EVALUATING SKIP-ROW PLANTING AS A DROUGHT ADAPTION STRATEGY FOR COTTON

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Abstract

Farmers can use a variety of technologies to conserve water and enhance resilience to drought. One of these technologies is skip-row planting. In 2013, a study was conducted to evaluate and demonstrate the yield and economic benefits of using skip-row planting as a drought adaptation strategy in dryland cotton production in South Carolina. Replicated experiments were established in two fields in Barnwell County, SC, one in a farmer's field and the other at the Edisto REC farm. At the farmer's field, single-skip and solid-planted cotton were compared. At the Edisto REC farm, four cotton planting configurations, including Solid-Planting, Single-Skip, Double-Skip, and Alternate-Skip, were compared. We found that at the Edisto REC farm the average yields were 765, 831, 1129, and 964 lb/acre for the Alternate-Skip, Double-Skip, Single-Skip, and Solid-Planting, respectively. Yield for the Single-Skip treatment was significantly higher than for the other planting configurations. The yield for the Single-Skip was 165 lb/acre higher than for the Solid. At the farmer's field, the average yield for the single-skip cotton was 1088 lb/acre, compared to 939 lb/acre for the solid-planted cotton. This was an average difference of 149 lb/acre, which was not significantly different. Economic analysis showed that the Single-Skip planting produced an average of $169/acre of additional revenue (crop income minus cost of seeds) compared to Solid-Planting in both fields, while Alternate-Skip and Double-Skip, produced less revenue (13.5% less) than Solid-planting.

Introduction

One of the proven ways to conserve soil water is to reduce plant population, since fewer plants per unit area extract less soil water. When water is limited, this technique could result in higher crop yields (Payero et al., 2012; Bange and Stiller, 2002; Gibb, 1995). It also reduces production costs by planting fewer seeds, therefore, reducing technology cost associated with genetically modified crop seeds. However, when water is plentiful, fewer plants also tend to produce lower yields. Plant populations can be reduced by reducing the number of seeds per crop row and also by skipping (not planting) some of the crop rows as shown in Figure 1. Skip-row planting configurations have become a common practice as a drought resilience strategy in some arid and semiarid areas of the world, but have not yet been adopted in more humid environments such as South Carolina and other states in the Southeast USA region.

Since production costs can be significantly reduced with skip row planting, especially for genetically modified crop varieties, researchers in Australia have shown economic advantages of skip row planted cotton for dryland production. For example, Gibb (1995) showed that for cotton the gross margins per unit area ($/acre) could actually increase with skip row planting compared to solid planting. Similarly, in a semi-arid environment in Australia, Goyne and Hare (1999) reported gross margins for single and double skip dryland cotton of $215/acre and $245/acre, respectively, compared with only $157/acre for solid planting. They also found that planting cotton using skip row configurations also significantly increased fiber quality. Farmers can choose to plant cotton using a variety of row configuration, including Solid, Single Skip, Double Skip, and Alternate Skip, among others. These four row configuration options are illustrated in Table 1.

Recent drought periods in many regions of the USA have highlighted the need for farmers to adopt farming practices that conserve water. Since there is not much experience with skip row configuration in South Carolina, there is a need to evaluate whether or not skip row planting would be beneficial for local growers. Therefore, the objectives of this study were to: (1) evaluate the yield and economic benefits of using skip-row planting as a drought adaptation strategy in dryland cotton production in South Carolina, and (2) introduce and demonstrate skip-row planting as a drought adaptation option for farmers in South Carolina.

Figure 1. Cotton planted in alternate skip (Top) and Single Skip row configurations.

Table 1. Row configurations options ("x" = planted row, "-" = skipped row).

Planting Configuration	Description	Crop Row (R1…R9)								
		R1	R2	R3	R4	R5	R6	R7	R8	R9
Solid (S)	Plant all rows	x	x	x	x	x	x	x	x	x
Single Skip (SS)	Plant 2 rows , then skip 1 row	x	x	-	x	x	-	x	x	-
Double Skip (DS)	Plant 2 rows , then skip 2 row	x	x	-	-	x	x	-	-	x
Alternate Skip (AS)	Plant 1 row , then skip 1 row	x	-	x	-	x	-	x	-	x

Materials and Methods

Two field experiments were established in 2013 to evaluate and demonstrate skip-row configuration technology with dryland cotton in Barnwell County, South Carolina. One of experiments was conducted on a field of a local commercial farm (FARMER). The other experiment was conducted at the Edisto Research and Education Center (EREC), located near Blackville, SC. At the FARMER field, a farm-scale experiment was established comparing Single Skip and Solid planting configurations. In this farm, three 12-row strips, 800 ft long, were planted. The center strip was planted using the Single Skip configuration and the other two strips, using the Solid configuration. Each strip was then divided into three blocks (replications) as indicated in Figure 2. The experiment at the EREC field, on the other hand, compared the performance of four cotton planting configurations using a randomized complete block design with four replications. Each experimental included eight rows of cotton, 85 ft long. The planting configurations included Solid, Single Skip, Double Skip, and Alternate Skip (Table 1). For both fields, yield from each plot was collected at harvest using a cotton plot combine instrumented with a yield monitor.

Figure 2. Experimental layout at the FARMER field in 2013 comparing Single Skip (Skip) and Solid planting configurations. Only blue and red plots were included in the experiment. The right panel shows one of the Single Skip plots.

Results and Discussion

Lint Yield

Cotton lint yields by planting configuration obtained in the two fields are shown in Figure 3. Analysis of variance (ANOVA) for the data obtained at the EREC field showed that planting configuration had a significant effect on yield ($\alpha = 0.05$). Yield for the Single Skip planting configuration was significantly higher than for the other planting configurations. The yield for the Single Skip was 165 lb/acre higher than for the Solid. There were not significant yield differences among the Solid, the Alternate Skip, and the Double Skip planting configurations at this site. Average yields were 765, 831, 1129, and 964 lb/acre for the Alternate Skip, Double Skip, Single Skip, and Solid, respectively. ANOVA for the FARMER site showed no significant differences between the Solid and Single Skip configurations. However, at this site yield for the Single Skip was 149 lb/acre higher than for the Solid.

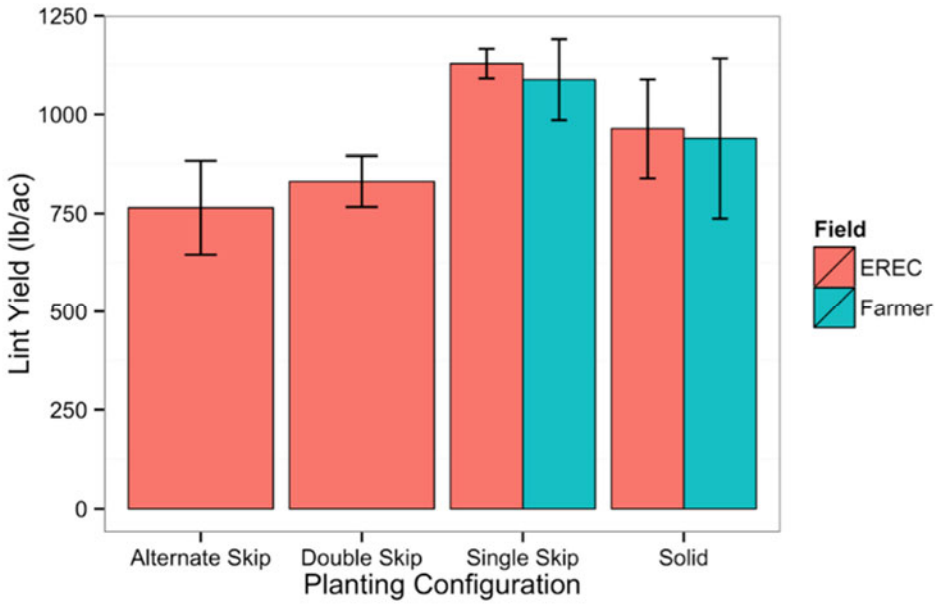

Figure 3. Cotton lint yield by row configuration for the EREC and FARMER fields obtained in 2013. The error bars are the standard error of the means.

Economic Analysis

Details of economic analysis for each planting configurations in the two fields are shown in **Table 2**. The analysis calculates crop income considering the reduction in the cost of seeds of the different skip row configurations compared to solid planting. The Single Skip configuration only requires planting 67% of the seeds, while the Alternate Skip and Double Skip both require planting 50% of the seeds compared with solid planting. Single Skip planting produced **an average of $169/acre** of additional income (crop income minus cost of seeds) compared to solid planting in both fields, while Alternate Skip and Double Skip, produced around 13.5% less income than solid planting. For the Single Skip, the increase in yield and the reduction in the cost of seeds compared with Solid planting combined to produce the higher income. For the Alternate Skip and the Double Skip, on the other hand, the reduction in the cost of seeds was not enough to compensate for the lost in yield compared to solid planting.

Table 2. Economics of cotton planted in different row configurations for two fields in 2013.

Item	EREC Field				FARMER Field	
	Solid	Single Skip	Alternate Skip	Double Skip	Solid	Single Skip
% Seeds planted	100%	67%	50%	50%	100%	67%
Seed cost ($/ac)	$84.00	$56.28	$42.00	$42.00	$84	$56.28
Yield (lb/ac)	964	1129	765	831	939	1088
2013 cotton price ($/lb)	$0.90	$0.90	$0.90	$0.90	$0.90	$0.90
Gross Income ($/ac)	$868	$1,016	$688	$748	$845	$979
Income minus seed cost ($/ac)	$784	$960	$646	$706	$761	$923
% income of Solid	100%	122%	83%	90%	100%	121%
Income over Solid ($/ac)	-	$176	(-$137)	(-$78)	-	$162

Summary

Results from 2013 indicated that planting cotton in a Single Skip row configuration, which reduced plant population by 33.3%, produced higher yields and an additional average income of $169/acre compared to solid planting (21.5% increase in income). On the other hand, using the Alternate Skip and Double Skip planting configurations, which reduced plant population by 50%, significantly reduced yield and income by and average of $108/ac (13.5% decrease in income).

Acknowledgements

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