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Testing Irrigated Cotton Production

J. Aguilar
USDA-ARS, Mandan, ND, jaguilar@k-state.edu

R. S. Currie
Kansas State University, rscurrie@ksu.edu

D. Tomsicek
Kansas State University, dtomsice@k-state.edu

See next page for additional authors

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Testing Irrigated Cotton Production

Abstract

Cotton research was initiated in Garden City, KS, which is the northern rim of the typical cotton production area. Initial results showed that with specific seed varieties and strategic irrigation management, cotton could be grown and provide decent yield in this region. There is still additional research that needs conducted, particularly with regards to germination and seeding rates.

Keywords

cotton, irrigation, thermo-limited cotton, irrigated cotton, southwest Kansas

Cover Page Footnote

This research project received support from the U.S. Department of Agriculture Agricultural Research Service, Ogallala Aquifer Program, and USDA Natural Resources Conservation Service Conservation Innovation Grant.

Authors

J. Aguilar, R. S. Currie, D. Tomsicek, L. Haag, and S. Duncan

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Summary

Cotton research was initiated in Garden City, KS, which is the northern rim of the typical cotton production area. Initial results showed that with specific seed varieties and strategic irrigation management, cotton could be grown and provide decent yield in this region. There is still additional research that needs conducted, particularly with regards to germination and seeding rates.

Introduction

Irrigated cotton production has been predominantly centered in the Texas Panhandle. In the past several years, the production area has been moving north and into the southwest corner of Kansas. New improved varieties and the drought-tolerant characteristics of the cotton are two major reasons for this expansion in acreage. Valuable traits include short/early season varieties and tolerance to herbicide drift (e.g., 2,4-D choline, glyphosate, and glufosinate herbicides). The objective of this study was to test if irrigated cotton would thrive north of the typical cotton production area, and if it did, test its response to different planting dates and irrigation treatments.

Experimental Procedures

An experiment was conducted at the Kansas State University Southwest Research-Extension Center's Finnup Farm (38°01'20.87"N, 100°49'26.95"W, elevation of 2,910 feet above mean sea level) near Garden City, KS. The soil at the study site is a deep, well-drained Ulysses silt loam with water holding capacity of 2 in./ft. Two planting dates were evaluated each with at least 10 days apart and centered around May 15 (typical planting date), whenever the soil temperature is above 65°F. Phytogen 210 cotton variety was planted for both years. Previous crops for the plots were either corn, grain sorghum, or wheat. The plot treatments were five irrigated (full, 60% ET, 30% ET, 1 inch at match head square (MHS), and 1 inch at MHS and another inch at boll formation) and one dryland, in a randomized complete block replicated at least 3 times. Irrigation was applied using a linear move sprinkler system (Model: Valley 8000 series, Valmont Industries, Inc., Valley, NE) with four spans and each span serving as a replicate. Each irrigation event applied 1 in. for all treatments irrigated on a given day, and irrigation treatments were based on frequency and soil water monitoring. Harvest was done using a 4-row mechanical cotton stripper and the samples were sent to Fiber and Biopolymer Research Institute in Texas for fiber analysis.

Results and Discussion

In 2019, only the later planted plot (May 30) was continued since the earlier planted plot (May 15) had a very low germination rate (<10%) and was abandoned. One of the most likely reasons for the low germination rate is the weather condition after planting, when the temperature dipped below 50°F for several days. The germination rate at the later planted plot was 43%. In 2020, the conditions were flipped, this time the germination rate of the earlier planted plot was better (53%) than the later planted plot (39%).

Results show that there were no significant differences in the lint value, lint yield, and other yield parameters across the different irrigation treatments, including dryland (Tables 1 and 2). However, there are notable numerical differences in some treatments. Fully irrigated cotton did show a diminished yield compared with other treatments. On the other hand, the strategic irrigation of 1 inch at match head square did show a consistently higher yield and lint value against other treatments.

Total soil water measurements showed that there was an aggressive use of water for the whole profile (Figure 1). By harvest time, there were not any noticeable differences in available soil water across treatments. There was a strong correlation between water productivity and lint yield, as shown in Figure 2c. A much stronger correlation existed between water use efficiency and lint yield (Figure 2d). In both cases, the higher the productivity and efficiency, the higher the lint yield.

Thus, going back to the objective of this study, it could be concluded that irrigated cotton can be grown in this region. Since the planting window for cotton is very narrow in this region, planting issues, such as the optimum condition and emergence rate, need further research. Based on this initial research, the emergence rate was spotty and poor, which was less than 50% (36% if we include the abandoned plots).

Acknowledgments

This research project received support from the U.S. Department of Agriculture Agricultural Research Service, Ogallala Aquifer Program, and USDA Natural Resources Conservation Service Conservation Innovation Grant.

Table 1. Irrigation treatment averages on irrigation amount, loan average, lint yield, Micronaire (MIC), and lint value in 2019

Treatments	Total irrigation	Loan average	Lint yield	Average of MIC	Lint value
	in.	$/lb	lb/a		$/a
Fully irrigated (100% ET)	5	0.36	658	2.61	238
Partially irrigated (66% ET)	4	0.41	845	2.87	344
Limited irrigated (33% ET)	1	0.48	1,061	3.46	507
Dryland	0	0.48	787	3.67	379
One irrigation (1.00 in.) at match head square only	1	0.45	902	3.28	408
One irrigation (1.00 in.) at match head square and at boll formation	2	0.41	820	2.89	334
Average		0.43	845	3.13	368

ET = evapotranspiration. Loan average = adjusted loan rate average.

Table 2. Water treatment effect on cotton lint yield, water productivity, irrigation water use efficiency (IWUE), Micronaire, loan value, and lint value in 2020

Factors	Micronaire	Lint yield	Productivity	IWUE	Loan value	Lint value
Water treatments	Mass/length	lb/a	lb/a-in.		$/lb	$/a
1. 100% ET	2.2	638.7	62.3	851.5	0.3	195.0
2. One irrigation MHS and Boll	2.2	735.4	71.8	980.5	0.3	220.9
3. 66% ET	**2.1**	**387.7**	**39.2**	**516.9**	**0.3**	**115.7**
4. One Irrigation MHS Only	2.4	766.6	82.1	1022.2	0.4	292.4
5. 33% ET	**2.2**	**434.3**	**46.9**	**579.0**	**0.3**	**130.2**
6. Dryland	2.4	683.9	81.5	---	0.4	290.6
HSD[1]	NS	NS	NS	NS	NS	NS
Type 3 test						
Pr > F	0.3912	0.5886	0.5759	0.2623	0.4511	0.5326

[1]HSD = Tukey's Honest Significant Difference Test. HSD is the minimum difference between two treatments used to declare they are significantly different at $P < 0.05$.
Bold treatments and numbers represent results that are relatively low, even though the statistical test showed no significant difference.
MHS = match head square. ET = evapotranspiration.

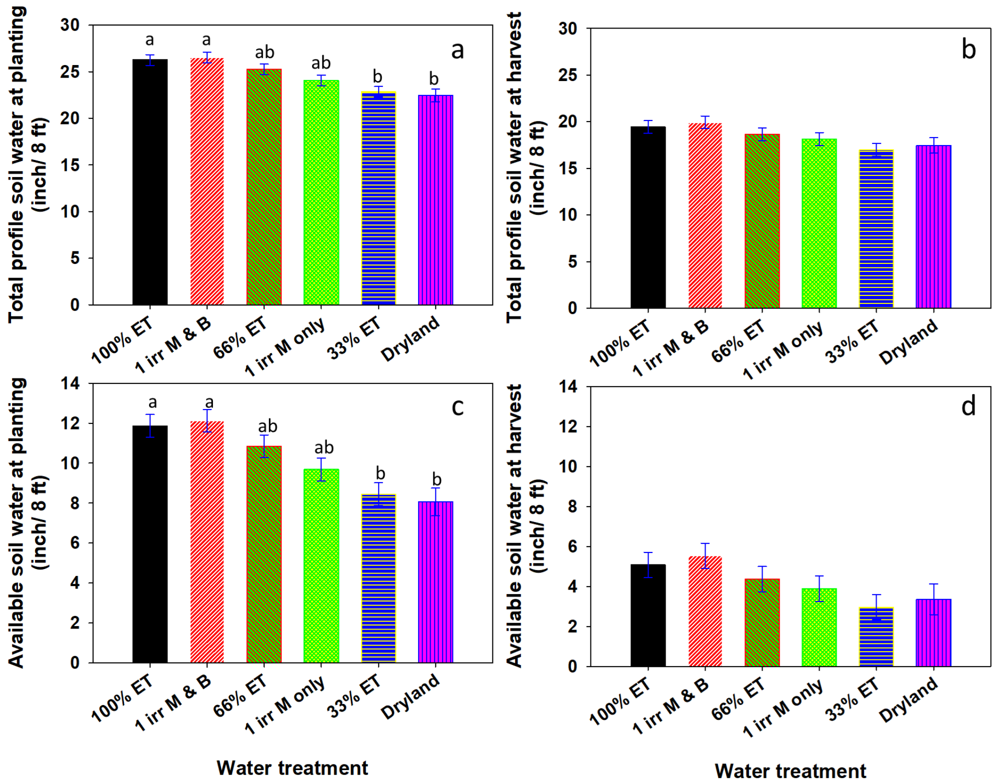

Figure 1. Total soil water (a) at planting and (b) at harvest; and available soil water (c) at planting and (d) at harvest of cotton across water treatments. Error bars are standard errors and bars with the same letters or no letter are not significantly different ($P < 0.05$). M = match head square. B = boll. ET = evapotranspiration.

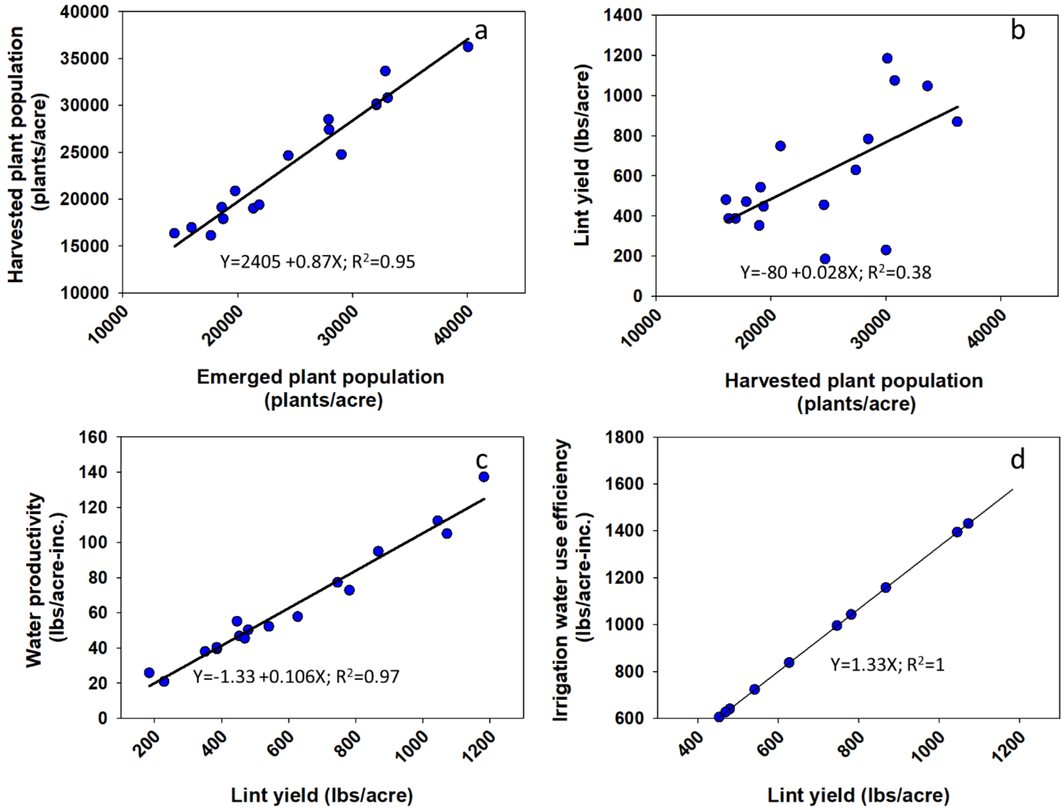

Figure 2. Simple linear relationships between (a) emerged plant population and harvested plant population, (b) harvested plant population and lint yield, (c) lint yield and productivity, and (d) lint yield and irrigation water use efficiency.