YIELD RESPONSE OF BT-TRANSGENIC COTTON TO EARLY TERMINATION OF IRRIGATION

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Abstract

This study determined the effects of early termination of furrow irrigation on yield of Deltapine's Bt-transgenic upland cotton variety NuCot33b. The experiment was conducted at the Texas A&M University Agricultural Research and Extension Center in Uvalde, TX, during the 1997 season. The irrigation termination treatments were as follows: termination at early bloom, termination at three wk after early bloom, and termination at early open boll. Early termination of furrow irrigation at early bloom and three wk after early bloom decreased lint yield by 45% and 16%. Data from plant samples showed that yield decrease resulted from the decrease in fruit retention and individual boll weight.

Introduction

Deficit-irrigation experiments conducted at the Texas A&M University Agricultural Research and Extension Center in Uvalde, TX from 1992 to 1994 showed that furrow irrigation (flooding) can be terminated three wk after early bloom without reducing yields of cotton grown in deep soils with high water holding capacity (Fernández et al., 1996). It was concluded that this experimental outcome resulted from the combination of the following three contributing factors: a) furrow irrigation by flooding increases the water storage in deep soils with high water holding capacity and secures the availability of soil water to the deep-rooted cotton plants towards the end of the growing season, b) when plants are exposed to soil water deficits they conserve water by decreasing leaf area production and leaf transpiration, thus prolonging the availability of stored water, and c) increased pest pressure towards the end of the growing season, particularly second generation of boll weevils and bud and boll worms, dooms the production of late fruits, and therefore renders the prolonged season ineffective from the view point of yield increase.

With the implantation of a boll weevil eradication program and the advent of Bt-transgenic cottons that incorporate resistance to budworms and bollworms, the latter factor associated with end-of-season pest pressure may be minimized and may no longer be a factor in the production equation. Under these new circumstances then results obtained from early termination of irrigation may differ from the ones found in the previous study.

The objective of this study was to determine the effects of early termination of furrow irrigation on the yield of a Bt-transgenic upland cotton variety.

Materials and Methods

The experiment was conducted at the Texas A&M University Agricultural Research and Extension Center in Uvalde, TX, during the 1997 season. The soil at the experimental site is a Uvalde silty clay loam. Triple superphosphate at a rate of 60 units of P_2O_5 per acre and herbicide Treflan were applied broadcast incorporated by double disking before bedding. Deep furrow irrigation amounting to 8.9 in. was applied three wk before planting to provide adequate soil moisture content for germination and growth during early season. Nitrogen fertilizer in the form of urea was applied broadcast at a rate of 90 lbs N/acre and incorporated to the beds with rodweeder immediately before planting. Temik was applied at planting. Deltapine's Bt-transgenic upland cotton cv. NuCot33b was planted to a plant population of about 40,500 plants per acre in 38-in. rows with a vacuum precision JD7300 Maximerge-2 planter. Plots were 6 rows wide and 400 ft long. Mepiquat chloride was applied at rates of 4, 8, and 8 oz/acre at match-head square, early bloom, and two wk after early bloom, respectively. Insect pests were controlled by aerial applications of insecticides as needed.

The experiment consisted in applying three irrigation termination treatments as follows: termination at early bloom, termination at three wk after early bloom, and termination at early open boll. Furrow irrigation with gated pipes was used for in-season irrigation of the plots. Because of sufficient rainfall during early stages of growth, in-season irrigation did not start until mid July during bloom stage. Water applications were as follows: 1.9 in. on Jul 11 (all three irrigation treatments), 1.8 in. on Jul 24 and 1.2 in. on Jul 30 (only three wk after early bloom and early open boll termination treatments), 2.4 in. on Aug 6, and 3.9 in. on Aug 15 (only early open boll termination treatment). The irrigation treatments were arranged in a randomized complete block design with four replications.

Prior to harvesting and after plants were completely defoliated, 5-plant samples (5-out-of-7 plants) were mapped in each plot to determine number and location of fruits. Bolls from these plant samples were harvested for boll weight determination. Two central rows of each plot were machine-harvested on Sep 13 with a JD299 picker modified for computerized recording of seedcotton yield.

The growing season was characterized by rainfall during the vegetative and square formation phase. A high

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proportion of early squares were lost to fleahoppers, but good soil moisture conditions and warm temperatures during late June and July favored plant growth and fruit set.

Results and Discussion

Yield Components. There were significant differences among irrigation treatments in percent of fruit retention (Figure 1). Total fruit retention was 28%, 35%, and 43% when irrigation terminated at early bloom, three wk after early bloom, and early open boll, respectively.

The number of open bolls per plant was 6.2, 8.7, and 9.0 for termination of irrigation at early bloom, three wk after early bloom, and early open boll, respectively (Figure 2). Only termination of irrigation at early bloom significantly decreased the number of bolls per plant.

There were differences in open boll weight among irrigation treatments (Figure 3). Early termination at early bloom and three wk after early bloom decreased boll weight 14% (P=0.0388) and 11% (P=0.0734), respectively. Boll weight was 4.5 g when irrigation was terminated at early open boll.

Lint Yields. Lint yield, as measured directly from the picker, was decreased by early termination of irrigation in both years. Lint yield was 1071, 1635, and 1948 lbs/acre when irrigation was terminated at early bloom, three wk after early bloom, and early open boll, respectively (Figure 4). The yield difference between three wk after early bloom and early open boll treatments was, however, only statistically marginal (P=0.1763) but fit well the declining trend of yield with early termination of irrigation.

Conclusions

Early termination of furrow irrigation at early bloom and three wk after early bloom decreased lint yield by 45% and 16%, respectively. Data from plant samples showed that yield decrease resulted from the decrease in fruit retention and individual boll weight.

The new production environment brought about by Bt-transgenic varieties and the boll weevil eradication program appear to render effective the application of late-season irrigation to obtain high yields. The individual contribution of each of these factors needs to be assessed.

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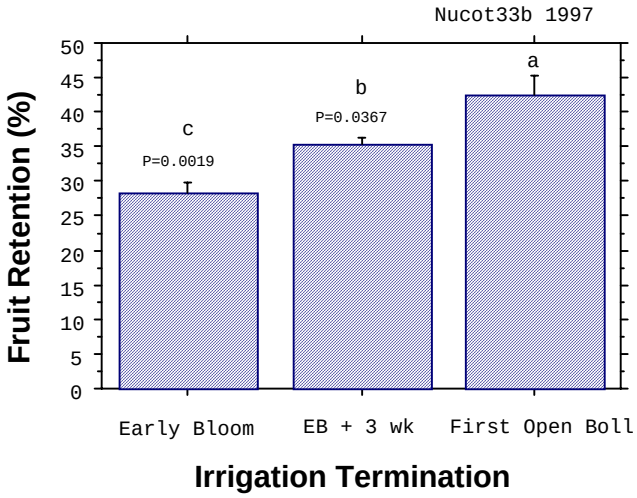

Figure 1. Fruit retention in cotton grown under three irrigation termination treatments in Uvalde, TX in 1997. Columns marked with same letter are not significantly different (P=0.05) based on Duncan's means comparison test. Probability values shown on top of columns are for differences between early termination treatments and the normal practice i.e., termination at early open boll. Vertical bars on columns indicate magnitude of standard error.

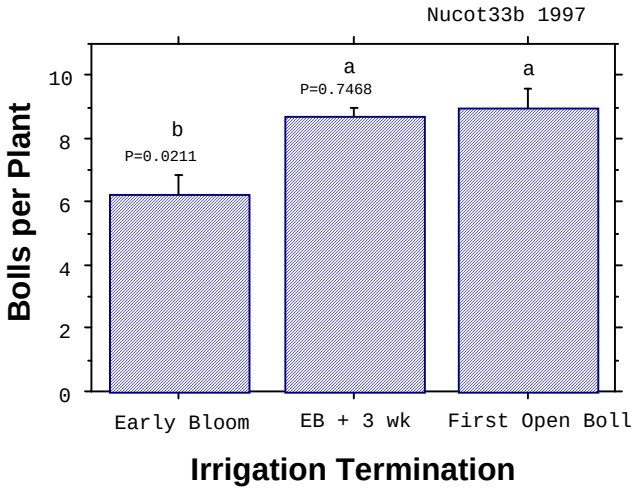

Figure 2. Number of open bolls per plant in cotton grown under three irrigation termination treatments in Uvalde, TX in 1997. Columns marked with same letter are not significantly different (P=0.05) based on Duncan's means comparison test. Probability values shown on top of columns are for differences between early termination treatments and the normal practice i.e., termination at early open boll. Vertical bars on columns indicate magnitude of standard error.

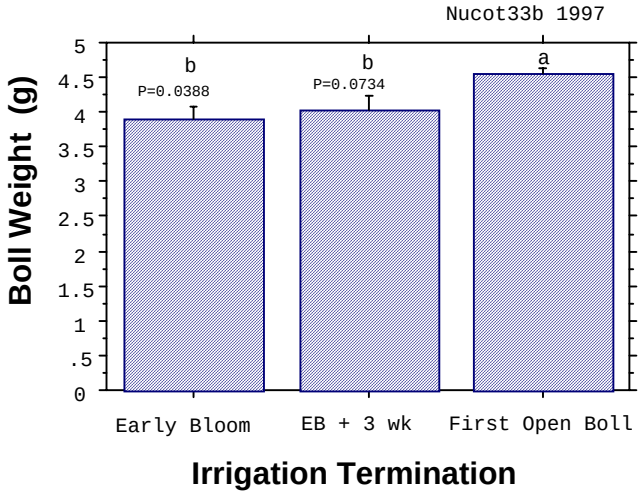

Figure 3. Average boll weight (lint + seed) in cotton grown under three irrigation termination treatments in Uvalde, TX in 1997. Columns marked with same letter are not significantly different (P=0.05) based on Duncan's means comparison test. Probability values shown on top of columns are for differences between early termination treatments and the normal practice i.e., termination at early open boll. Vertical bars on columns indicate magnitude of standard error.

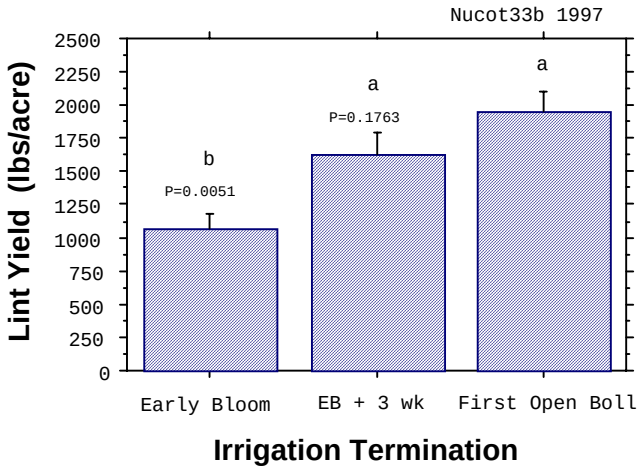

Figure 4. Lint yield of cotton grown under three irrigation termination treatments in Uvalde, TX in 1997. Columns marked with same letter are not significantly different (P=0.05) based on Duncan's means comparison test. Probability values shown on top of columns are for differences between early termination treatments and the normal practice i.e., termination at early open boll. Vertical bars on columns indicate magnitude of standard error.

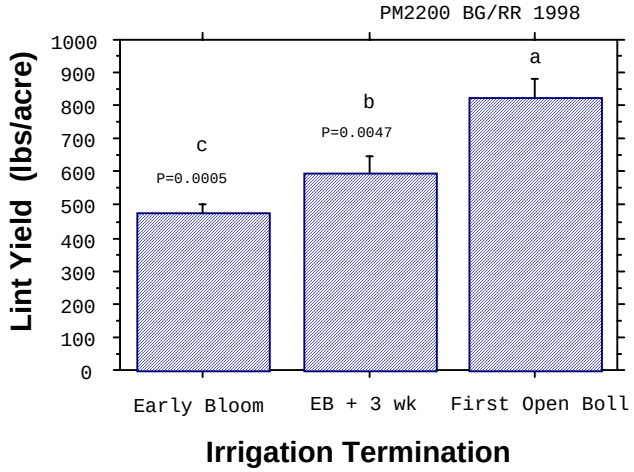

Figure 5. Lint yield of cotton grown under three irrigation termination treatments in Uvalde, TX in 1998. Columns marked with same letter are not significantly different (P=0.05) based on Duncan's means comparison test. Probability values shown on top of columns are for differences between early termination treatments and the normal practice i.e., termination at early open boll. Vertical bars on columns indicate magnitude of standard error.