

2006 Evaluation of Commercial Harvest Aid Materials in Arizona Cotton Production Systems

E.R. Norton and D.L. Hatch

Abstract

A defoliation experiment was conducted during the 2006 growing season in an effort to evaluate the effectiveness of Ginstar[®] and FreeFall[®] defoliant alone and in combination with CottonQuik[®]. This study was conducted at the University of Arizona Safford Agricultural Center on Upland (cultivar DP655BR). Plots were planted on 20 April. Treatments were arranged in a randomized complete block design with four replications and treatments 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 CottonQuik[®] (1.5, 2, 3, and 4 pts./acre). We also evaluated a new product from DuPont, FreeFall[®] SC at different rates (3.2, 4.8, 6.4 oz./acre) in combination with CottonQuik[®] (2 pts./acre). The standard defoliation protocol among growers in southeastern Arizona is sodium chlorate plus Gramoxone[®], so this treatment combination was also included. A control, not receiving any harvest prep material was also included for a total of fifteen treatments. Treatments were imposed on 13 October and evaluations were made on 20 October and 1 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. Plots were harvested on 2 November directly after the second evaluation date in an attempt to evaluate the boll opening effectiveness of the CottonQuik[®] material. Results indicated higher effectiveness of leaf drop or defoliation in the plots that included CottonQuik[®] as opposed to Ginstar[®] alone. The treatments performed much better than the standard sodium chlorate treatment. Percent leaf drop also increased at the higher rates of FreeFall[®] (4.8, 6.4 oz./acre). The percentage of open boll was also improved with the addition of CottonQuik[®] to the all of the treatments. However, very little significant differences were observed in lint yield and fiber quality. A trend of increased yield with the addition of CottonQuik[®] was observed when compared to Ginstar[®] alone or the standard sodium chlorate treatment. All aspects of harvest preparation including percent defoliation and boll opening appear to be significantly enhanced with the use of CottonQuik[®] when compared to standard Ginstar[®] rates alone.

Introduction

Proper defoliation (leaf drop) 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 CottonQuik®.

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 CottonQuik® on the yield and fiber quality of cotton grown in Arizona in an attempt to refine University recommendations on defoliation materials. A new product from DuPont, FreeFall® was also evaluated tank mixed with CottonQuik®. The standard treatment used in southeastern Arizona includes sodium chlorate tank mixed with a dessicant such as Gramoxone®. This treatment was also included for evaluation in the 2006 trial.

Materials and Methods

Plots were arranged in a randomized complete block design with fifteen 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 20 April 2006. 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 30 August 2006.

Treatments were imposed on 13 October 2006 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 7 and 19 days after treatment (DAT) are shown in Table 2. Evaluations of treatment effects were made on two separate days after treatment (20 October and 1 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 on 2 November 2006. 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. However, conditions following the initial treatment began to cool dramatically and remained much cooler than normal for the 20 days post treatment until harvest. Figure 1 shows daily maximum air temperature for 2006 and normal for the 20 days between treatment and harvest. Table 2 shows that, as a result, lower than normal heat unit accumulations were observed during this time period. Even though cooler than normal conditions prevailed all defoliation treatments performed an adequate job of prepping the crop for harvest, although some important trends among treatments were observed.

Percent leaf drop for both dates of sampling are shown in Figure 2. Little significant differences were observed in defoliation, however trends toward higher defoliation with the addition of CottonQuik® were observed. Increase in defoliation with increasing rates of FreeFall® was also observed. In general all treatments of Ginstar® in combination with CottonQuik® performed better in terms of defoliation than Ginstar® alone.

Percent open boll for each treatment at the two sampling dates is shown in Figure 3. Statistical differences were again not observed but trends toward higher percent open boll was observed with the addition of CottonQuik® compared to Ginstar® alone. The sodium chlorate treatment had higher open boll when compared to all other treatments on the first evaluation date but was did not make significant gains in percent open boll between the first and second evaluation dates as the other treatments experienced.

Percentage control of regrowth is plotted in Figure 4 for only the second observation date. On the first observation date none of the treatments except the control had any appreciable regrowth. By the second evaluation date differences among treatments in the amount of regrowth was evident. In general, treatments with the higher rate (8 oz./acre) of Ginstar® resulted in better control of regrowth. The higher rates of FreeFall® produced very good control of regrowth. The sodium chlorate treatment resulted in the lowest amount of regrowth control aside from the control.

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. Although significant differences were not observed in lint yield, trends toward higher lint yield with the addition of CottonQuik® was observed (Table 3) as was the case in the trial conducted in 2005. The control treatment also placed near the top of the means as it did in 2005 which is likely due to the fact that increased green leaf content was harvested from this treatment as compared to all other treatments.

Fiber quality analysis did not produce any significant trends with respect to treatments in 2006 (Table 3). In the 2005 trial, lower micronaire was observed in treatments receiving CottonQuik®. Significant differences were observed in 2006 but no discernable trends with respect to treatment were observed. No other fiber quality parameter produced significant differences with respect to any harvest aid material.

We will continue to conduct evaluations of defoliation materials during the 2007 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 harvest aid evaluation, Safford Agricultural Center, 2006.

Treatment Number	Product	Rate
1	Ginstar	8 oz./acre
2	Ginstar+ CottonQuik	6 oz./acre + 1.5 pts./acre
3	Ginstar+ CottonQuik	8 oz./acre + 1.5 pts./acre
4	Ginstar+ CottonQuik	6 oz./acre + 2.0 pts./acre
5	Ginstar+ CottonQuik	8 oz./acre + 2.0 pts./acre
6	Ginstar+ CottonQuik	6 oz./acre + 3.0 pts./acre
7	Ginstar+ CottonQuik	8 oz./acre + 3.0 pts./acre
8	Ginstar+ CottonQuik	6 oz./acre + 4.0 pts./acre
9	Ginstar+ CottonQuik	8 oz./acre + 4.0 pts./acre
10	FreeFall + CottonQuik	3.2 oz./acre + 2.0 pts./acre
11	FreeFall + CottonQuik	4.8 oz./acre + 2.0 pts./acre
12	FreeFall + CottonQuik	6.4 oz./acre + 2.0 pts./acre
13	Ginstar	6.0 oz./acre
14	Sodium Chlorate + Gramoxone	2.5 gallon/acre + 8 oz./acre
15	Control	--

Table 2. Heat unit accumulation data for the Upland defoliation trial, Safford Agricultural Center, 2006.

	Heat Unit Accumulations (86°/55° F) – Since Planting	
	Observed	Normal
Day of Treatment (13 October)	3411	3393
7 DAT (20 October)	208	228
19 DAT (1 November)	295	340

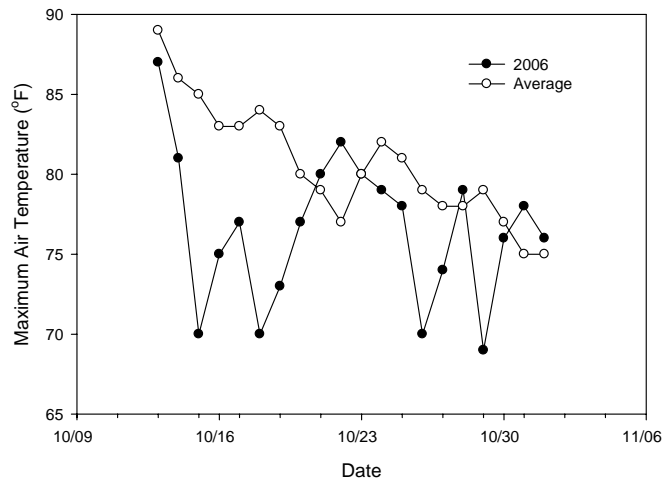


Figure 1. Average and current daily maximum temperature (°F) for the dates following initial treatment through the evaluation period (13 Oct through 1 Nov).

Table 3. Lint Yield and fiber quality results for the harvest aid evaluation trial, Safford, AZ, 2006.

Treatment Code	Treatment	Lint Yield		Lint	HVI	Staple	Strength	Uniformity	Micronaire	Leaf	Premium	Value
				Tumout	Color					Grade		
		lbs/acre		Percent		32nds	g/tex	Percent			cent/lb	\$/acre
4	Ginstar 6 oz/acre + CottonQuick 2.0 pts/acre	2199.9	a*	38.9	31	37.8	29.2	82.0	3.78	3	611.25	1278.99
6	Ginstar 6 oz/acre + CottonQuick 3.0 pts/acre	2144.0	a b	39.2	21	36.8	28.5	80.3	3.90	3	561.25	1236.82
15	Control	2140.3	a b	39.1	21	37.8	28.4	81.3	3.98	3	666.25	1255.78
2	Ginstar 6 oz/acre + CottonQuick 1.5 pts/acre	2089.4	a b c	39.3	21	37.0	27.6	80.0	3.93	2	698.75	1232.61
11	FreeFall 4.8 oz/acre + CottonQuick 2 pt/acre	2087.2	a b c	38.9	21	37.8	28.7	81.1	3.88	3	643.75	1220.06
10	FreeFall 3.2 oz/acre + CottonQuick 2 pt/acre	2048.3	a b c	38.4	31	37.8	28.3	80.7	3.60	4	267.50	1120.61
7	Ginstar 8 oz/acre + CottonQuick 3.0 pts/acre	2028.0	a b c	38.5	21	36.8	28.8	80.9	3.88	3	627.50	1182.25
9	Ginstar 8 oz/acre + CottonQuick 4.0 pts/acre	2020.7	a b c	38.8	31	37.0	29.0	80.9	3.93	3	548.75	1159.75
3	Ginstar 8 oz/acre + CottonQuick 1.5 pts/acre	2007.3	a b c	38.6	21	37.0	28.6	80.9	3.83	3	643.75	1172.74
12	FreeFall 6.4 oz/acre + CottonQuick 2 pt/acre	1992.6	a b c	38.6	21	37.0	29.2	81.0	3.80	2	705.00	1176.67
8	Ginstar 6 oz/acre + CottonQuick 4.0 pts/acre	1940.7	b c	38.6	21	36.8	28.0	80.9	3.60	3	588.75	1124.01
5	Ginstar 8 oz/acre + CottonQuick 2.0 pts/acre	1934.7	b c	38.4	21	36.8	28.4	80.4	3.70	2	622.50	1127.14
1	Ginstar 8 oz/acre	1922.0	b c	39.2	31	37.8	29.2	80.8	3.58	3	518.75	1100.82
14	Na Chlorate 2.5 g/acre + Gramoxone 8 oz/acre	1909.4	b c	38.3	21	37.3	29.0	80.4	3.73	3	616.25	1110.24
13	Ginstar 6 oz/acre	1877.7	c	39.0	21	37.0	28.6	81.0	3.73	3	645.00	1097.53
LSD§		236.3		0.8	—	1.0	1.1	1.1	0.2	0.6	181.1	147.2
OSL†		0.2247		0.2571	—	0.2119	0.1653	0.1591	0.008	0.0004	0.01	0.22
CV‡		8.2		1.5	—	2.0	2.7	0.9	4.2	15.8	21.2	8.8

*Means followed by the same letter are not statistically different according to a Fisher's least significant difference means separation test

§ Least Significant Difference

† Observed Significance Level

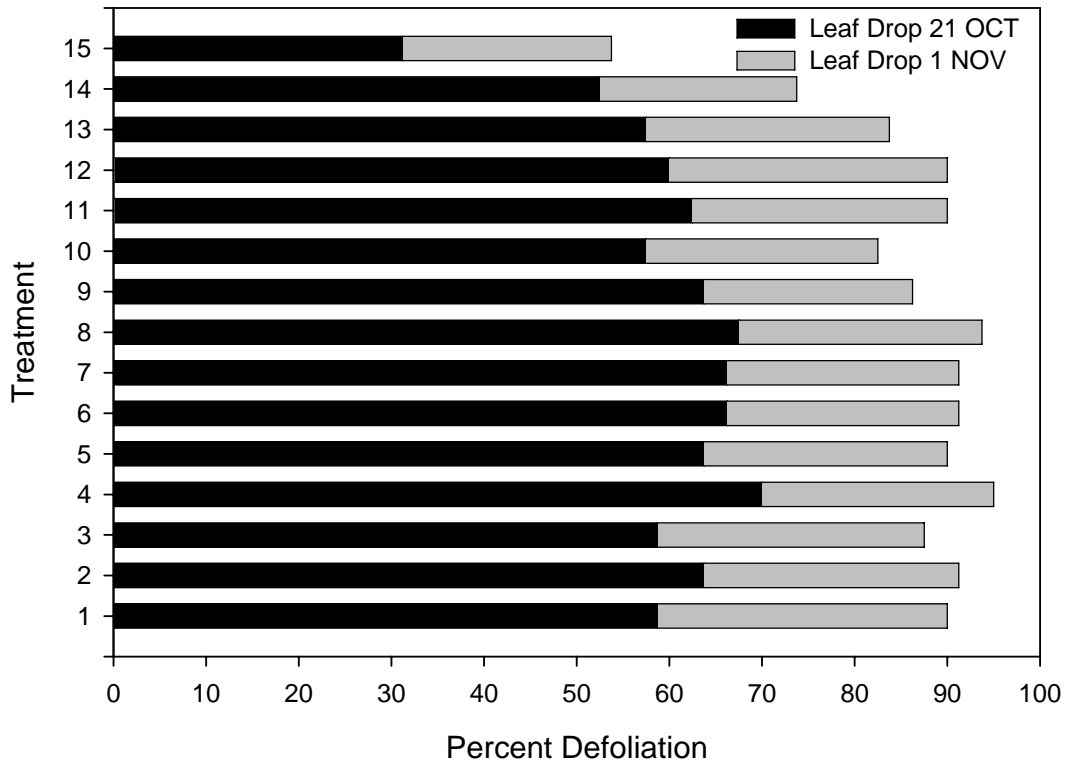


Figure 2. Percent defoliation for each treatment and each observation date in the Upland cotton defoliation trial, Safford Agricultural Center, 2006.

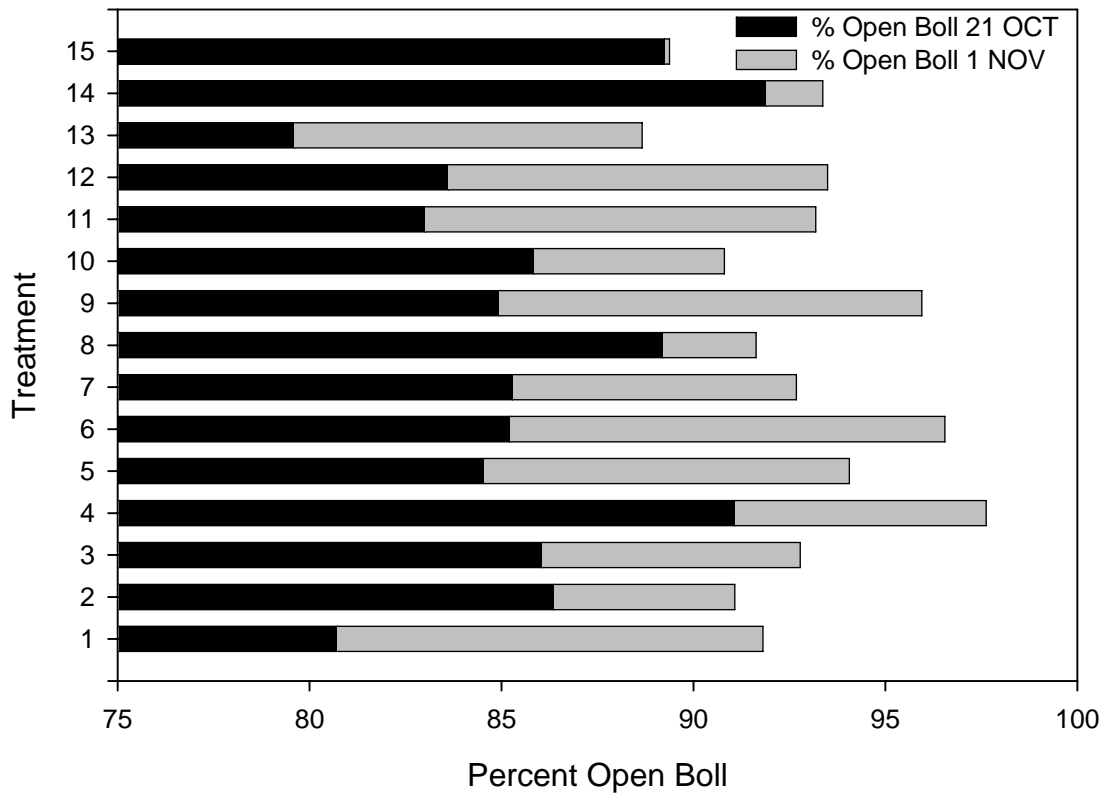


Figure 3. Percent open boll for each treatment and each observation date in the Upland cotton defoliation trial, Safford Agricultural Center, 2006.

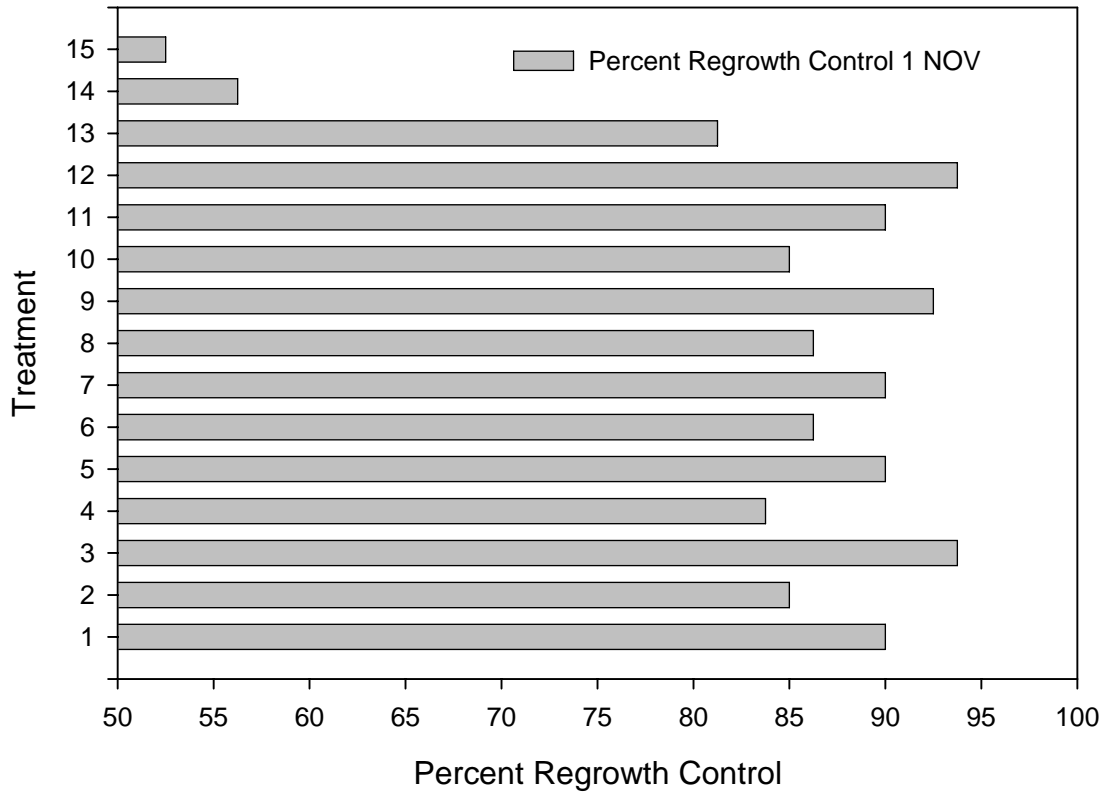


Figure 4. Percent control of regrowth for each treatment and each observation date in the Upland cotton defoliation trial, Safford Agricultural Center, 2006.