Irrigation Withdrawal Time, Nitrogen Fertilization, and Cultivar Maturity Interactions in Upland Cotton

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ABSTRACT

Normal cotton management practices in South Texas terminate irrigation as early as first open boll (about 6 weeks after first bloom) and use N fertilization rates ranging from 135 to 200 kg/ha. Experiments were conducted at the Texas A&M University Agricultural Research and Extension Centre in Uvalde, TX during the 1995, 1996, and 1997 seasons. This study evaluated growth and yield responses of very early, early, medium, and medium late maturing upland cultivars to early termination of irrigation and reduced level of N fertilization. Termination of irrigation three wk after early bloom did not decrease yields. High rates of N fertilization do not increase yields. Very early and early cultivars showed superior yield performance when soil moisture availability is plentiful during early season. DP5409 showed superior yield performance in all three years, including the droughty 1996. Medium-late DP90 produced superior yield under early-season droughty conditions and heavy early boll set. Earlier than normal termination of furrow irrigation and lower than normal nitrogen fertilization rates appear to be feasible practices leading to reduced-input production. Selection of appropriate cultivars is key for superior yield performance.

Introduction

Normal cotton management practices in South Texas terminate irrigation as early as first open boll (about 6 weeks after first bloom) and use N fertilization rates ranging from 135 to 200 kg/ha.

Research conducted at this Research and Extension Centre has indicated that furrow irrigation may be terminated early at three weeks after first bloom without reducing yields (Fernandez *et al.*, 1996). Also this research has shown that when cotton follows two years of corn or fallow there is no yield response to N fertilization. These experiments evaluated the response of one upland cultivar only, namely the medium maturity cultivar Deltapine 50. Further research was needed to evaluate the responses of different maturity cultivars to early termination of irrigation and N fertilization.

The objective of this study was to evaluate growth and yield responses of very early, early, medium, and medium late maturing upland cultivars to early termination of irrigation and reduced level of N fertilization.

Materials and Methods

Experiments were conducted at this Research and Extension Centre during the 1995, 1996, and 1997 seasons. The soil at the experimental site is a Uvalde silty clay loam. Triple superphosphate at a rate of 67 kg of P_2O_5 per ha and Treflan were applied broadcast and incorporated by double disking before bedding. Preplanting furrow irrigation was applied in early March every year (7, 6, and 9 in. in 1995, 1996, and
Treatments were arranged in a split-split randomized plot design with three replications and irrigation

1997, respectively) to provide adequate soil moisture content for germination and early-season growth. Temik was applied at planting. Nitrogen fertilizer in the form of urea was applied broadcast at a rate of 100-kg N/ha and incorporated to beds with rodweeder immediately before planting. Plots were planted on Apr 7, Apr 10, and Apr 12 in 1995, 1996, and 1997, respectively to a target plant population of 100,000 plants per ha in 0.96-m rows with a vacuum precision JD Maximerge-2 planter. Plots were 6 rows wide and 60 m long. Insect pests were controlled by aerial applications of insecticides as needed.

Experimental treatments were as follows:

- Termination of irrigation at three weeks after first bloom (3wkFB) vs. first open boll (FOB).
- N fertilization rate of 100 kg/ha vs. 200 kg/ha.
- Four upland cotton cultivars of different maturity: Stoneville 132 (STN132, very early), Deltapine 5409 (DP5409, early), Deltapine 5690 or Deltapine 50 (DP5690 or DP50, medium), and Deltapine 90 (DP90, medium-late.

Furrow irrigation with gated pipes was used for in-season irrigation of the plots. In-season irrigation in 1997 started on Jul 10. The 3wkFB treatment received 90 mm in two applications, while the FOB treatment received 150 mm in five applications.

Plots with 200 N treatment received additional 100 kg N/ha of N in the form of urea broadcast and incorporated by cultivation shortly before first bloom.

treatments in main plots, cultivars in sub-plots, and N rates in sub-sub-plots.

Prior to harvesting and after plants were completely defoliated, seven consecutive plants representative of the entire plot were sampled from each plot for mapping to determine plant structure and location of fruiting parts. Bolls from these plant samples were harvested for boll weight determination.

Two central rows of each plot were machine-harvested with a JD299 picker modified for computerized recording of seedcotton yield. Harvest dates were Sep 10 in 1995, Sep 4 in 1996, and Sep 13 in 1997.

The 1996 growing season was droughty throughout, with no rainfall occurrences except at the end of August prior to harvest. A heavy early boll set also characterized this year. The 1995 and 1997 growing seasons, on the other hand, were characterized by fairly good rainfall during the vegetative and square formation phases. A high proportion of early squares were lost to fleahoppers in both seasons.

Results and Discussion

Irrigation effects. In all three years there were no significant differences in yield, bolls per plant, or boll weight between irrigation treatments. Lint yield across treatments was 1028 kg/ha in 1995, 1109 kg/ha in 1996, and 1640 kg/ha in 1997. Bolls per plant across treatments was 8.1 in 1995, 7.6 in 1996, and 8.8 in 1997. Average boll weight across treatments was 4.3 g in 1995, 4.9 g in 1996, and 4.6 g in 1997.

N fertilization effects. In all three years there were no significant differences in yield or bolls per plant between N fertilization treatments. Differences in boll weight between N fertilization treatments were not significant in 1996 and 1997. In 1995, boll weight was 5.5% higher with the high N fertilization rate.

Cultivar effects. Bolls per plant did not differ among cultivars in 1995 and 1996. In 1997, the number of bolls per plant was higher in DP5409 and STN132 (9.8 and 9.1, respectively) than in DP50 and DP90 (8.2 and 8.0, respectively).

Average boll weight was consistently higher in STN132 as compared to the other cultivars; about 7% in 1995, about 20% in 1996, and about 15% in 1997.

There were differences in yield among cultivars in all three years. In 1995, lint yield was highest in DP5409, followed by STN132 and DP50, and lowest in DP90 (Fig. 1). In 1996, lint yields of DP5409 and DP90 were higher than those of STN132 and DP50 (Fig. 2). In 1997, lint yield was highest in DP5409, followed closely by that of STN132, lower in DP50, and lowest in DP90 (Fig. 3).

Treatment interactions. Yield interaction between irrigation and cultivar was significant in 1995 as yield of STN132 was increased when irrigation was maintained until FOB. In 1997, late irrigation increased two bolls per plant in STN132. All other interactions between treatments and yield and yield components were not significant.

In 1995 and 1997, when fairly good rainfall events occurred during the vegetative and square formation phases, yield performance of early maturing cultivars was better than that of medium and medium-late cultivars.

DP5409 showed superior yield performance in all three years including the droughty 1996. This confirms findings from a parallel study in 1997 that showed this cultivar as having lower sensitivity to drought (Fernandez *et al.*, 1998). Medium-late cultivar DP90 also showed superior yield performance in droughty 1996. More vigorous growth of this cultivar during early boll formation may have helped to overcome the limiting effects of early boll set on plant canopy development, particularly under droughty conditions.

Earlier than normal termination of furrow irrigation and lower than normal nitrogen fertilization rates appear to be feasible practices leading to successful reduced-input production. Selection of appropriate cultivars is key for superior yield performance.

References

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Figure 1. Lint yield of cotton cultivars with different maturity in Uvalde, TX in 1995[1].

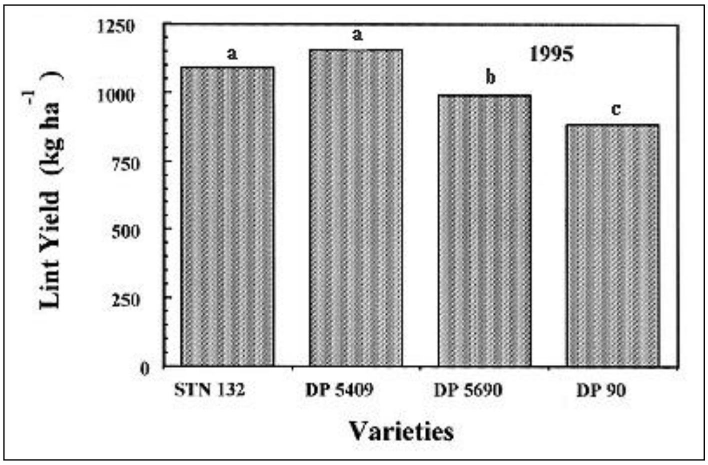


Figure 2. Lint yield of cotton cultivars with different maturity in Uvalde, TX in 1996[1].

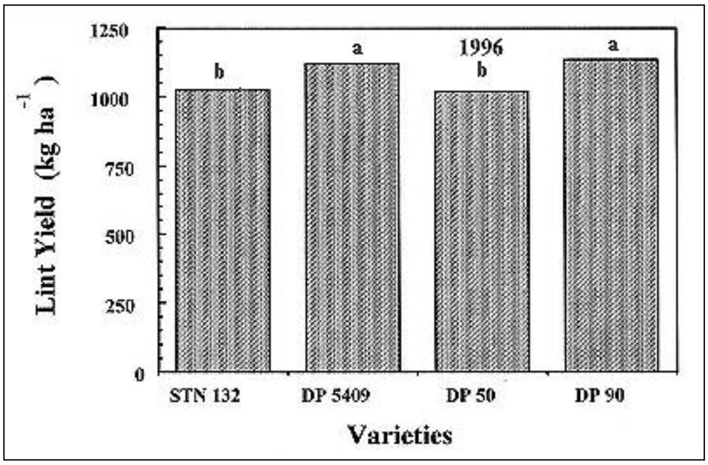
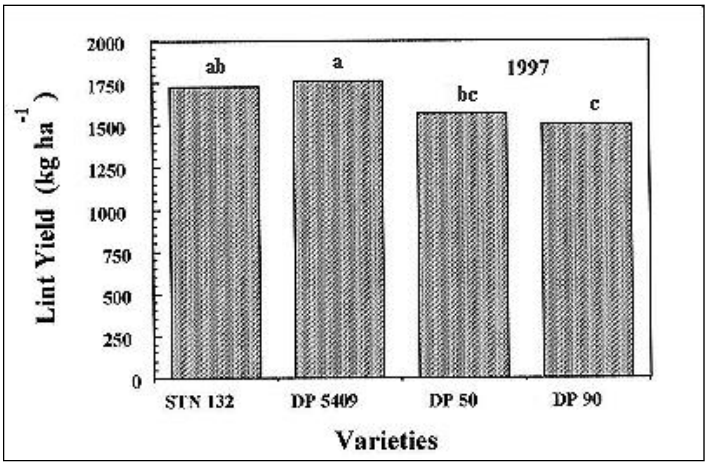


Figure 3. Lint yield of cotton cultivars with different maturity in Uvalde, TX in 1997[1].

1/ Columns marked with different letters differ at the 5%



level of significance according to the LSD test