Plots were planted with the cultivar Deltapine DP655BR on 22 April 2005. Plots were managed in an optimum fashion with respect to fertilization, irrigation, and pest control throughout the entire season. The final irrigation was applied on 9 September 2005.

Treatments were imposed on 3 October 2005 as outlined in Table 1. A John Deere Hi-Cycle (JD6000) that has been customized with a small plot CO_2 sprayer was used to apply the treatments. Defoliants were applied at a carrier rate of 19 gallons per acre and a pressure of 35 psi. Heat unit accumulations on the day of treatment and at 11 and 23 days after treatment (DAT) are shown in Table 2. Evaluations of treatment effects were made on two separate days after treatment (14 October and 26 October). Evaluations included estimations of percent leaf drop, percent regrowth control, and percent open boll. Lint yield estimates were made by harvesting the center two rows of each plot and weighing the resultant seedcotton. Sub-samples were collected for fiber quality determination and sent to the USDA Phoenix Classing Office.

All data was subjected to analysis of variance in an effort to separate out statistical differences for all dependant variables including lint yield, fiber quality parameters, percent leaf drop, percent regrowth control and percent open boll. All statistical analysis was conducted in accordance with procedures outlined by the SAS Institute (2002) and Gomez and Gomez (1985).

Results

Temperature and weather conditions near the time of treatment application were optimum for effective defoliation. Heat unit accumulations indicate warmer than normal conditions in the 20 days following application. These conditions allow for effective defoliation with most commercial defoliation products. Defoliation of all treatments was satisfactory but interesting trends were observed in both lint yield and fiber quality with respect to the addition of Cotton Quick™. Percent leaf drop and percent regrowth control for both dates of sampling are shown in Figures 1 and 2 respectively. Little significant differences were observed in any of the defoliation parameters shown in these two figures. Ginstar™ alone at the 6 oz./acre rate produced significantly lower leaf drop than other treatments. It appears that Cotton Quick™ enhances leaf drop at lower rates of Ginstar™ (Figure 1). An interesting trend observed in percent regrowth control was seen in that the lower rates of Ginstar™ in combination with Cotton Quick™ appeared to produced better control of regrowth than higher Ginstar™ + Cotton Quick™ rates (Figure 2).

Plots were harvested as near to treatment application dates as was reasonable in an attempt to pick up any differences in open boll percentages with yield. This was successfully accomplished (Table 3). However the differences observed in lint yield were not substantiated by measurement of percent open boll (Figure 3). Lint yields were significantly higher for defoliation treatments receiving Cotton Quick™ in addition to the Ginstar™ application. Lint yield for the control also was high but was due to the amount of fresh green leaves harvested along with the lint. This contributed significantly to the overall weight observed in the plot.

Fiber quality also produced interesting tends with respect to treatment. In general, lower micronaire was observed in treatments receiving Cotton Quick™ (Table 3). This could be explained by the fact that additional less mature bolls were open and available for harvest thus contributing to the lower overall fiber thickness of the sample collected. Percent lint was also affected by the addition of Cotton Quick™. Once again, in general, percent lint values were higher by nearly 3% in treatments with Cotton Quick™ added to the standard Ginstar™ treatment.

The results of this trial indicate that the addition of Cotton Quick™ to a standard Ginstar™ treatment has the potential to slightly increase lint yield and lower fiber micronaire. This trial will be conducted again during the 2006 growing season to continue to refine these recommendations.

Literature Cited

Cathey, G. W. 1986. "Physiology of defoliation in cotton production." *In J. R. Mauney and J. M. Stewart (ed.),* Cotton Physiology. *No. 1, Cotton Foundation, Memphis, TN. p. 143-153.*

Gomez, K.A. and A.A. Gomez. 1984. Statistical Procedures for Agricultural Research, Inc. Ed. John Wiley and Sons, Inc. p. 307.

SAS Institute. 2002. SAS/STAT: Procedures. Release 9.0 ed. SAS Inst., Cary, NC.

Table 1. List of products and rates applied for each treatment in the Upland defoliation trial, Safford Agricultural Center, 2005.

Treatment Number	Product	Rate
1	Ginstar	8 oz./acre
2	Ginstar+ Cotton Quick	6 oz./acre + 4 pts./acre
3	Ginstar+ Cotton Quick	8 oz./acre + 4 pts./acre
4	Ginstar+ Cotton Quick	6 oz./acre + 3 pts./acre
5	Ginstar+ Cotton Quick	8 oz./acre + 3 pts./acre
6	Ginstar+ Cotton Quick	6 oz./acre + 2 pts./acre
7	Ginstar+ Cotton Quick	8 oz./acre + 2 pts./acre
8	Ginstar+ Cotton Quick	6 oz./acre + 1.5 pts./acre
9	Ginstar+ Cotton Quick	8 oz./acre + 1.5 pts./acre
10	Ginstar	6 oz./acre
11	Control	--

Table 2. Heat unit accumulation data for the Upland defoliation trial, Safford Agricultural Center, 2005.

	Heat Unit Accumulations ($86^{o}/55^{o}$ F) – Since Planting	
	Observed	Normal
Day of Treatment (3 October)	3407	3373
11 DAT (14 October)	151	152
23 DAT (26 October)	300	281

Table 3. Lint yield and fiber quality results for each of the 11 treatments in the Upland defoliation trial, Safford Agricultural Center, 2005.

Treatment	Yield lbs. lint/acre	Percent Lint (%)	Micronaire	Fiber Length (100ths)	Staple Length (32nds)	Fiber Strength (g/tex)	Uniformity Index	Leaf Grade
1	1273 b	33.1	4.6 a	1.14 de	36.5 b	30.5 d	81.0 ef	2.5 a
2	1389 ab	34.4	4.3 d	1.13 e	36.0 c	30.7 cd	81.6 cd	2.0 b
3	1397 ab	35.0	4.4 bcd	1.15 bcd	37.0 a	30.9 bcd	81.8 bc	2.5 a
4	1592 a	35.4	4.3 d	1.13 e	36.0 c	30.6 d	81.7 c	2.0 b
5	1429 ab	34.8	4.4 bcd	1.16 a	37.0 a	31.3 abcd	82.1 a	2.0 b
6	1516 a	34.7	4.5 abc	1.14 cd	36.5 b	30.8 cd	81.3 de	2.0 b
7	1440 ab	35.3	4.4 cd	1.14 de	36.5 b	30.5 d	82.1 a	2.0 b
8	1547 a	33.8	4.3 d	1.14 cd	36.5 b	31.4 abcd	81.7 bc	2.0 b
9	1488 ab	34.0	4.35 cd	1.14 de	36.5 b	31.5 abcd	81.3 de	2.0 b
10	1268 b	32.6	4.6 ab	1.15 abc	37.0 a	32.1 a	80.9 f	2.0 b
11	1554 a	33.7	4.4 bcd	1.16 ab	37.0 a	31.8 ab	82.0 ab	2.0 b
§LSD	220	--	0.2	0.01	0.4	0.9	0.3	0.3
†CV	10.5	--	2.6	0.7	0.8	2.1	0.3	8.7
‡OSL	0.0651	--	0.0058	0.0001	0.0001	0.0105	0.0001	0.0003

*Means followed by the same letter are not statistically different according to a Fisher's LSD means separation test.
§Least Significant Difference
†Coefficient of Variation
‡Observed Significance Level

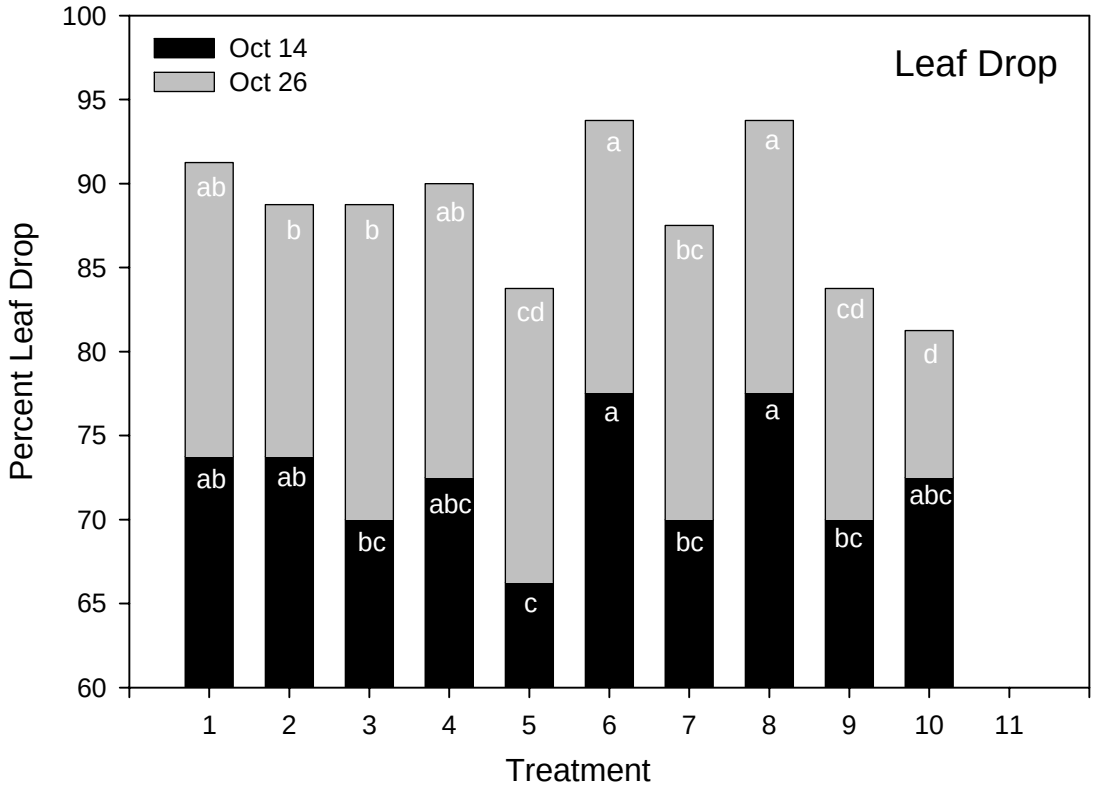

Figure 1. Percent leaf drop for each treatment and each observation date in the Upland cotton defoliation trial, Safford Agricultural Center, 2005.

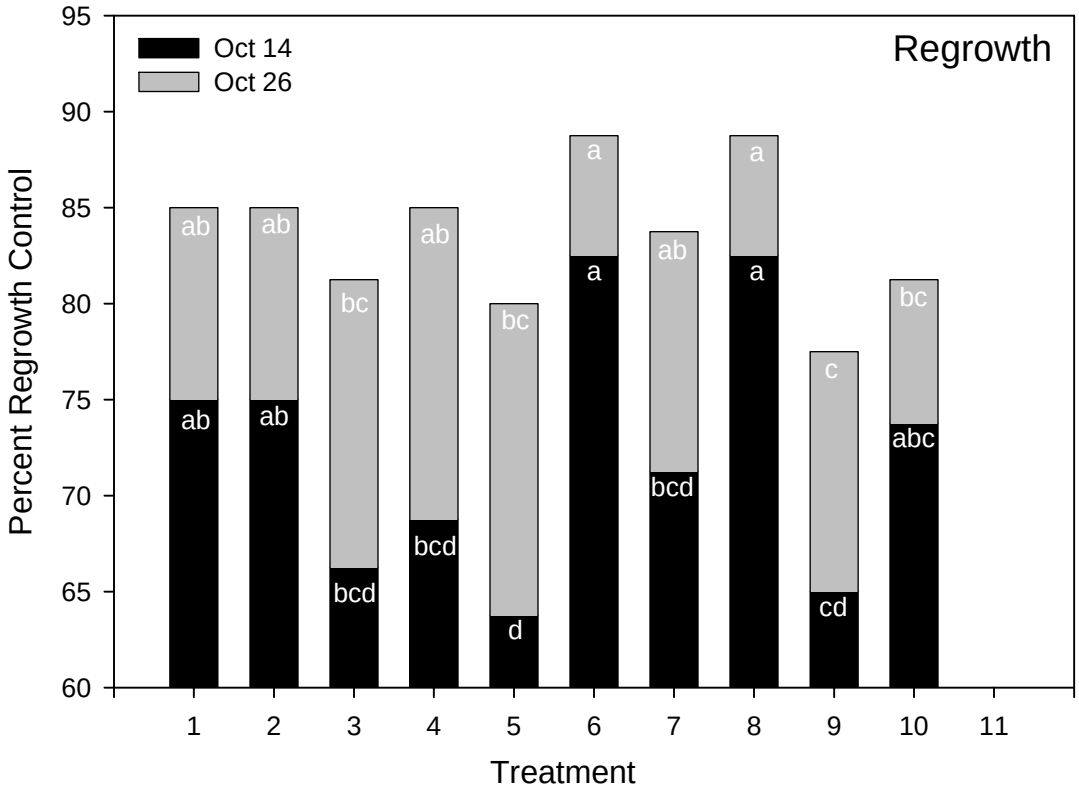

Figure 2. Percent control of regrowth for each treatment and each observation date in the Upland cotton defoliation trial, Safford Agricultural Center, 2005.

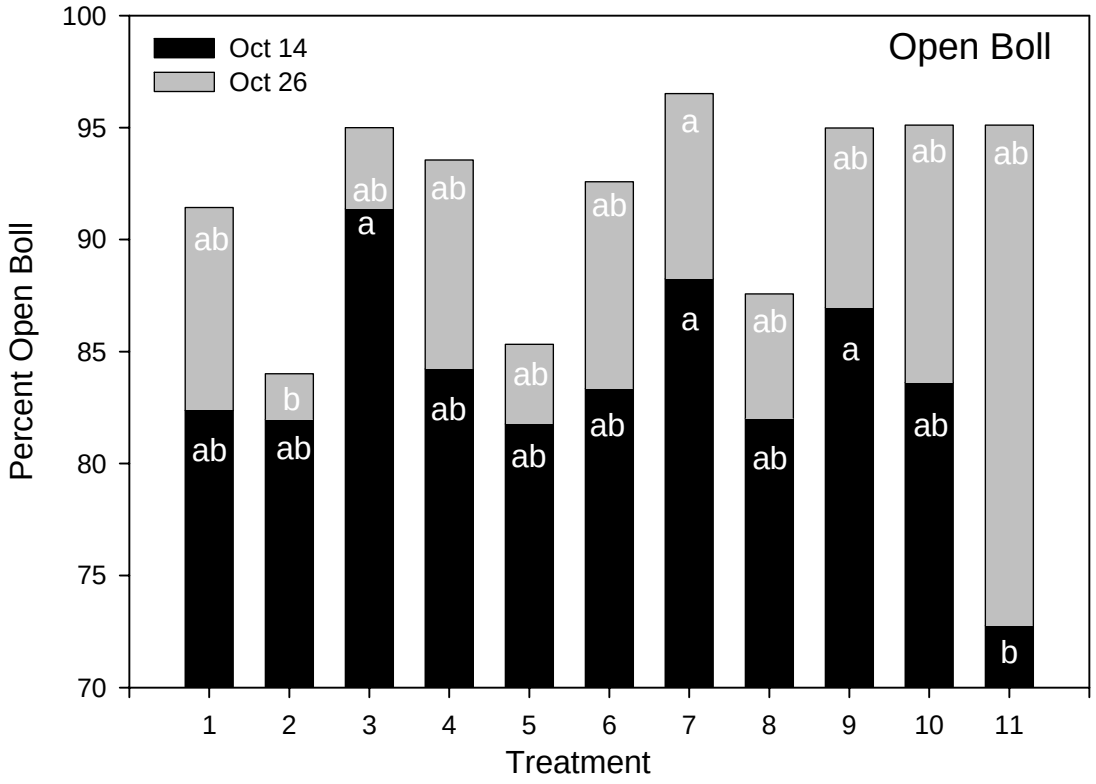

Figure 3. Percent open boll for each treatment and each observation date in the Upland cotton defoliation trial, Safford Agricultural Center, 2005.