Evaluation of Planting Date Effects on Crop Growth and Yield for Upland and Pima Cotton, Marana, 1995

E.R. Norton, J.C. Silvertooth, and P.W. Brown

Abstract

A single field study was conducted in 1995 at the Marana Agricultural Center (2000 ft. elevation) to evaluate the effects of three planting dates on yield and crop development for one Pima and two Upland varieties. Planting dates ranged from 6 April to 18 May (469-931 HU/Jan 1 86/55° F thresholds). Crop monitoring revealed vegetative growth tendencies with later plantings. General trends showed decreasing lint yield with the later (18 May) plantings for all varieties. Early plantings (6 April) however, for both Pima S-7 and DPL 20 resulted in slightly lower yields than the later two planting dates. This reduced yield for planting date 1 can be explained by extremely cool weather conditions which occured immediately after planting and in-season fruit loss which impacted the final fruit retention levels.

Introduction

There are numerous factors that contribute to the realization of a successful cotton crop. 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 will have a large impact on the selection of a suitable variety.

Earlier research in Arizona has demonstrated that delayed plantings may result in higher vegetative growth tendencies at the expense of yield and 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; and Silvertooth et al., 1993; Silvertooth et al., 1994; Unruh et al., 1995). Planting date management not only has a large effect on crop growth, development, and yield but also impacts insect pest management (Brown et al. 1992, 1993, 1994, and 1995). Reduced season management, of which early planting plays a major role, has become increasingly important in recent years. The ability to get a crop in 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 pressure from whitefly in Arizona. Another method used for insect pest management is delayed planting. Delayed plantings have been a utilized by many producers in some parts of Arizona to aid in the management of pink bollworm (Pectinophora gossypiella (Saunders)) populations. The delayed plantings are intended to encourage suicidal emergence of overwintering pink bollworm populations, theoretically lowering early season infestation levels.

The objective of this study was to further validate and refine planting date windows and recommendations and continue to investigate the effects of planting date management on the growth, development, and yield of both Upland (Gossypium hirsutum L.) and Pima (Gossypium barbadense L.) varieties.

Methods and Materials

This study was conducted in 1995 at the Marana Agricultural Center (2000 ft.) on a Pima clay loam soil. The experimental design was a split-plot within a randomized complete block design. The mainplots were planting dates with subplots being varieties. Each subplot consisted of 8, 40 inch rows that extended the full length of the irrigation run (600 ft.). Planting dates were constructed 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°F thresholds). Varieties selected for this study ranged in maturity from a short season, determinate variety, Delta Pine 20 (DPL 20) to a full season, indeterminate variety (Pima S-7). The third variety, Delta Pine 5415 (DPL 5415), fell between the two extremes as a medium maturity type variety. All plots were planted into moisture across all varieties and planting dates. All inputs such as fertilizer and water were managed in an optimal fashion.

A complete set of plant measurements were collected from the site on 14 day intervals. Measurements taken included: plant height, number of mainstem nodes, first fruiting branch, total number of aborted sites (positions 1 & 2), number of nodes above the top (1st position) fresh bloom, canopy closure, and number of blooms per unit area. Climatic conditions were also monitored using an Arizona Meteorological network (AZMET) site located on the station.

Planting dates one and two (PD1 and PD2) were terminated receiving the last irrigation on 20 August. Planting date three (PD3) received one additional irrigation and was terminated on 29 August. The center 4 rows from each plot were harvested on 1 November to obtain seedcotton estimates. Actual turn-out averages for each variety were used to calculate lint yield.

Results

Vegetative growth tendencies as noted by height to node ratios (HNR),that have proven to be associated with later plantings were observed in this study throughout the course of the season. The most pronounced differences among planting dates were observed with the two Upland varieties (DPL 20 and DPL 5415). The same trend was also observed in the Pima plots but were not as dramatic, mainly due to the more indeterminate nature of the Pima variety (Figure 2). The increased vegetative growth between planting dates was most pronounced in the range of approximately 1200-2200 heat units accumulated after planting (HUAP). This is the period from approximately first bloom to peak bloom which is a critical time for fruit development and retention. The increase in height to node ratios indicate that the plant is placing more carbohydrate energy into vegetative growth than into fruit development and retention, thus decreasing its yield potential.

Early fruit retention levels were average but a sharp decrease occurred, apparently due to inclement weather conditions and a lygus infestation (Figure 3). Due to the loss in fruit load, a corresponding sharp increase was observed in the HNRs for all three planting dates. Fruit retention levels subsequently increased and at the end of the season were higher than average. Lint yield differences were found to be significant among varieties and planting dates ($P>0.05$). A significant ($P=0.0024$) planting date by variety interaction was also observed. Lint yields were analyzed and summarized by variety (Table 2).

DPL 5415 demonstrated the classic response for a medium to long season variety. Final fruit retention levels for DPL 5415 are similar among the three planting dates but lint yields decreased as planting was delayed (Figure 4). A 24% reduction in yield was observed from PD1 to PD3. The earlier planting date apparently gave this medium to long maturity variety more time to set and mature the harvestable fruit.

Lint yield differences among planting dates were not statistically significant for the DPL or Pima S-7. However, both the DPL 20 and Pima S-7 yields tended to decrease from PD2 to PD3 and increase from PD1 to PD2. Final fruit retention levels for PD1,for both varieties, are much lower than PD2, which might explain the increase in yield from PD1 to PD2 (Figure 3). It is also interesting to note that for the later planting (PD2) the shorter season variety type (DPL 20) showed a 6% (approximately 65 lbs/acre) higher lint yield than the longer season DPL 5415, which is also consistent with earlier work.

Summary

The delayed plantings generally demonstrated higher vegetative tendencies for all varieties which is consistent with earlier research (Silvertooth et al., 1989; Silvertooth et al., 1990; Silvertooth et al., 1991; Silvertooth et al., 1992; and Silvertooth et al., 1993; Silvertooth et al., 1994; Unruh et al., 1995). A lint yield decrease (Figure 4) was seen for all varieties from PD2 to PD3 (755 to 931 HU/1Jan.). The DPL 5415 also showed a decrease in lint yield from PD1 to PD2 (469 to 755 HU/1Jan.). A lint yield increase however was seen from PD1 to PD2 in both the Pima S-7 and DPL 20 plots which was attributed to the lower final fruit retention levels of PD1 for both varieties. This study also demonstrated the importance of selecting a variety that is best suited to planting conditions. In a delayed planting situation, a higher yield potential can often be realized from a more determinate, shorter season variety.

Acknowledgements

We gratefully acknowledge the fine assistance from the personnel at the Marana Agricultural Center. Also the technical assistance provided by Rick Belknap, Valerie Osborne, Eric Norton, Justin Smith, Hank Auza, and Chris Rouille.

References

Brown P. W., B. Russel, J. C. Silvertooth, L. Moore., S. Stedman, G. Thacker, L. Hood, S. Husman, D. Howell, and R. Cluff. 1992. The Arizona cotton advisory program. p. 233-240. Cotton, Univ. of Arizona Rep. P-91.

Brown P. W., B. Russel, J. C. Silvertooth, L. Moore., S. Stedman, G. Thacker, L. Hood, S. Husman, D. Howell, and R. Cluff. 1993. The Arizona cotton advisory program. p. 11-16. Cotton, Univ. of Arizona Rep. P-94.

Brown P. W., B. Russel, J. C. Silvertooth, P. Ellsworth., S. Stedman, G. Thacker, L. Hood, S. Husman, D. Howell, and R. Cluff. 1994. The Arizona cotton advisory program. p. 11-17. Cotton, Univ. of Arizona Rep. P-96.

Brown P. W., B. Russel, J. C. Silvertooth, P. Ellsworth., S. Stedman, G. Thacker, S. Husman, D. Howell, R. Cluff, S. Winans, and R. Grumbles. 1995. The Arizona cotton advisory program. p. 13-19. Cotton, Univ. of Arizona Rep. P-99.

Silvertooth J. C., J. E. Malcuit, D. R. Howell and P. Else. 1989. Effect of date of planting on the lint yield of several cotton varieties planted at four locations in Arizona, 1988. p. 69-72. Cotton, Univ. of Arizona Rep. P-77.

Silvertooth J. C., T. F. Watson, J. E. Malcuit, and P. W. Brown. 1992. Evaluation of date of planting and irrigation termination in the yield of Upland and Pima cotton. p. 252-273. Cotton, Univ. of Arizona Rep. P-91.

Silvertooth J. C., T. F. Watson, J. E. Malcuit, and P. W. Brown. 1993. Evaluation of date of planting and irrigation termination in the yield of Upland and Pima cotton. p. 27-39. Cotton, Univ. of Arizona Rep. P-94.

Silvertooth J. C., T. F. Watson, L. I. Terry, and J. E. Malcuit. 1990. Evaluation of date of planting and irrigation termination in the yield of Upland and Pima cotton. p. 6-12. Cotton, Univ. of Arizona Rep. P-81.

Silvertooth J. C., T. F. Watson, L. I. Terry, and J. E. Malcuit. 1991. Evaluation of date of planting and irrigation termination in the yield of Upland and Pima cotton. p. 1-14. Cotton, Univ. of Arizona Rep. P-87.

Silvertooth J.C., P.W. Brown, E.R. Norton, and B.L. Unruh. 1994. Evaluation of date of planting on the yield of several Upland varieties at Marana, 1993. p. 26-32. Cotton, Univ. of Arizona Rep. P96.

Unruh, B.L., J.C. Silvertooth, P.W. Brown, and E.R. Norton. 1995. Effect of planting date on yield of Upland and Pima cotton varieties at Marana. p. 20-24. Cotton, Univ. of Arizona Rep. P96.

Table 1. Planting dates and associated heat units accumulated from January 1.

Planting Dates	**Heat Units/Jan. 1 (86/55°F Thresholds)**
6 April	469
4 May	755
18 May	931

Table 2. Lint yields summarized by variety for each date of planting.

	Lint Yield (lbs. lint/acre)
DPL 5415	
PD1	1123 a*
PD2	1061 a
PD3	853 b
LSD (α=0.05)	66.5
OSL	0.0001
C.V. (%)	3.79
DPL 20	
PD1	1041 a
PD2	1140 a
PD3	1064 a
LSD (α=0.05)	NS
OSL	0.1150
C.V. (%)	5.37
Pima S-7	
PD1	706 a
PD2	765 a
PD3	723 a
LSD (α=0.05)	NS
OSL	0.3407
C.V. (%)	7.39

* Means followed by the same letter, within a variety grouping, are not significantly different ($P<0.05$) according to pairwise comparisons using a Fisher's LSD.

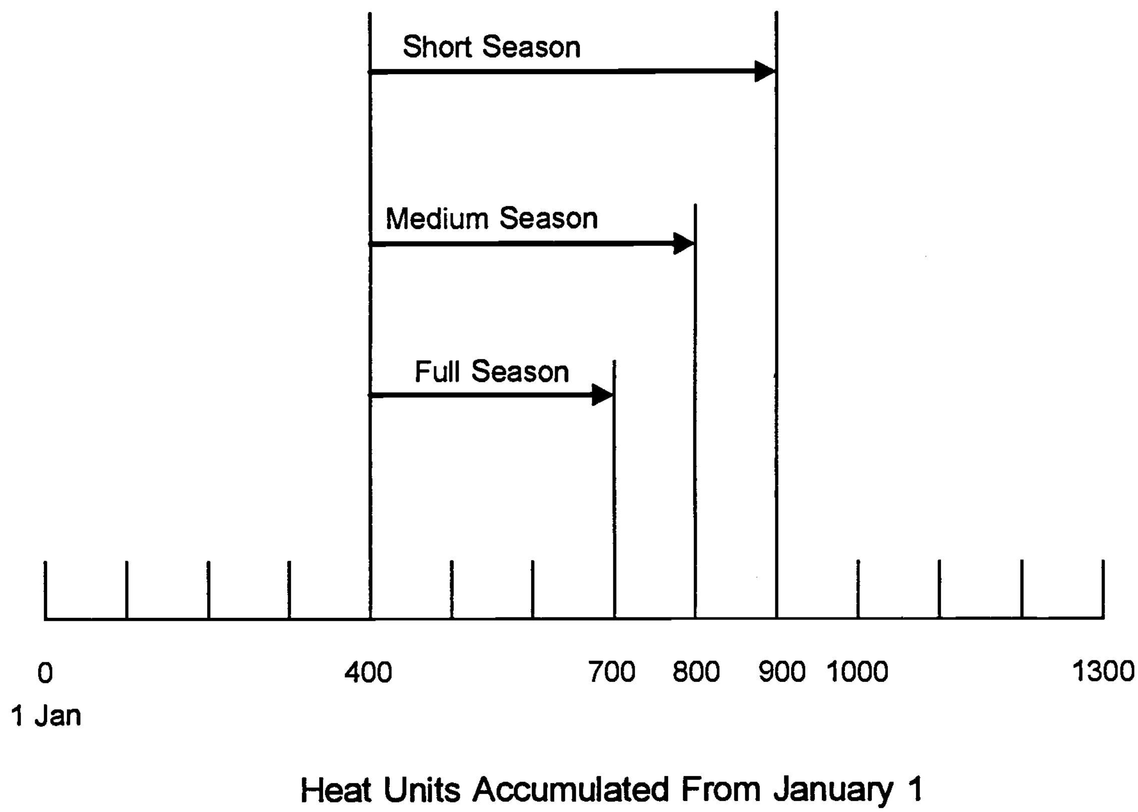

Figure 1. General recommended planting date windows for different maturity type varieties grown in Arizona (J.C. Silvertooth, Univ. of Arizona).

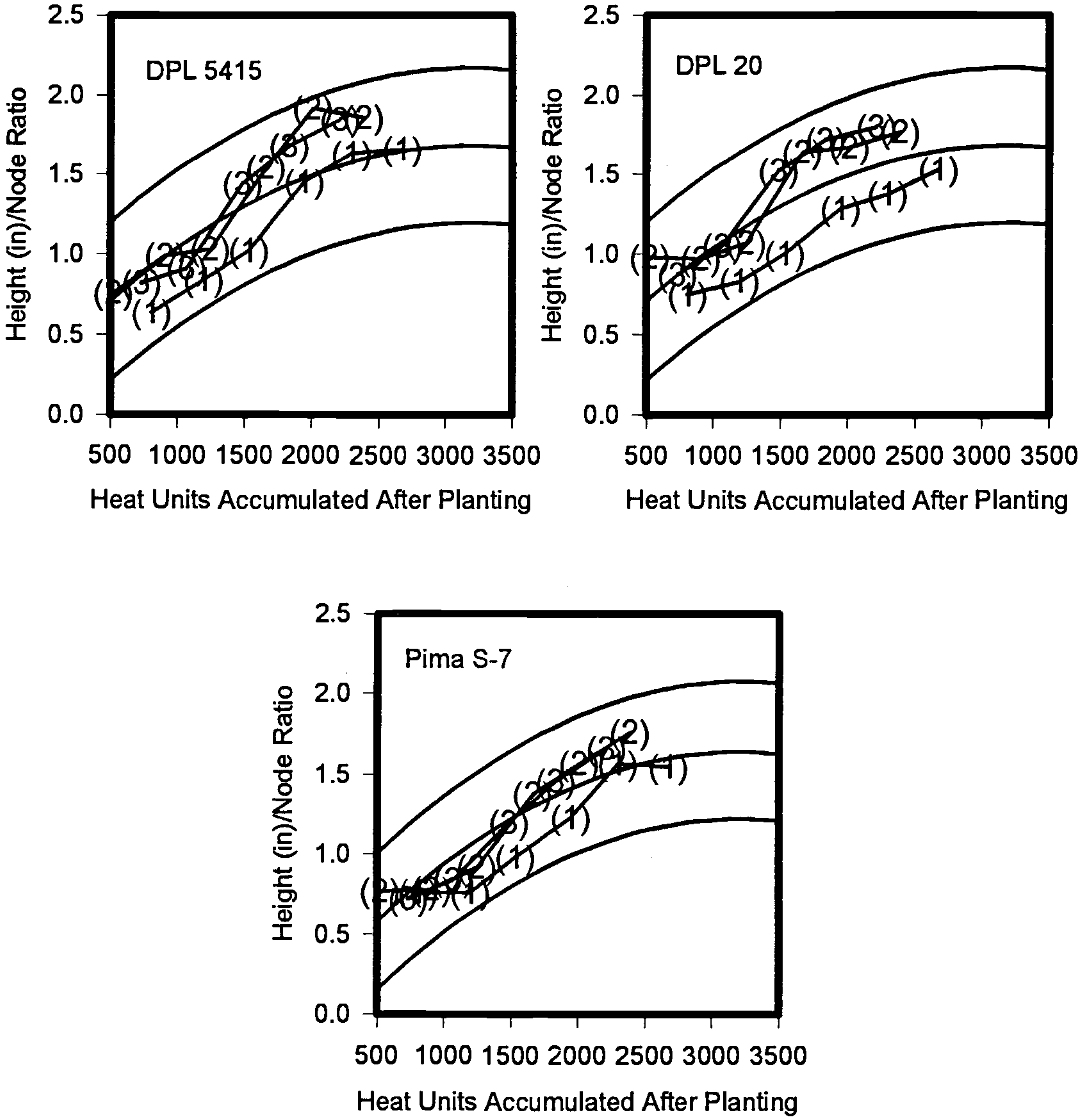

Figure 2. Height to node ratios for each planting date by variety combination, Marana, 1995.

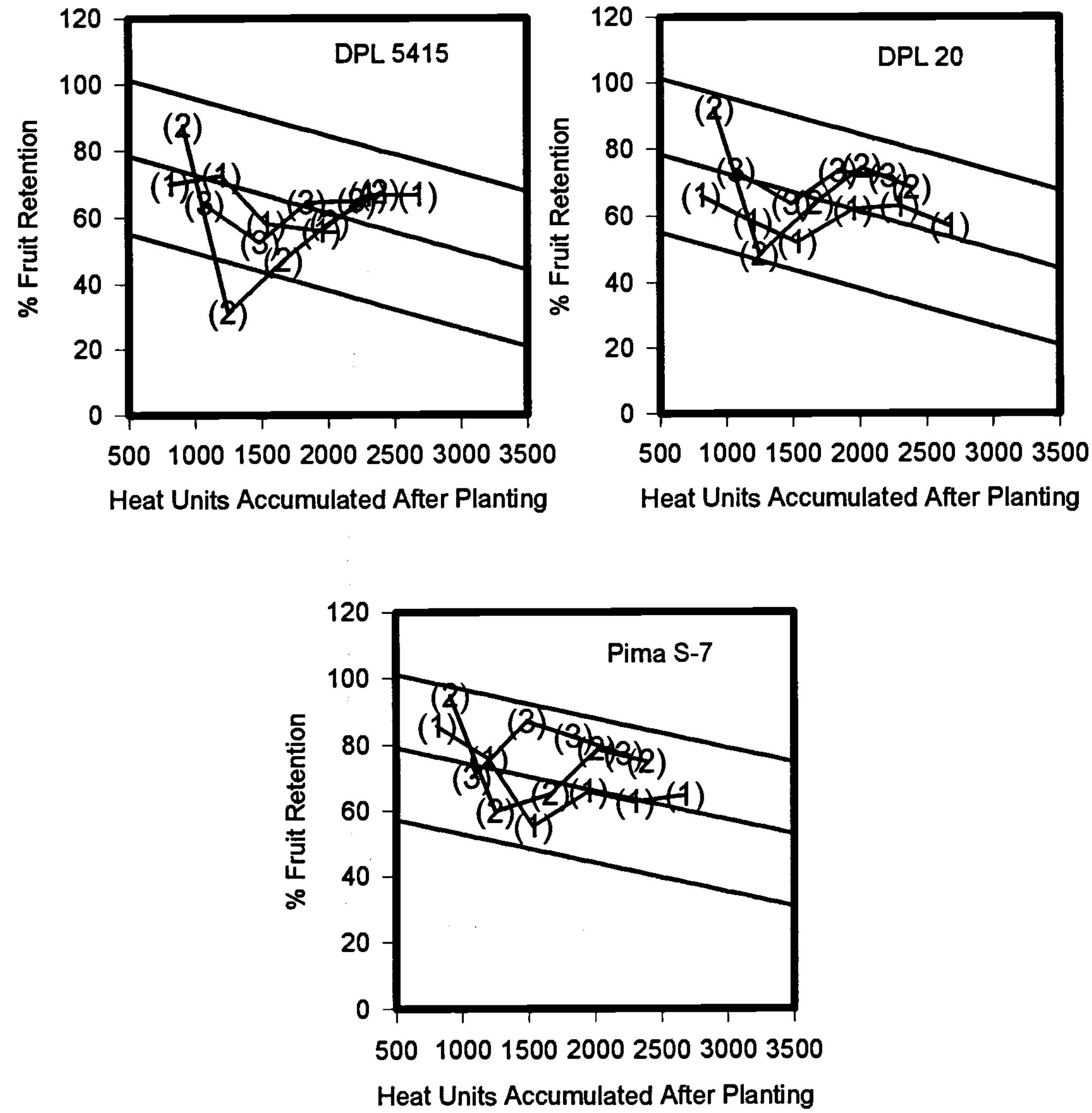

Figure 3. Fruit retention levels for each planting date by variety combination, Marana, 1995.

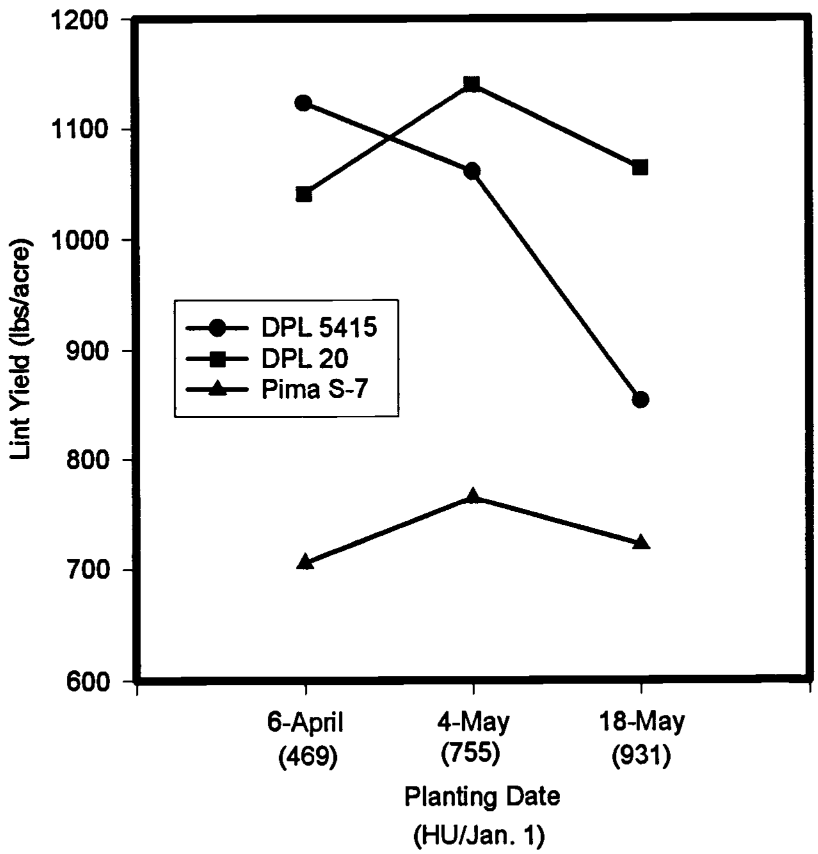

Figure 4. Yield results for each planting date by variety combination, Marana, 1995.