Effect of Heat Unit Accumulation on Cotton Defoliation, Lint Yield and Fiber Quality

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Abstract

This study evaluated the effectiveness of defoliating at various heat unit accumulations: 630HU, 730 HU, 830 HU, 930 HU, 1030 HU, 1130 HU and 1330 HU and impact on lint yield and fiber quality. American Upland cotton variety DP 449 BR was planted on 12 April 2005 at the University of Arizona Maricopa Agriculture Center in Maricopa, Arizona. The experimental design was a split plot with four replications of each of seven defoliation timings. Final irrigation occurred on 05 August 2005. When heat unit accumulation reached 630 HU (on 20 August 2005), 730 HU (on 01 September 2005), 830 HU (on 04 September 2005), 930 HU (on 08 September 2005), 1030 HU (on 12 September 2005), 1130 HU (on 19 September 2005) and 1330 HU (on 27 September 2005) using the 86/55 F model chemical defoliants were applied. A mixture of Def (tribufos) at 24 oz/A, Dropp (thidiazuron) at 0.2 lb/A and Prep (ethephon) at 24 oz/A was applied using a high clearance research sprayer. The earliest treatments (630 and 730 HU accumulated) had significantly fewer open bolls at defoliation than those that received later treatments. At harvest, this trend disappears: the latest application (at 1330 HU) had significantly fewer open bolls than any other timing. Seven days after defoliant application (7 DAT), highest levels of defoliation were observed in the following treatments in descending order: 830 HU, 630 HU, 1130 HU, 930 HU and 730 HU followed by 1030 HU and 1330 HU. At harvest, there were no significant differences among mean defoliation percentages with the exception of the 1330 HU timing, which was significantly less defoliated than any of the other timings. Highest lint yield and gin turnout were observed in the earliest defoliation timings, lowest in the later timings. No significant differences in micronaire, length or uniformity were observed between defoliation timings. Differences did occur in fiber strength which was highest in earlier timings and lowest in the last timing, but all were above the discount level.

Introduction

Several factors must be taken into account when determining the optimal time to defoliate cotton in Arizona and a number of methods exist to determine crop maturity and readiness for defoliation. Defoliating before the crop is mature may lead to reduced yields. Defoliating too late can result in poor fiber quality and increased expenses related to management. The growth and development of cotton, like many other plants, is directly related to the amount of heat to which the plant is exposed. Heat units are a measurement of the amount of heat accumulated by a plant over a certain period of time and there are different methods for calculating heat units. In Arizona, the 86/55 F method is used wherein each day of the growing season the amount of time is recorded that the temperature is above 55^{o}F and below 86^{o}F. Determining the optimal heat unit accumulation for cotton defoliation is important to maximize yield and fiber quality while minimizing costs of inputs. This study evaluated the effectiveness of defoliating at various heat unit accumulations: 630HU, 730 HU, 830 HU, 930 HU, 1030 HU, 1130 HU and 1330 HU and impact on lint yield and fiber quality.

Materials and Methods

American Upland cotton variety DP 449 BR was planted on 12 April 2005 at the University of Arizona Maricopa Agriculture Center in Maricopa, Arizona. The experimental design was a split plot with four replications of each of seven defoliation timings. Each plot consisted of 4 rows, totaling 13.33 feet wide by 30 feet long. Conventional tillage was used as were standard cotton management practices for irrigation, fertilization and insect pest management.

Final irrigation occurred on 05 August 2005. When heat unit accumulation reached 630 HU (on 20 August 2005), 730 HU (on 01 September 2005), 830 HU (on 04 September 2005), 930 HU (on 08 September 2005), 1030 HU (on 12 September 2005), 1130 HU (on 19 September 2005) and 1330 HU (on 27 September 2005) using the 86/55 F model chemical defoliants were applied. A mixture of Def (tribufos) at 24 oz/A, Dropp (thidiazuron) at 0.2 lb/A and Prep (ethephon) at 24 oz/A was applied using a high clearance research sprayer.

Before chemical defoliants were applied, crop maturity was assessed by measuring the percent bolls open on the plant. This value was calculated by first randomly selecting three plants per plot and counting the total number of bolls per plant then dividing that number into the number of open bolls per plant. This measurement was repeated just prior to harvest.

Percent defoliation was measured 7 DAT and again at harvest using a visual rating system with zero equal to no defoliation and 100 equal to complete defoliation . The two center rows of each plot was harvested, weighed and ginned and lint yield and percent lint were determined.

Fiber quality measurements including color, leaf grade, micronaire, staple length, strength and uniformity were taken by the USDA AMS Cotton Classing Office in Phoenix, Arizona. Mean values for each measurement were compared by analysis of variance (split plot with no pooled error) using the Agriculture Research Manager software.

Results and Conclusions

Crop Maturity

The earliest treatments (630 and 730 HU accumulated) had significantly fewer open bolls at defoliation than those that received later treatments (Figure 1). At harvest, this trend disappears: the latest application (at 1330 HU) had significantly fewer open bolls than any other timing.

Percent Defoliation

Seven days after defoliant application (7 DAT), highest levels of defoliation were observed in the following treatments in descending order: 830 HU, 630 HU, 1130 HU, 930 HU and 730 HU followed by 1030 HU and 1330 HU (Figure 2). At harvest, there were no significant differences among mean defoliation percentages with the exception of the 1330 HU timing, which was significantly less defoliated than any of the other timings.

Gin Turnout and Lint Yield

Highest lint yield and gin turnout were observed in the earliest defoliation timings, lowest in the later timings (Figure 3).

Fiber Quality

No significant differences in staple length, micronaire or uniformity were observed between defoliation timings. Differences did occur in fiber strength which was greatest in earlier timings and least in the latest timing (data not shown) but all were above the discount level.

There is no benefit to delaying defoliation in terms of fiber quality, yield or gin turnout. Further research is needed to investigate the effectiveness of earlier defoliation timing (accumulation of 230, 330, 430 and 530 HU).

Acknowledgments

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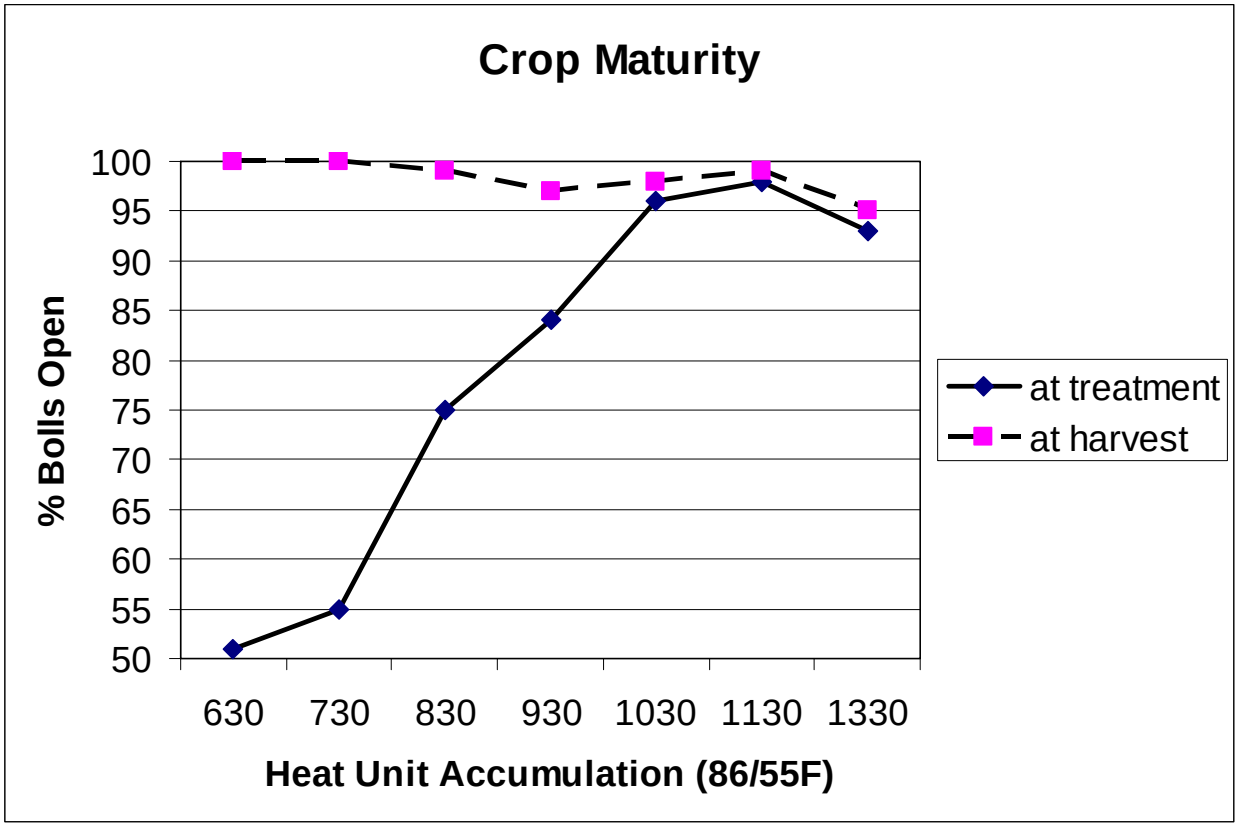

Figure 1. Percent bolls open just prior to defoliation application and at harvest at different heat unit accumulations in Upland cotton in Maricopa, AZ, 2005.

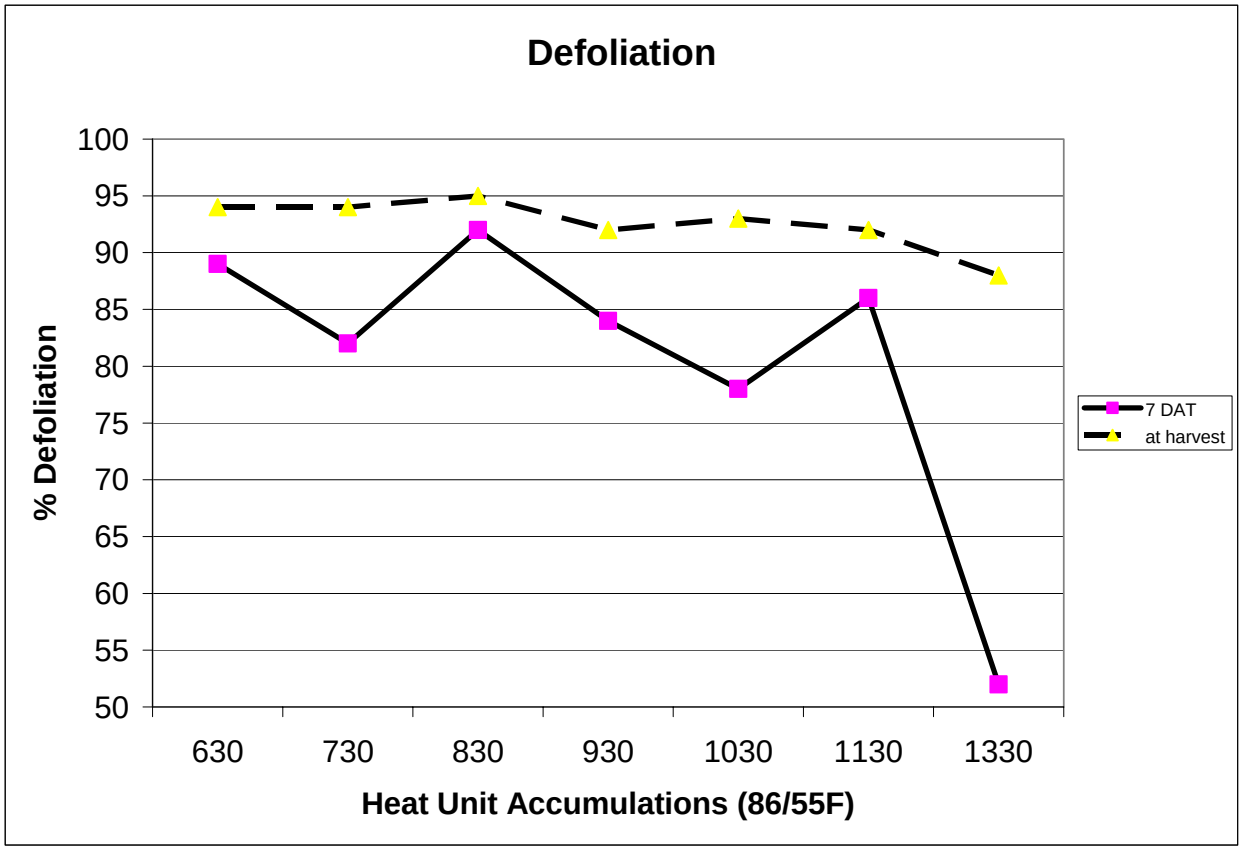

Figure 2. Defoliation of Upland cotton 7 DAT and at harvest at different levels of heat unit accumulation in Maricopa, AZ, 2005.

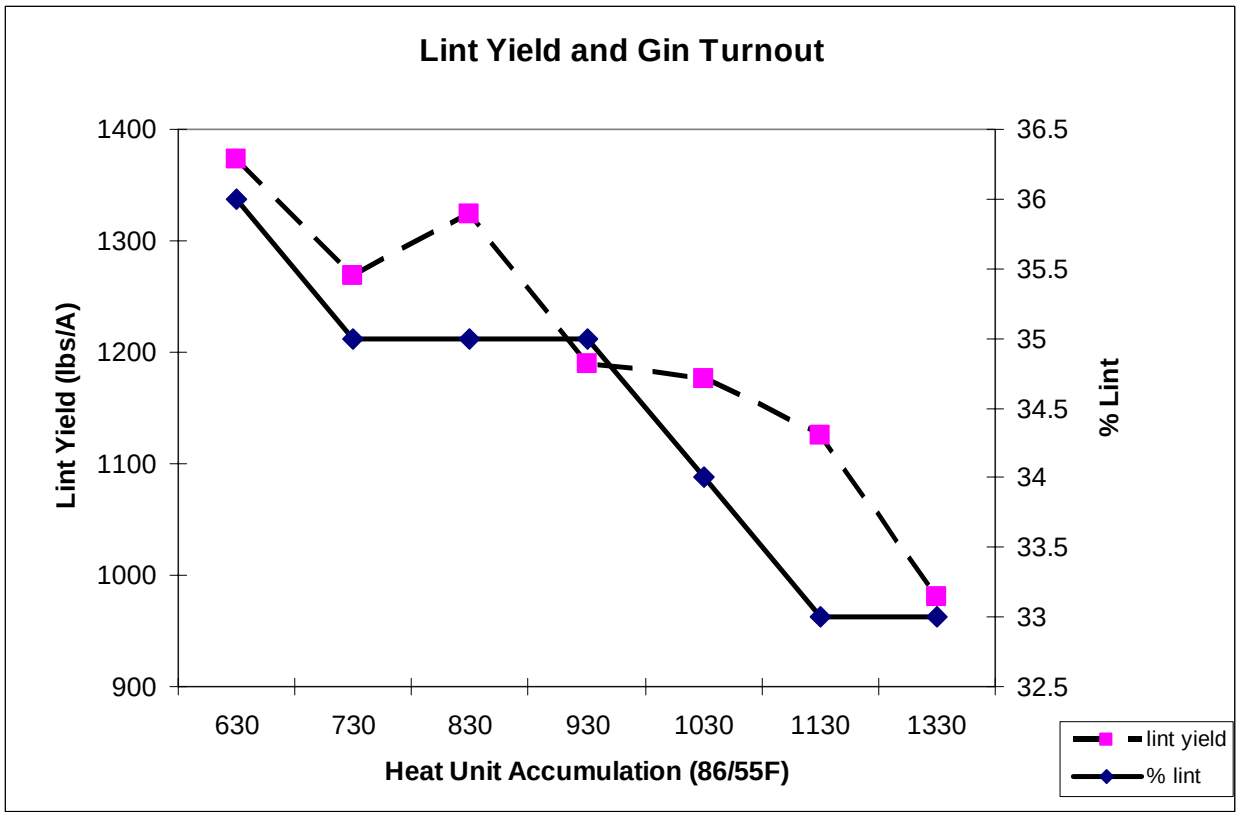

Figure 3. Effect of heat unit accumulation on Upland cotton lint yield and gin turnout in Maricopa, AZ, 2005.