COTTON PROFITABILITY AS INFLUENCED BY ROTATION, CULTIVAR AND IRRIGATION LEVEL

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Abstract

Cotton is the leading agronomic crop produced on the Texas High Plains (THP) with annual planting exceeding 3.5 million acres. Recent agricultural water restrictions along with ever more volatile commodity prices and wide ranges in rainfall during the growing season all greatly affect crop production. This study conducted an economic analysis comparing continuous cotton production and a cotton-grain sorghum rotation with an emphasis on irrigation capacity, crop rotation and cultivar selection. The objective of this study is to compare cotton profitability as influenced by cultivar, irrigation level and crop rotation. Cotton yield and quality data were obtained from trials conducted at the Agricultural Complex for Advanced Research and Extension Systems (AG-CARES) research farm in Lamesa,TX, from the years 2009-2011. Irrigation was applied using a center-pivot and Low Energy Precision Application (LEPA). Both cropping systems were irrigated with three irrigation levels.

Introduction

A majority of the cotton production in the THP region is grown in a continuous cotton sequence. In 2008, grain prices greatly increased, while cotton prices remained near loan levels, making sorghum production an attractive rotational crop to produce in this region. Increasing disease and nematode pressure, especially in locations such as the AG-CARES farm, could be better managed with a rotation of crops, such as sorghum with cotton. The objective of this study is to evaluate the influence of cultivar selection, irrigation level and crop rotation on cotton lint yield, fiber quality and profitability.

Crop rotations in the THP of grain-sorghum and cotton have shown to increased cotton yields following a year of sorghum production, as well as a significantly impact cotton profitability (Johnson et al., 2006). With the loss of Temik©, root-knot nematode infestation will have a significant impact on producer's crop decisions. Nematode pressure is continuing to increase across the cotton belt, especially in the southern areas of the THP region. Crop rotations may be beneficial in controlling the effects of this problem. This study analyzes whether implementing a sorghum-cotton rotation will produce higher yields and profitability for cotton when compared to a continuous cotton sequence.

Materials and Methods

Studies were conducted over a three-year period at the Agricultural Complex for Advanced Research and Extension Systems (AG-CARES) research farm located in Lamesa,TX. Irrigation was applied with a center-pivot using Low Energy Precision Application (LEPA). The crop years used in this study were 2009, 2010 and 2011. The two different crop sequences used were a continuous cotton production system and a grain sorghum-cotton production system. In the rotation system, cotton was planted following sorghum from the year before, sorghum stalks were shredded prior to planting. This study focused on the cotton portion of the rotation and did not factor in grain prices from the year. Four cultivars were used over each year and crop sequence. The four cultivars used were: ST 5458

B2RF, DP 0935 B2RF, AM 1532 B2RF, and FM 9160 B2RF. The three irrigation levels used were a base level, base+25% and base-25%. Due to the differences in rainfall in each of the three growing seasons, different amounts were applied each year. During the 2009 growing season, the base irrigation level was 7.2 acre inches, which represented a normal irrigation level paired with the amount of rainfall. In 2010, the THP region received an above average amount of rainfall, both preplant and during the growing season. Therefore, the base irrigation amount in 2010 was only 5.1 acre inches. The base irrigation amount rose substantially in 2011 to 20.4 acre inches due the extreme drought and extreme temperatures that were experienced across the region.

Irrigation cost was assumed to be $9 per acre inch, using the 2010 Texas Crop Budgets for Texas Extension District 2 (Texas AgriLife Extension, 2010). This irrigation cost was then multiplied by the actual amount applied to each plot to determine the total irrigation cost. Cotton loan values were determined for each sample after undergoing fiber analysis at the Texas Tech University Fiber and Biopolymer Research Institute (FBRI). Cotton lint yields were multiplied by the respective loan value to determine the total revenue per acre for each plot. For this analysis, only the revenue produced from cotton in each sequence was evaluated. Irrigation applied was multiplied by the irrigation cost to determine the total irrigation cost per acre. Then, the total revenue of the crop was subtracted by the irrigation cost to determine the net returns above irrigation cost. For this analysis, all other costs were held constant, therefore were not taken into consideration.

Results and Discussion

The effect of crop sequence, cultivar selection and irrigation level was determined for both cotton lint yield as well as net revenue over irrigation cost. It was determined that irrigation level, cultivar selection and year were all significant at a 1% level for yield, loan value, total revenue and net return over irrigation cost. Crop sequence was significant at a 1% level for yield, total revenue and net revenue over irrigation cost, but was not significant to loan value.

The first set of tables report on the effects of crop sequence, cultivar selection and irrigation level on cotton lint yields.

Table 1 shows when averaged across 4 cultivars and 3 irrigation levels, the effect of crop sequence on cotton lint yield, lint yields ranged from 864 to 960 lbs/ac in 2009, with the sorghum-cotton rotation being the preferred crop sequence. In 2010, lint yield increased for both crop sequences to a range of 1070 to 1136 lbs/ac, again resulting in the sorghum-cotton rotation being the preferred crop sequence. Cotton lint yields were reduced across both crop sequences in 2011, ranging from 298 to 303 lbs/ac. During this crop year, crop sequence had no impact on cotton lint yields.

Table 1. Effects of crop sequence on cotton lint yields at AG-CARES.

Cultivar	2009	2010	2011
	lbs/ac		
Cotton-Cotton	864b	1070b	303a
Sorghum-Cotton	960a	1136a	298a

Table 2 shows when averaged across 2 crop sequences and 3 irrigation levels, lint yields ranged from 759 to 1036 lbs/ac in 2009. Higher cotton lint yields were produced with the ST 5458 B2RF, DP 0935 B2RF and AM 1532 B2RF cultivars in 2009. In 2010 lint yields ranged from 948 to 1316 lbs/ac, higher cotton lint yields were achieved across all cultivars, with ST 5458 B2RF separating from the others as the top performing cultivar in 2010. During 2011, cotton lint yields were all diminished greatly due to the adverse weather conditions ranging from only 253 to 340 lbs/ac, with ST 5458 B2RF, DP 0935 B2RF and AM 1532 B2RF producing the highest yields in 2011.

Table 2. Effects of B2RF cultivar on cotton lint yields at AG-CARES.

Cultivar	2009	2010	2011
	lbs/ac		
ST 5458 B2RF	1036a	1316a	293ab
DP 0935 B2RF	955ab	1089a	340a
AM 1532 B2RF	898b	1068bc	316ab
FM 9160 B2RF	759c	948c	253b

Table 3 shows when averaged across 2 crop sequences and 4 cultivars the effects of irrigation level on cotton lint yield, lint yields ranged from 951 to 1019 lbs/ac in 2009. During this year there was no significant yield increase in the high irrigation treatment when compared to the medium or base irrigation level. In 2010, cotton lint yield increased across all irrigation levels, ranging from 926 to 1296 lbs/ac. During this crop year the high irrigation level produced the highest cotton lint yield. Due to the amount of rainfall received both preplant and during the growing season, the base irrigation level was only at 5.1 acre inches. Therefore, the high irrigation treatment in 2010 was comparable to base or even low irrigation level during other years. In 2011, cotton lint yields were greatly decreased, ranging from 118 to 472 lbs/ac. The high irrigation level was the preferred irrigation treatment in the 2011 crop year.

Table 3. Effects of LEPA irrigation levels on cotton lint yields at AG-CARES.

Irrigation Level	2009	2010	2011
	lbs/ac		
High	951b	926c	118c
Medium	966a	1087b	311b
Low	1019a	1296a	472a

Next, the effects of rotation, cultivar selection and irrigation level on net revenue over irrigation cost is analyzed. Net revenue over irrigation cost was determined by taking total revenue minus total irrigation cost.

Table 4 shows when averaged across 4 cultivars and a base irrigation level, the effect of crop sequence on net revenue over irrigation costs ranged from 420 to 488 $/ac in 2009, with the sorghum-cotton rotation being the preferred crop sequence. In 2010, net revenue over irrigation cost increased to a range of 553 to 588 $/ac. During this crop year, crop sequence did not have an effect on net revenue over irrigation cost. In 2011, net revenue over irrigation cost decreased to a range of -8 to 29 $/ac. Again, the sorghum-cotton rotation was the preferred crop sequence in 2011.

Table 4. Effects of crop sequence on net revenue over irrigation cost at AG-CARES.

Cultivar	2009	2010	2011
	$/ac		
Cotton-Cotton	420b	588a	-8b
Sorghum-Cotton	488a	553a	29a

Table 5 shows when averaged across 2 crop sequences and a base irrigation level, the effect of cultivar selection on net revenue over irrigation cost ranged from 381 to 522 $/ac in 2009. The top performing cultivars in 2009 were ST 5458 B2RF, DP 0935 B2RF and AM 1532 B2RF. In 2010, net revenue over irrigation cost increased with each cultivar to a range of 501 to 628 $/ac. ST 5458 B2RF separated as the top performing cultivar during the 2010 crop year. Net revenue over irrigation cost diminished greatly in 2011 to a range of -16 to 51 $/ac. The top producing cultivars in this crop year were ST 5458 B2RF, DP 0935 B2RF and AM 1532 B2RF.

Table 5. Effects of B2RF cultivar on net revenue over irrigation cost at AG-CARES.

Cultivar	2009	2010	2011
	$/ac		
ST 5458 B2RF	522a	628a	2ab
DP 0935 B2RF	474ab	559b	51a
AM 1532 B2RF	438ab	532bc	4ab
FM 9160 B2RF	381b	501c	-16b

Table 6 shows when averaged across 2 crop sequences and 4 cultivars the effect of irrigation level on net revenue over irrigation cost, values ranged from 346 to 474 $/ac in 2009. During this crop year, the net revenue over irrigation cost was not higher for the high irrigation level when compared to the medium or base irrigation level. In 2010, net revenue over irrigation cost increased across all irrigation levels, ranging from 468 to 656 $/ac. During the 2010 crop year, the high irrigation level produced the highest net revenue over irrigation cost. In 2011, net revenue over irrigation cost was greatly decreased across all irrigation levels, ranging from -45 to 47 $/ac, with the high irrigation level producing the most net revenue over irrigation cost.

Table 6. Effects of LEPA irrigation levels on net revenue over irrigation cost at AG-CARES.

Irrigation Level	2009	2010	2011
	$/ac		
High	474a	656a	47a
Medium	454a	555b	10b
Low	346b	468c	-45

Table 7 shows the optimal combination of crop sequence, cultivar selection and irrigation level on cotton profitability for each of the three years. During the 2009 crop year, which experienced a normal level of rainfall, the ST 5458 B2RF cultivar, the sorghum-cotton rotation and base irrigation level yielded the highest net return over irrigation cost? In 2010, which received an above average amount of rainfall, the ST 5458 B2RF cultivar, continuous cotton crop sequence and the high irrigation level had the highest net return over irrigation cost. In 2011, an extremely dry year, the DP 0935 B2RF, the sorghum-cotton rotation and high irrigation level yielded the highest net return over irrigation cost.

Table 7. Optimal combination of cultivar selection, crop sequence and irrigation level on cotton profitability.

	2009	2010	2011
Cultivar	ST 5458 B2RF	ST 5458 B2RF	DP 0935 B2RF
Crop sequence	Rotation	Continuous cotton	Rotation
Irrigation level	Base	High	High

Summary

The focus of this study was to determine whether a continuous cotton crop sequence or a grain sorghum-cotton rotation was economically preferred with respect to cultivar selection and irrigation level. Cotton lint yields were increased with a grain sorghum-cotton rotation in 2 of the 3 years. The cultivar with the highest root-knot nematode tolerance produced the highest yields each year during this study. Yields were increased when irrigation level was increased in 2010 and 2011; in 2009 yields were not greater with the high irrigation treatment when compared to the base treatment. Net revenue over irrigation cost was greater with a grain sorghum-cotton rotation in 2 of the 3 years, and was increased with optimal cultivar selection for all 3 years, and higher irrigation input in 2 of the 3 years.

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