Planting Date by Variety Evaluation in Graham County

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Abstract

*A single field study was established to evaluate the effects of planting date (PD) on the yield and fiber quality characteristics of several cotton varieties commonly grown in the Upper Gila River Valley of Safford. Eight varieties selected for evaluation in 2003 ranged from medium to medium-full varieties. These varieties included two Delta and Pine varieties (DP555BR and DP655BR), two Fiber Max varieties (FM989BR and FM991BR), two Stoneville varieties (ST5303R and ST5599BR), one CPCSD variety (Riata), and one variety from the Arizona Cotton Growers Association breeding program (AG3601). These eight varieties were planted on three separate planting dates (1 April, 23 April, and 12 May; 341, 525, and 779 heat units accumulated after January 1, respectively) in a split-plot within a randomized complete block design with four replications. Overall analysis of variance revealed significant differences due to main effects (PD; OSL=0.00043), sub effects (variety; OSL=0.0029), and interaction effects (PD*variety; OSL=0.0266). Extremely cool conditions surrounding the first PD resulted in significantly lower yields that the other two planting dates. Yields for PD 1 ranged from 506 lbs. lint/acre to about 850 lbs. lint/acre with DP555BR producing the highest and CPCSD Riata producing the lowest yield. Conditions surrounding the second PD were much improved over PD 1. However, soil temperatures still hovered near to and below the optimum temperature of 65^{o}F. Yields were dramatically higher in PD 2 when compared to PD 1, ranging from a low of 847 lbs. lint/acre (AG3601) to 1139 lbs. lint/acre (FM991BR). PD 3 resulted in the best conditions for seedling emergence and stand establishment and produced the highest yield. Yields ranged from a low of 945 lbs. lint/acre (CPCSD Riata) to 1465 lbs. lint/acre (FM991BR). Fiber quality data demonstrated a couple of interesting trends. Micronaire tended to increase with later plantings for most varieties while fiber length had an inverse relationship with PD. Micronaire levels tended to be high enough to be discounted for every variety in at least one and usually two PDs, except for Riata. Riata had the lowest micronaire, and the longest and strongest fiber grades. These results are consistent with other evaluations of the high fiber quality associated with many of the California Acala varieties. However, relatively lower yields for this variety currently make it an unsuitable variety for this region despite the high fiber quality. Results from this evaluation demonstrate the importance of monitoring soil temperature and keeping a close eye on local weather forecasts when making planting date decisions regardless of the calendar date.*

Introduction

There are numerous factors that contribute to the realization of a successful cotton crop in Arizona. Two major management decisions, variety selection and planting date management can have a profound effect on the development and final outcome of the crop. Selection of a specific variety will have a large impact on the way in which planting date should be managed. Similarly, the time frame in which a crop can be planted due to weather and/or other circumstances should have a large impact on the selection of a suitable variety.

Previous research in Arizona has shown that delayed plantings often result in higher vegetative growth tendencies at the expense of yield. Optimum planting date windows have been developed for different variety maturity groups (Figure 1) based upon heat units accumulated from January 1 (Silvertooth et al., 1989; Silvertooth et al., 1990; Silvertooth et al., 1991; Silvertooth et al., 1992; Silvertooth et al., 1993;

Silvertooth et al., 1994; Unruh et al., 1995; Norton et al., 1997; Silvertooth et al., 1997, and Silvertooth et al., 1998). Planting date management not only has a large effect on crop growth, development, and yield but it also impacts insect pest management (Brown et al. 1992, 1993, 1994, 1995, 1996, 1997, and 1998). Reduced season management, of which early planting plays a major role, has become increasingly important in recent years. The ability to plant and establish a crop early, carry it through the primary fruiting cycle in a timely and efficient manner, followed by early termination; has become increasingly important with increased late-season insect pressures in Arizona. This approach to earliness management has also been important in terms of avoiding inclement weather conditions commonly associated with the summer monsoon season, which creates higher humidity (higher dew point temperatures) and higher night temperatures, resulting in accelerated rates of fruit loss and abortion (Brown and Zeiher, 1997).

Another method used for insect pest management is delayed planting. Delayed plantings have been utilized by many producers in some parts of Arizona to aid in the management of pink bollworm (PBW, Pectinophora gossypiella (Saunders)) populations. Delayed plantings are intended to encourage suicidal emergence of over wintering PBW populations, theoretically lowering early season infestation levels. However, with the increasing use of transgenic cotton varieties that provide resistance to PBW pressures this method of pest management is becoming less common.

The objective of this study is to further evaluate planting date windows and use the information for the validation and refinement of current UA Extension agronomy recommendations particularly as they apply to the higher elevations of southeastern Arizona. New varieties are being released every year with the need for evaluation with respect to optimum PD.

Materials and Methods

A study was conducted in 2003 at the University of Arizona Safford Agricultural Center to investigate the effects of planting date on yield and fiber quality characteristics of eight commercially available varieties. The experimental design was a split-plot within a randomized complete block design. The main-plots consisted of three planting dates with sub-plots being the eight varieties. Each sub-plot consisted of 4, 36-inch rows that extended approximately 40ft. Planting dates were planned so as to have three representative points along the recommended planting date range (Figure 1). Table 1 summarizes planting dates and respective heat units accumulated since 1 January (HU/1Jan., 86/55^{o}F thresholds). Varieties selected for this study (Table 2) ranged in maturity from medium maturity to more indeterminate varieties, as classified by the seed companies. Plots were planted into moisture for all varieties and planting dates. All inputs such as fertilizer, water, and pest control were managed on an as-needed basis. Climatic conditions were also monitored using an Arizona Meteorological Network (AZMET) site located at the station. Lint yields were obtained for each treatment by harvesting the center two rows of each plot with a two row mechanical picker. Results were analyzed statistically in accordance to procedures outlined by Steele and Torrie (1980) and the SAS Institute (SAS, 1998).

Results and Discussion

Planting conditions as revealed by soil temperature data (Figure 2) were less than ideal for both PD 1 and 2. Soil temperatures remained well below optimum the first two weeks in April resulting in poor seedling emergence and stand establishment for the first PD. Soil temperature trends surrounding the second PD hovered near to below optimum for planting. The third PD experienced optimum soil temperatures and resulted in a healthy vigorous stand. Similar results in soil temperature patterns were experienced in 2001 and 2002 (Norton et. al., 2002 and Norton et. al., 2003).

Overall analysis of variance revealed significant differences due to the main effect (PD), the sub effect (variety) and also a significant PD by variety interaction (Table 3). Due to the poor conditions surrounding the first PD extremely low yields were observed (Tables 4 and 5). Significant increases in yield were observed for the next two PD with the third PD producing the highest yield. Significant differences among varieties were observed for PD two and three but not one. The high degree of variability in seedling emergence due to cool soil temperatures resulted in no significant differences among varieties. For the next two PD, similar differences were observed among varieties with respect to lint yield (Table 4). Fiber Max FM991BR produced the highest yield in both PD two and three. Differences in lint yield with respect to PD were significant for each of the eight varieties (Table 5). Each variety produced increasing lint yield with each subsequent PD with the exception of CPCSD Riata. PD two resulted in the highest yield for Riata. Five of the eight varieties produced an increasing yield with each subsequent PD in a linear fashion. Three of the varieties (AG3601, DP655BR, and Riata) responded differently to PD effects (Figure 3). All three varieties experienced increased yields in PD two and three over PD 1. However, for both Riata and DP655BR very little difference was observed between PD two and three.

Fiber quality data for each of the eight varieties and three PD's is displayed in Table 6. A lack of replicated samples prevented a statistical analysis of the data. However, several trends are evident in the data. In general, fiber micronaire increases with later plantings. Fiber length produced a negative relationship with PD. Fiber strength did not appear to be significantly impacted by PD. Varietal differences in fiber quality were also observed. Riata, which is known for high quality fiber production, had the lowest micronaire, longest fiber, and strongest fiber. All other varieties were similar with respect to fiber quality.

Summary

Results from this study and previous studies conducted in this valley (Norton et. al., 2002 and Norton et. al., 2003) reaffirm the planting recommendations using soil temperature and heat unit accumulations. Mid-April has proven to be the most effective planting date for the Upper Gila River Valley. More determinate varieties seem to be affected more by the earlier planting conditions that tended to be cooler. This is likely due to the fact that a more determinate variety has less capability to compensate for early season stress placed upon it. This study will be conducted again in the 2004 season to continue to evaluate planting date effects on new and existing varieties.

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Table 1. Planting dates with associated heat units accumulated from January 1 for each planting date, Safford Agricultural Center, 2003.

Planting Dates	Heat Units/Jan. 1 (86/55°F Thresholds)
1 April	341
23 April	525
12 May	779

Table 2. Listing of the eight varieties and their characteristics planted at the Safford Agricultural Center, 2003.

Company	Variety	Maturity*
Arizona Cotton Growers Assoc.	AG3601	Mid-Full
Deltapine	DP555BR	Mid-Full
Deltapine	DP655BR	Mid-Full
Fiber Max	FM989BR	Medium
Fiber Max	FM991BR	Mid-Full
CPCSD	Riata	Mid-Full
Stoneville	ST5303R	Mid-Full
Stoneville	ST5599BR	Medium

*As designated by seed company.

Table 3. Overall analysis of variance for main-plot (PD), sub-plot effects (variety), and interaction (PD by variety), Safford Agricultural Center, 2003.

Effect	Observed Significance Level (OSL)
Main Effects (Planting Date)	0.0043
Sub Effects (Variety)	0.0029
Interaction (PD by variety)	0.0266

Table 4. Analysis of variance results for differences among varieties as a function of PD, Safford Agricultural Center, 2003.

Variety	Planting Date		
	1 April	23 April	12 May
	----------Lint Yield (lbs lint/acre)----------		
DP555BR	849	1075 a	1325 ab
FM989BR	822	1081 a	1345 ab
FM991BR	797	1139 a	1465 a
DP655BR	770	1115 a	1147 bc
ST5303R	746	1048 a	1281 ab
ST5599BR	705	1136 a	1302 ab
AG3601	595	847 b	1359 ab
Riata	506	1041 a	945 c
LSD†	NS	152	230
OSL§	0.0835	0.0157	0.0054
CV(%)¶	22.3	9.7	12.3

*Means followed by the same letter are not significantly different according to the Fisher's LSD means separation test.
†LSD – Least significant difference
§OSL – Observed Significance Level
¶CV(%) – Coefficient of Variation

Table 5. Analysis of variance results for differences among PD as a function of variety, Safford Agricultural Center, 2003.

Planting Date	Variety							
	AG3601	DP555BR	DP655BR	FM989BR	FM991BR	Riata	ST5303R	ST5599BR
	Lint Yield (lbs. lint/acre)							
1 April	595 b*	849 b	770	822	797 b	506 b	746 b	705 b
23 April	847 b	1075 ab	1115	1081	1139 ab	1041 a	1048 ab	1136 a
12 May	1359 a	1325 a	1147	1345	1465 a	945 a	1281 a	1302 a
LSD†	404	296	NS	310	386	252	371	214
OSL§	0.0096	0.0220	0.0668	0.0176	0.0158	0.0043	0.0340	0.0013
CV(%)¶	25.0	15.8	19.7	16.5	19.7	17.5	20.9	11.8

*Means followed by the same letter are not significantly different according to the Fisher's LSD means separation test.
†LSD – Least significant difference
§OSL – Observed Significance Level
¶C.V. (%) – Coefficient of Variation

Table 6. Fiber quality results for each PD by variety scenario, Safford Agricultural Center, 2003.

Planting Date	Variety							
	AG3601	DP555BR	DP655BR	FM989BR	FM991BR	Riata	ST5303R	ST5599BR
	Micronaire							
	5.2	5.0	4.8	4.8	5.1	4.1	5.1	5.0
	5.1	5.0	4.6	5.0	5.0	4.5	5.0	5.0
	5.4	5.1	5.4	5.0	5.3	4.3	5.3	5.3
	Fiber Length (1/100 inch)							
	106	106	103	107	105	110	105	99
	108	106	102	102	106	111	107	104
	106	101	103	107	100	108	106	105
	Fiber Strength (g/tex)							
	30.7	29.9	30.6	31.6	31.2	35.4	31.0	27.9
	33.9	30.7	28.9	28.4	31.7	33.7	30.5	29.9
	31.1	27.5	31.2	32.1	29.6	31.6	32.2	31.1

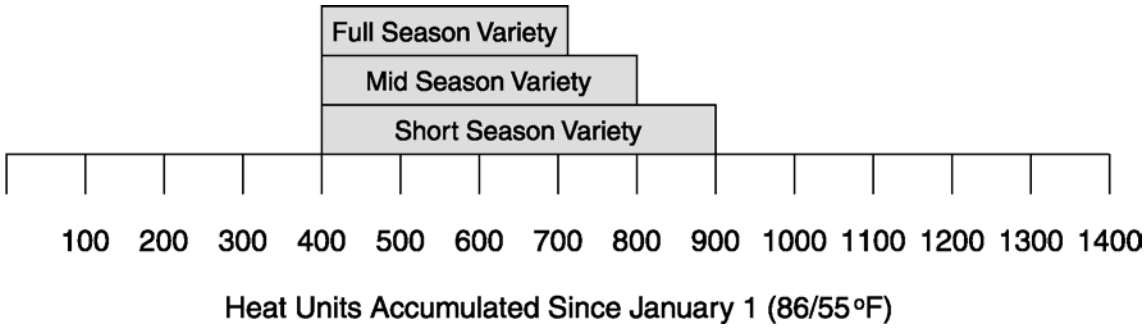

Figure 1. General recommended planting date window for different maturity type varieties grown in Arizona.

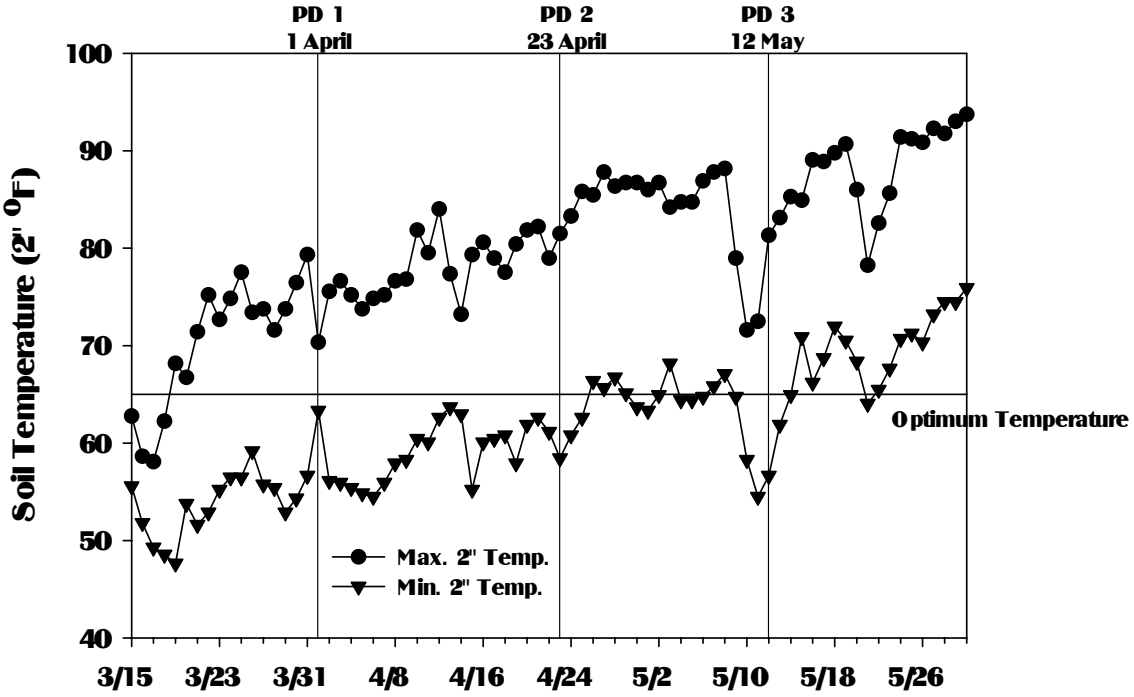

Figure 2. Maximum and minimum soil temperature for the three selected planting dates, Safford Agricultural Center, 2003.

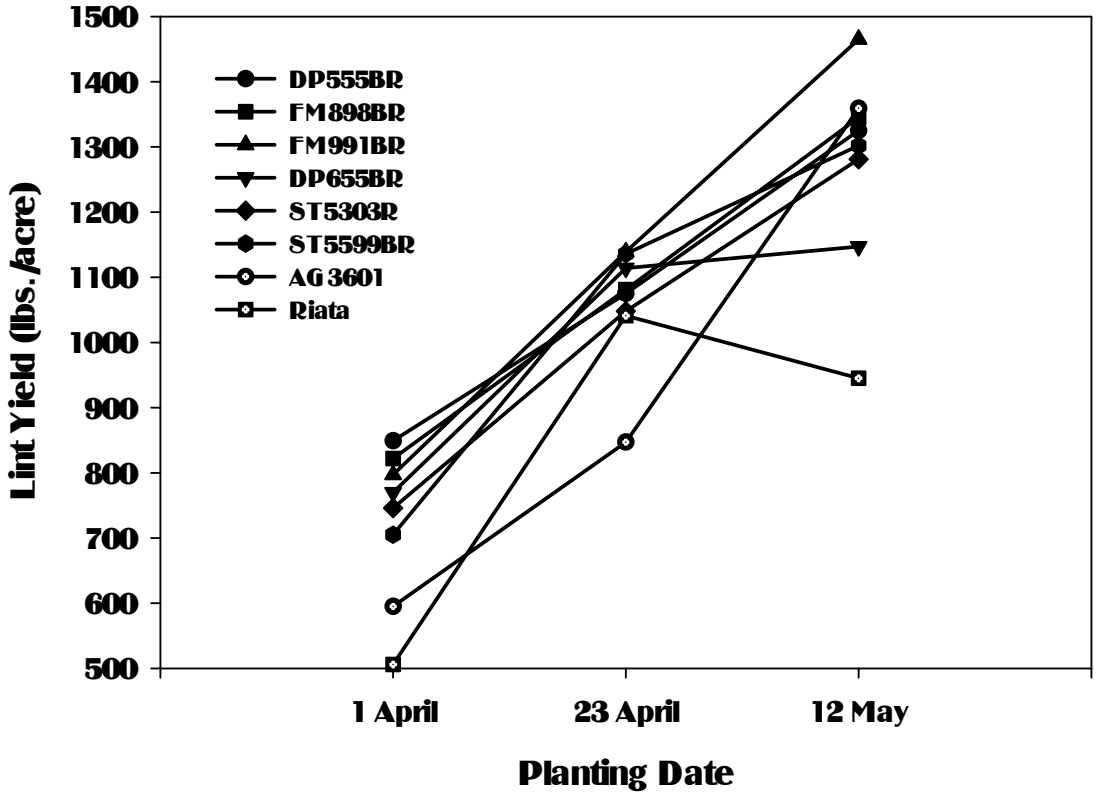

Figure 3. Lint yield results for all seven varieties and three planting dates, Safford Agricultural Center, 2003.