Planting Date Effects on Crop Growth and Yield of Several Varieties of Cotton, Marana, 2000

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Abstract

A field study was conducted in 2000 at the University of Arizona Marana Agricultural Center (1,974 ft. elevation) to evaluate the effects of three planting dates on yield and crop development of 13 varieties of upland cotton. Planting dates included 4 April, 21 April, and 9 May. The associated heat units accumulated since 1 January were 617, 877, and 1203 respectively (using 86/55 ^{o}F maximum/minimum thresholds respectively). Results indicate that there was a significant interaction between planting date and variety. Overall, lint yields significantly declined with later planting dates and significantly varied among varieties within each planting date.

Introduction

Among numerous factors that contribute to a successful cotton crop in Arizona, management decisions regarding variety selection and planting date can have a profound effect on the development and final outcome of the crop. The time frame in which a crop can be planted due to weather and/or other circumstances should have a profound impact on the selection of a suitable variety.

Previous studies in Arizona have shown that delayed planting often results 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 1 January (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; Silvertooth et al., 1998; Norton and Silvertooth, 1999; Silvertooth and Norton, 2000). 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 Arizona. 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 can be a viable approach 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 that creates higher humidities (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 primary objective of this study was to further evaluate planting date windows and use the information for the validation and revision of current UA Extension agronomy recommendations. This evaluation involves an investigation of the effects of planting date management on the growth, development, and yield of cotton.

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Materials and Methods

The experiment was conducted at the University of Arizona Marana Agricultural Center in Marana, Arizona on a Pima clay loam soil (1,974 ft. elevation). The experimental design was a split plot within a randomized complete block with four replications. Mainplots involved the planting dates and the subplots included the varieties (Table 1). Subplots were four, 40" rows in width and 30' in length with 10' alleys. Planting date mainplots were pre-irrigated two weeks prior to planting. The beds were then mulched and the seed was planted into a moist seedbed.

Planting dates were selected to obtain three representative dates for this area. Varieties selected for this study (Table 1) ranged in maturity from an early-season, determinate variety (Deltapine DP20) to more indeterminate varieties (DP 5415 and DP33B). The varieties selected for this study also provide a direct comparison between a transgenic Bt variety and its recurrent parent in some cases. All inputs such as fertilizer, water, and pest control were managed on an as-needed basis. Each of the three planting dates was managed to complete the first cycle fruit set. Irrigation termination dates were selected based upon completion of the primary fruiting cycle.

Crop climatic conditions and heat unit accumulations were monitored using an Arizona Meteorological Network (AZMET) station located at the site. Lint yields were obtained for each treatment by harvesting the center two rows of each plot with a two row mechanical picker. Results were then analyzed statistically in accordance to procedures outlined by Steel and Torrie (1980) and the SAS Institute (SAS, 1991).

Results and Discussion

Results from the analysis of variance for lint yield are shown in Table 2 with all main effects and interaction terms for the experiment. The degree of variation within the experiment was relatively small for this type of study with a coefficient of variation (CV%) of about 8 % for the first two dates of planting and approximately 10 % for the third. Main effects associated with planting date and variety were significant ($P \leq 0.05$). There were no significant interaction terms. Thus, lint yields are presented among varieties by planting date in Table 3 with mean separations and appropriate statistical parameters.

In general, higher lint yields were realized for all varieties at the earlier date of planting (4 April). Lint yield trends among planting dates for each variety are also shown graphically in Figure 2. Lint yield results among dates of planting for each variety are shown in Table 4. The varieties DP 422BR and DP 428B demonstrated the greatest degree of stability among the three dates of planting. The varieties DP33B, DP5415, and DP655BR had a significant decline in yield from the first to the second dates of planting, which is indicative of these being more indeterminate (full season) varieties. Many varieties performed just as well if not better with the second planting date, which might be due to their medium season maturity season characteristics. Varieties such as SG 125BR, DP 655BR, and DP 5415 exhibited the most sensitivity to later planting dates, where they performed very poorly. Overall, there was a trend towards reduction in yield associated with later planting dates (Figure 3).

Results from this study are very consistent with those of previous seasons. The varieties used in this project have varied over the past 14 seasons. However, the patterns revealed from these studies have shown that optimum growth, development, and crop yield are usually realized with the earlier dates of planting as used in these experiments. The general planting management guidelines that are currently in place (Figure 1), based on HU accumulations since 1 January and modified by actual soil temperature conditions are valid.

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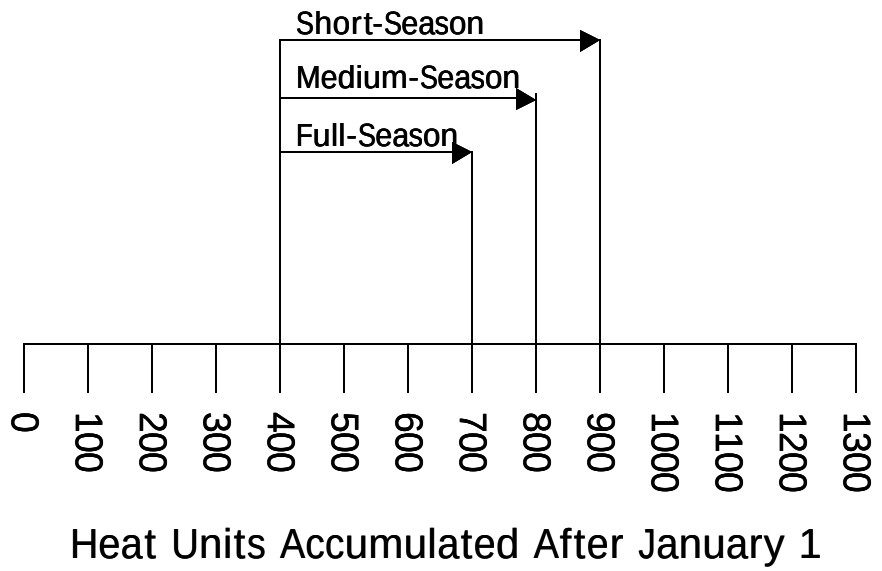

Fig. 1. Recommended planting date windows for different maturity type varieties grown in Arizona.

Table 1. Planting dates and varieties, planting date by variety study, Marana, AZ, 2000.

Varieties	
BXN47	STV4691B
DP428B	SG125BR
DP422BR	SG747
DP33B	DP655BR
DP20B	DP451BR
DP388	DP5415
STV474	
Planting Dates*	
Planting Date 1	4 April (617 HU/Jan. 1)
Planting Date 2	21 April (877 HU/Jan. 1)
Planting Date 3	9 May (1203 HU/Jan. 1)

*Actual planting date for pre-irrigated plots and water-up date for dry planted plots.

Table 2. Experimental effects and statistical significance from the analysis of variance, planting date by variety study, Marana, 2000.

Source of Variation (Effect)	**OSL (Pr >F)**
Planting Date	0.0004
Variety	0.0012
Planting Date * Variety	0.0016

Table 3. Lint yield results for all varieties by planting date, Marana, AZ, 2000.

Planting Date 1 (4 April)	**Lint Yield (lbs. lint/acre)**
DP33B	1456 a*
DP655BR	1363 a
ST4691	1305 ab
SG125BR	1296 ab
DP5415	1296 ab
DP451BR	1283 ab
DP20B	1277 ab
BXN47	1267 ab
DP428B	1248 abc
DP388	1207 bc
SG747	1174 bc
DP422BR	1153 bc
ST474	1143 bc
LSD*	147
OSL**	0.018
CV (%)	8.1
Planting Date 2 (21 April)	
ST4691	1382 a*
DP20B	1296 ab
DP451BR	1267 ab
SG747	1248 ab
DP388	1220 bc
BXN47	1210 bc
ST474	1210 bc
DP428B	1201 bc
DP33B	1191 bc
DP422BR	1182 bc
SG12R5BR	1172 bc
DP655BR	1086 c
DP5415	1001 d
LSD*	149
OSL**	0.0034
CV (%)	8.6
Planting Date 3 (9 May)	
ST4691	1010 a
SG747	962 ab
DP388	962 ab
ST474	953 ab
DP451BR	934 ab
DP20B	915 abc
DP422BR	905 abc
DP428B	905 abc
DP33B	886 abc
SG125BR	867 bc
BXN47	858 bc
DP655BR	791 c
DP5415	638 d
LSD*	126
OSL**	0.0002
C.V. (%)§	9.9

*Least Significant Difference – means followed by the same letter within a planting date are not significantly different according to a Fishers mean separation test.
**Observed Significance Level
§Coefficient of Variation

Table 4. Lint yield results by variety for each planting date, Marana, AZ, 2000.

Planting Date	BXN 47	DP 20B	DP 33B	DP 388	DP 422BR	DP 428B	DP 451BR	DP 5415	DP 655BR	SG 125BR	SG 747	STV 4691B	STV 474
1	1267 a	1296 a	1481 a	1020 a	1182 a	1248 a	1272 a	1296 a	1363 a	1295 a	1178 a	1305 a	1143 a
2	1210 a	1277 a	1216 b	1033 a	1153 a	1200 a	1256 a	1001 b	1086 b	1172 a	1252 a	1361 a	1210 a
3	656 b	915 b	911 c	876 b	905 a	905 a	873 b	638 c	791 c	867 b	966 b	1010 b	953 b
LSD*	207	130	186	108	231	317	140	161	276	160	106	155	141
OSL**	0.0057	0.0006	0.0005	0.0033	0.050	0.076	0.0028	0.0003	0.0068	0.0012	0.001	0.0025	0.008
CV (%)§	10.7	6.5	9.3	5.3	12.4	16.4	6.7	9.6	14.8	8.3	5.6	7.3	7.4

*Least Significant Difference – means followed by the same letter within a column are not significantly different according to a Fishers means separation test.
**Observed Significance Level
§Coefficient of Variation

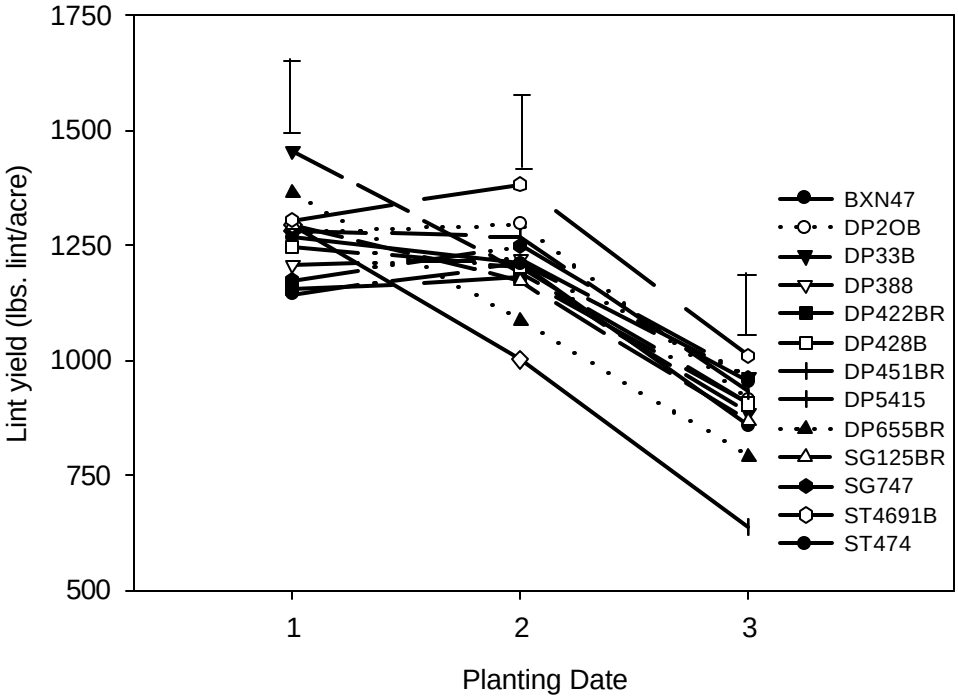

Fig. 2. Lint yield as affected by planting date for each variety, Marana, 2000.

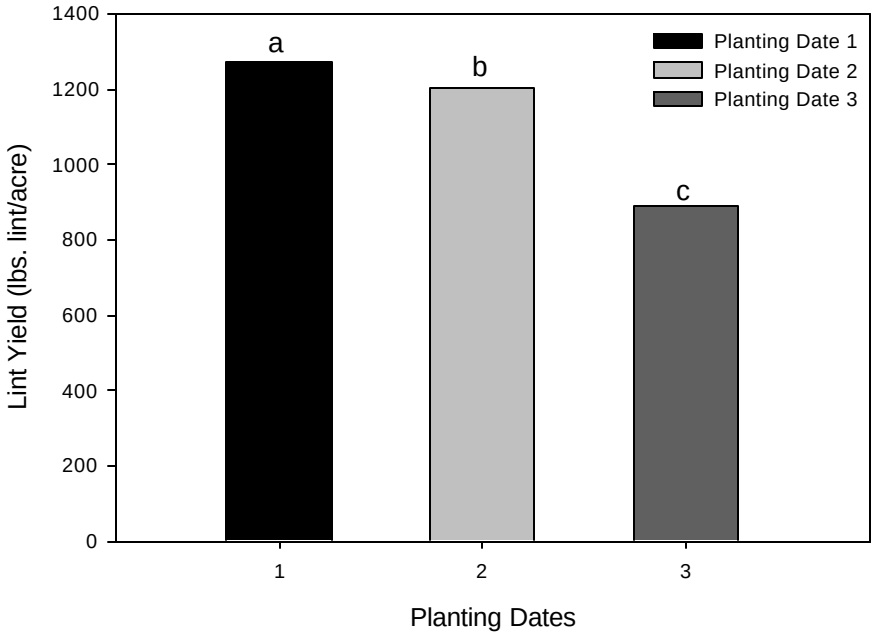

Fig. 3. Mean lint yield as affected by planting date for all varieties, Marana, 2000.