Timing of Episodic Drought on West Texas Cotton Cultivars

[1]Curtis Schaefer, [2]Glen Ritchie, [3]Chase Snowden, and [4]Fulvio Simeo

[1]Texas Tech University; [2]Texas AgriLife Research; [3]Utah State University; [4]Epamig

Introduction

Recent prolonged periods of drought in West Texas have increased the necessity to lower the dependence on the Ogallala Aquifer for cotton production. In cotton production, extended periods of water deficit affects cotton plant growth rate, maturity, boll distribution, and fiber quality. However, extensive research on short term water paucity has not been heavily executed and studied.

Episodic drought is a water deficit that only occurs over part of the growing season. Short-term water stress may occur in many cases such as a period of atypical dry weather, irrigation system breakdowns or hindrances, or the necessity to divert water to another crop at a critical growth stage. Furthermore, many factors may affect a crop's sensitivity to episodic drought including genotype and crop age.

Increased knowledge of deficit irrigation and episodic drought effects may help to increase the sustainability of the Ogallala aquifer and help improve irrigation management practices. Cotton producers may be able to decrease dependency on irrigation and have better water management strategies.

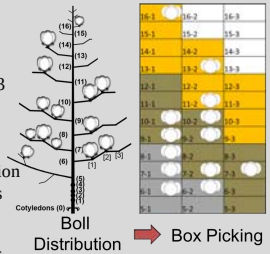
Objectives

1. Determine the effects of 10 different timings of episodic drought on in-season growth, yield, boll distribution, and fiber quality of six cotton cultivars.

2. Help with production-level decision making in cultivar selection and decision making following drought events.

Materials and Methods

- Six cotton cultivars representing a gamut of genotypes and drought tolerances were planted in West Texas during the 2013 growing season.
- Split plot design with four replicates was used, irrigation was main plot, cultivar was split plot.
- In-season measurements of total nodes, NAWF, and plant height were taken.



Cultivars

DP1219B2RF DP1212B2RF PHY367WRF
DP1044B2RF PHY499WRF FM2484B2RF

Materials and Methods Cont.

- Soil moisture was measured in each irrigation regime throughout the season with a soil neutron probe.
- Weather data was recorded by automatic stations located on site.
- Episodic drought treatments were administered by turning off the sub surface drip irrigation system at first square (FS), 1 week after FS (FS), 2 weeks after FS, 3 weeks after FS, 4 weeks after FS, and 5 weeks after FS
- End of season data was collected by plant mapping and box picking by fruiting site of 1-m row samples
- Yield was determined by harvesting both rows of each plot using a cotton stripper equipped with calibrated load cells.
- Cotton lint quality was analyzed using HVI at the Fiber and Biopolymer Research Institute.

Analysis

In-season measurements were used to illustrate basic maturing characteristics.
Distribution of boll numbers were compared by irrigation zone and cultivar. Relative maturity of the cultivars in environments based on boll distribution were also compared.
Cultivar effects, irrigation effects, and cultivar x irrigation interactions were analyzed for significance for lint yield using proc GLIMMIX

Environmental Conditions

The trial was originally planted on May 9th, only to be hailed out a few weeks later. The trial was then replanted on June 15th. This replanting led to a shorter growing season for the cotton and only allowed for seven of the episodic drought treatments to be administered. The cotton thus did not have as much time as it might in a typical growing season to mature.

The 2013 growing season once again turned out to be a below average year for rainfall in West Texas. Even though there was not copious amounts of rainfall, there were some timely precipitation occurrences that may have caused there to be less separation between treatments. Still, separation was evident in both maturity and yield.

Sponsored Publications

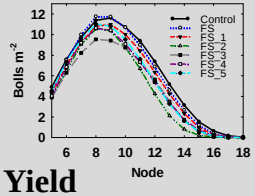
Simao F.R., G.L. Ritchie, C.W. Bednarz. (2013) Cotton Physiological Parameters Affected by Episodic Irrigation Interruption. Journal of Agricultural Science and Technology A 3:443-454.

Snowden M.C., G.L. Ritchie, F.R. Simao, J.P. Bordovsky. (2014) Timing of Episodic Drought Can Be Critical in Cotton. Agronomy journal 106:452-458.

Results: Boll Distribution

Differences in boll distribution were distinct among episodic drought treatments in 2013.

- The earliest maturing treatment was the one that endured the episodic drought 3 weeks after first square.
- The control, which had no drought, was one of the latest maturing treatments.
- When cotton was stressed at FS, it still tended to mature later.
- Most treatments that experienced drought later in the season matured earlier.



Results: Yield

Differences in yield were distinct among episodic drought treatments and cultivars in 2013.

- The control, which had no drought treatment, surprisingly did not yield the most.
  - It most likely did not have time to mature fully
- When the cotton was stressed at 1 week after FS it yielded the best.
- When cotton was stressed at 5 weeks after FS it yielded the worst.
- Overall, DP 1212 had the greatest yields in the study.
- DP 1219 had the least amount of yield.
- Typically, if a cultivar was an earlier maturing variety, it had a greater yield because of the short growing season.

Episodic drought	Lint Yield (kg/ha)
FS-1	1453 A†
FS	1437 A
Control	1421 AB
FS-4	1371 ABC
FS-3	1366 ABC
FS-2	1327 BC
FS-5	1298 C
	LSD = 106

† denotes treatments with the same letter are not significantly different

Cultivar	Lint Yield (kg/ha)
DP1212	1591 A†
PHY367	1421 B
PHY499	1417 B
FM2484	1332 C
DP1044	1267 CD
DP1219	1263 D
	LSD = 67

† denotes treatments with the same letter are not significantly different

Conclusions

Cultivars in this study exhibited similar responses to episodic drought (no cultivar by irrigation interaction). It was evident that the maturity of a variety based on boll distribution and the occurrence of episodic drought at certain points in the growing season had a discernible relationship with final yield.
More in depth analysis on cotton fiber quality, as well as boll distribution related to maturity and episodic drought is planned for the future.

Acknowledgments

This research was funded by the Ogallala Aquifer Initiative. Several graduate students, technicians, and other personnel contributed significant amounts of time to the research for this project. We appreciate their help, without which we would not have been able to do this work.