

Effects of Synergistic Additives to Standard Defoliation Materials in both Upland and Pima Cotton

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Abstract

Two separate defoliation experiments were conducted during the 2004 growing season in an effort to evaluate the effectiveness of commercially available harvest preparation materials alone at full label rates and to also evaluate these materials at reduced rates with the addition of various synergistic chemicals designed to enhance the effectiveness of commercially available harvest prep materials. The studies were conducted at the University of Arizona Safford Agricultural Center on both Upland (cultivar DP555BR) and Pima (cultivar DP340) cotton. Plots were planted on 20 April and 27 April for the Upland and Pima, respectively. Plots were arranged in a randomized complete block design with four replications and treatments included Ginstar at recommended rates and Ginstar at reduced rates with the addition of three chemical enhancement materials (A, B, and C). Sodium chlorate was also included at a full rate and at reduced rates with the three enhancement materials. A control, not receiving any harvest prep material was also included for a total of eleven treatments. Treatments were imposed on 15 October and evaluations were made on 27 October and 4 November. 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. Results indicated that the most effective treatment for both Upland and Pima trials was Ginstar at the full rate. Reduced rates of Ginstar in combination with the enhancement chemicals of B and C also provided good defoliation results. The chemicals that were designed to enhance the efficacy of the commercial harvest prep materials appeared to have an antagonistic affect with the sodium chlorate. Defoliation effectiveness decreased with the addition of chemicals A, B, and C to sodium chlorate. No statistical differences were detected among lint yield or any of the fiber quality parameters in any of the treatments of both the Upland and Pima trials.

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.

The objective of this study was to evaluate the effect of several harvest preparation materials and some additional additives in an attempt to refine 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 the cultivar Deltapine DP555BR on 20 April 2004. 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 13 September 2004.

Treatments were imposed on 15 October 2004 as outlined in Table 1. A John Deere Hi-Cycle (JD6000) that has been customized with a small plot CO₂ 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 12 and 20 days after treatment (DAT) are shown in Table 2. Evaluations of treatment effects were made on two separate days after treatment (27 October and 4 November). 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

The 2004 growing season was cooler than normal so the crop was carried further into the fall in an effort to mature the crop. Defoliation applications were made slightly later than normal due to the extended season. Weather conditions surrounding the application and for the following three weeks were significantly cooler than normal as indicated by heat unit accumulations described in Table 2. However, both the Upland and Pima plots were near 60% open boll when defoliation applications were made on 15 October 2004.

Statistical analysis revealed no significant differences among treatments with respect to yield or fiber quality. General yield levels for these trials were high which is indicative of yields experienced around the region but differences were not statistically different as affected by defoliation treatments (Tables 3 and 4).

Differences were detected among the defoliation variables of percent leaf drop, regrowth control, and open boll. Differences in the parameters will be discussed for each individual trial.

Upland Trial

Ginstar alone at the rate of 8 oz./acre was the most effective treatment and also the most efficient providing the highest degree of defoliation and regrowth control during the first week after application. Figure 1, 2, and 3 show results for leaf drop, regrowth control and open boll for both observation dates respectively. Very little change was observed in the full rate Ginstar plots between the two sample dates. The lower rates of Ginstar in combination with the enhancing materials B and C were also nearly as effective as the high Ginstar rate after the three week observation period; however they were slower to accomplish the

desired result of over 80 percent defoliation. The sodium chlorate response was the inverse of what was observed with the Ginstar treatments. The addition of the enhancing materials appeared to have an antagonistic effect with the sodium chlorate. Levels of percent leaf drop and regrowth control decreased linearly with the addition of A, B, and C. Very little differences were observed in percent open boll measurements as affected by defoliation treatments. All treatments were near 100 percent three weeks post treatment.

Pima Trial

Overall defoliation in the Pima trial was less effective than the Upland trial. Less variation due to treatment was also observed. However, it appears that the antagonistic effects of the enhancement materials with the sodium chlorate were as pronounced in the Pima as they were in the Upland (Figure 4, 5, and 6). The synergistic products A, B, and C appeared to be just as effective as the full-rate of Ginstar by the end of the three week period post application.

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 and Pima defoliation trial, Safford Agricultural Center, 2004.

Treatment Number	Product	Rate
1	Ginstar	8.0 oz./acre
2	Ginstar	2.5 oz./acre
3	Ginstar + Formula A	2.5 oz./acre + 2% A
4	Ginstar + Formula B	2.5 oz./acre + 2% B
5	Ginstar + Formula C	2.5 oz./acre + 2% C
6	Sodium Chlorate	3 gpa
7	Sodium Chlorate	1 gpa
8	Sodium Chlorate + Formula A	1 gpa + 2% A
9	Sodium Chlorate + Formula B	1 gpa + 2% B
10	Sodium Chlorate + Formula C	1 gpa + 2% C
11	Control	--

Table 2. Heat unit accumulation data for the Upland and Pima defoliation trial, Safford Agricultural Center, 2004.

	Heat Unit Accumulations (86°/55° F) – Since Planting	
	Observed	Normal
		Upland Trial
Day of Treatment (15 October)	3433	3562
12 DAT (27 October)	113	129
20 DAT (4 November)	147	191
		Pima Trial
Day of Treatment (15 October)	3350	3476
12 DAT (27 October)	113	129
20 DAT (4 November)	147	191

Table 3. Lint yield and fiber quality results for each of the 11 treatments in the Upland defoliation trial, Safford Agricultural Center, 2004.

Treatment	Yield lbs. lint/acre	Micronaire	Fiber Length (100ths)	Staple Length (32nds)	Fiber Strength (g/tex)	Uniformity Index	Leaf Grade
1	1685.8 abc*	39.5 a	106.5 a	34.5 a	29.25 a	79 a	2 a
2	1860.6 ab	42 a	110 a	35 a	28.5 a	79.5 a	2.5 a
3	1948.8 a	42 a	110.5 a	35.5 a	28.75 a	79 a	2 a
4	1703.7 abc	42 a	111 a	35.5 a	28.45 a	80.5 a	2 a
5	1744.6 abc	37.5 a	112.5 a	36 a	28.75 a	81 a	2.5 a
6	1579.6 bc	45 a	106 a	34 a	27.7 a	79.5 a	3 a
7	1756.0 abc	44.5 a	107.5 a	34.5 a	27.7 a	80 a	2.5 a
8	1785.4 abc	38.5 a	112 a	36 a	29.05 a	80.5 a	2 a
9	1497.9 c	42.5 a	109 a	35 a	28.4 a	79.5 a	3 a
10	1718.4 abc	40.5 a	109.5 a	35.5 a	29.1 a	79.5 a	2.5 a
11	1762.5 abc	40.5 a	109 a	35 a	28.9 a	80 a	2.5 a
§LSD	NS	NS	NS	NS	NS	NS	NS
†CV	12.9	5.85	2.56	2.62	3.99	1.18	26.5
‡OSL	0.3376	0.18	0.42	0.53	0.91	0.54	0.72

*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

Table 4. Lint yield and fiber quality results for each of the 11 treatments in the Pima defoliation trial, Safford Agricultural Center, 2004.

Treatment	Yield lbs. lint/acre	Micronaire	Fiber Length (100ths)	Staple Length (32nds)	Fiber Strength (g/tex)	Uniformity Index	Leaf Grade
1	1136.9 ab*	39.5 a	138 a	48 a	38.85 a	86 a	1.5 a
2	1048.7 ab	40 a	138 a	48 a	39.55 a	85 a	1.5 a
3	1092.8 ab	40 a	137.5 a	48 a	37.9 a	84.5 a	1.5 a
4	1060.1 ab	38 a	139.5 a	48 a	38.7 a	85.5 a	1 a
5	1076.5 ab	39 a	140 a	48 a	37.8 a	85 a	1 a
6	1217.5 ab	40 a	139 a	48 a	38.4 a	86 a	1 a
7	1304.6 a	40.5 a	136.5 a	47 a	37.5 a	84.5 a	1.5 a
8	986.6 ab	37 a	138.5 a	48 a	38.45 a	84.5 a	1.5 a
9	965.4 b	38.5 a	137.5 a	48 a	39.05 a	85 a	1 a
10	1089.5 ab	38 a	138 a	48 a	38.55 a	85 a	1.5 a
11	1069.9 ab	39.5 a	137.5 a	47 a	38.3 a	85.5 a	1.5 a
§LSD	NS	NS	NS	NS	NS	NS	NS
†CV	20.1	4.8	0.98	1.39	2.95	0.83	46.44
‡OSL	0.9188	0.73	0.56	0.69	0.85	0.39	0.96

*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

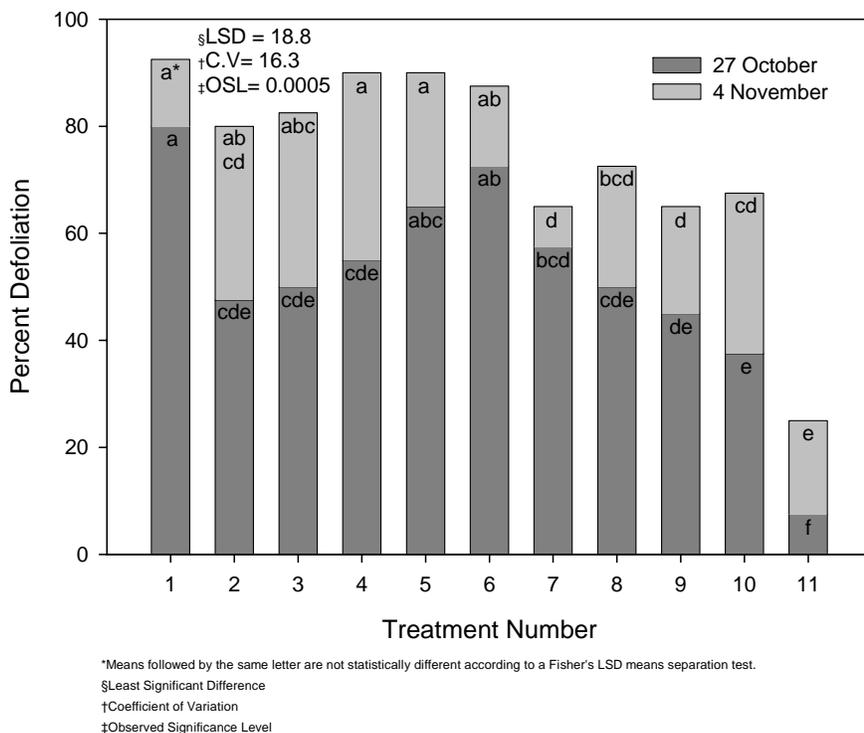


Figure 1. Percent leaf drop for each treatment and each observation date in the Upland cotton defoliation trial, Safford Agricultural Center, 2004.

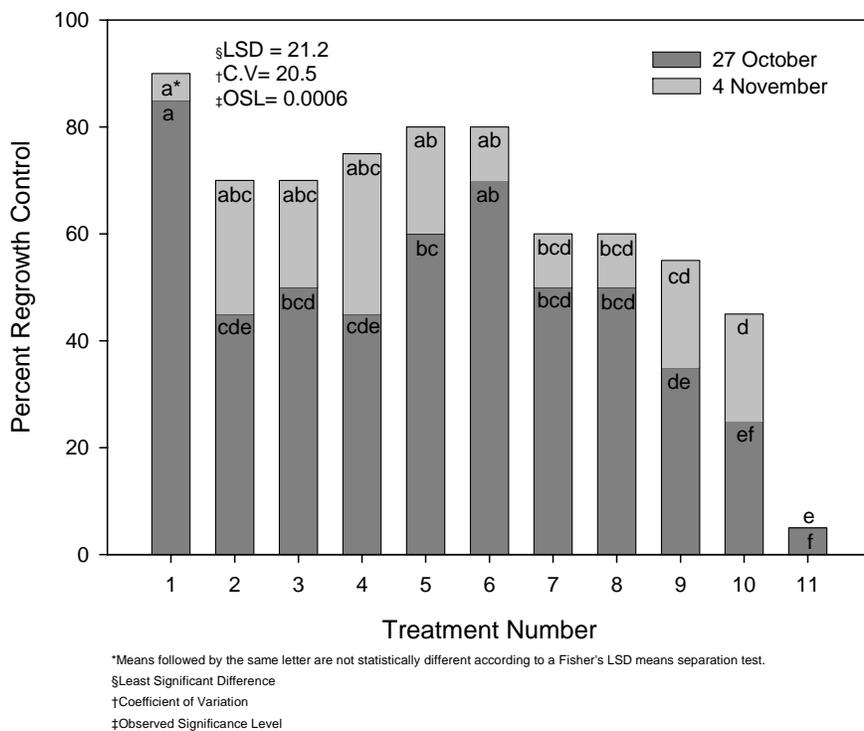


Figure 2. Percent control of regrowth for each treatment and each observation date in the Upland cotton defoliation trial, Safford Agricultural Center, 2004.

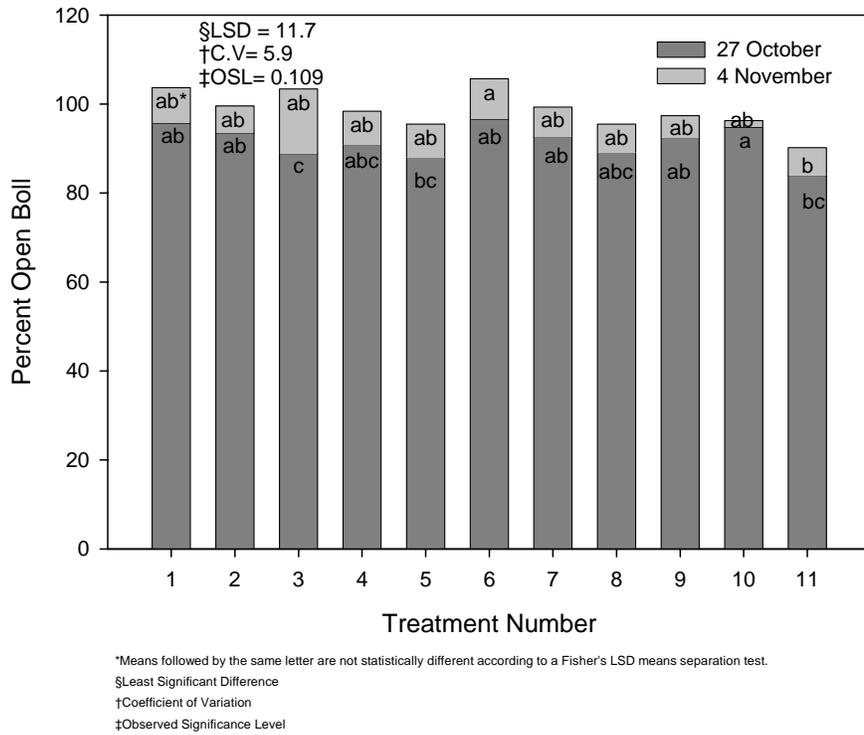


Figure 3. Percent open boll for each treatment and each observation date in the Upland cotton defoliation trial, Safford Agricultural Center, 2004.

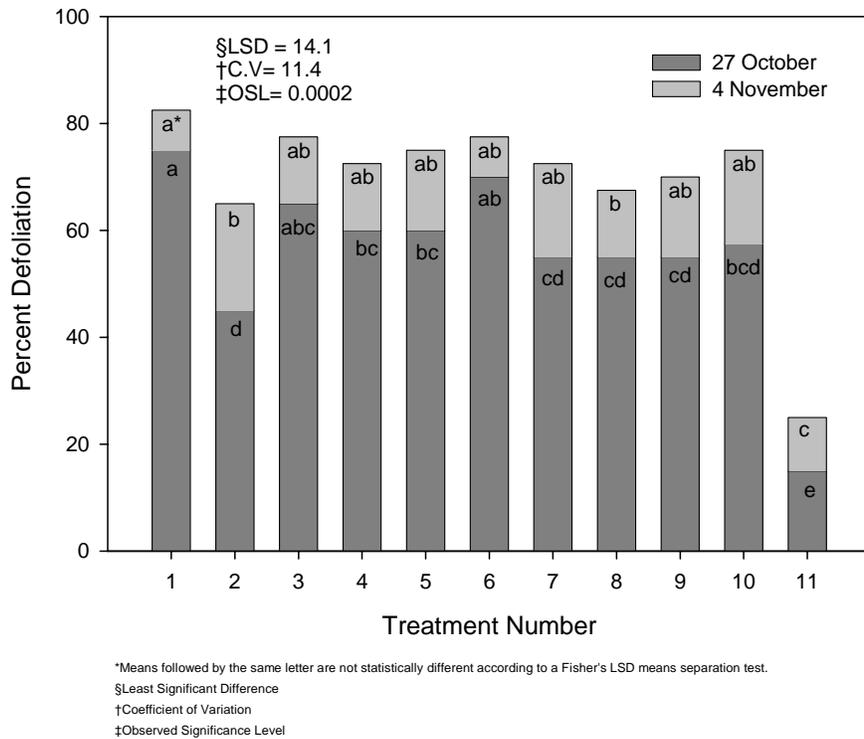


Figure 4. Percent leaf drop for each treatment and each observation date in the Pima cotton defoliation trial, Safford Agricultural Center, 2004.

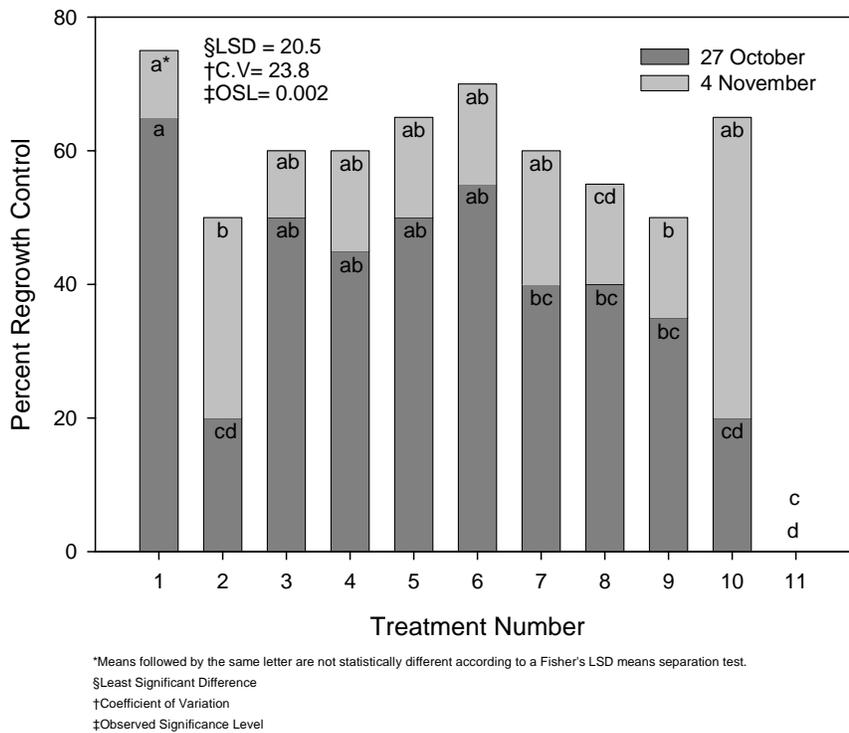


Figure 5. Percent control of regrowth for each treatment and each observation date in the Pima cotton defoliation trial, Safford Agricultural Center, 2004.

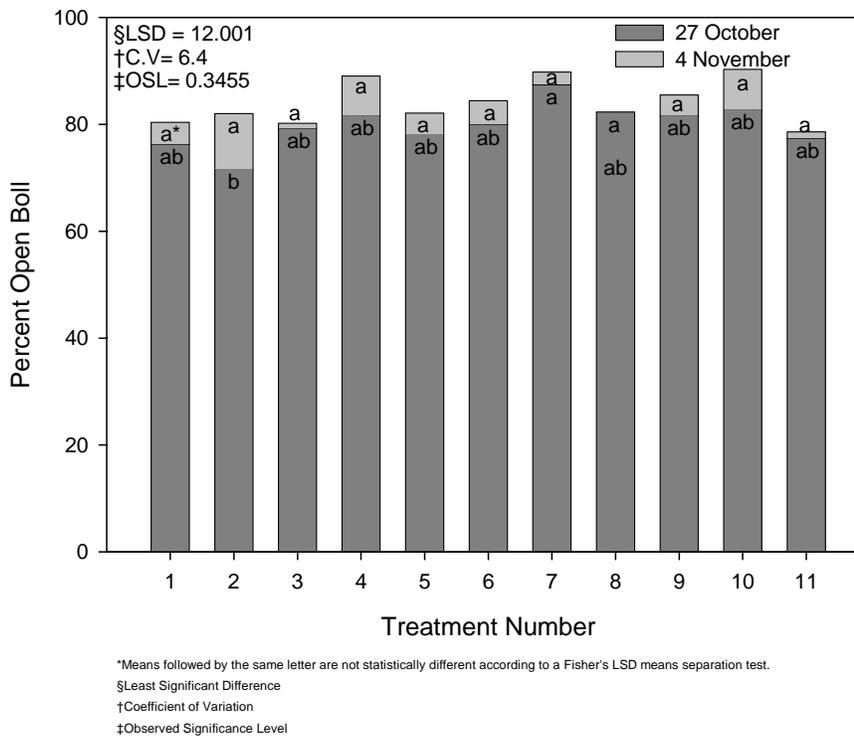


Figure 6. Percent open boll for each treatment and each observation date in the Pima cotton defoliation trial, Safford Agricultural Center, 2004.