COTTON PRODUCTION IN A TWO-YEAR CORN-WHEAT-COTTON ROTATION WITH CONSERVATION TILLAGE

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Abstract

Conservation tillage can conserve natural resources. However, physiographic regions are different in soils, weather, and cropping systems. We investigated a two-year corn-wheat-cotton rotation from 1988 to 1992. The soil was a Norfolk loamy sand (*Typic Kardiudult*), and the plots were 23 by 61 m arrayed in a randomized complete block design with five replications. Conventional tillage consisted of multiple diskings and cultivations; surface tillage was eliminated for conservation tillage. We subsoil-planted with a Kelley conservation tillage subsoiler and International 900 conservation tillage planters. Planting dates ranged from June 7 to 18, and two years had crop failure because of early freezes. However, the other three years had > 150 days of growth and lint yield ranges of 0.78 to 1.58 bales/ac for conservation tillage and 0.68 to 1.39 bales/ac for conventional tillage. Conservation tillage was significantly greater every year. Delta Pineland 20 had the best lint yields with 1.34 and 1.09 bales/ac for conservation and conventional tillage, respectively. PD 3 had lint yields of 1.06 and 0.98 bales/ac for conservation and conventional tillage, respectively. Selection of early maturing cotton and wheat cultivars will be important for this crop rotation. Further studies are needed to capitalize on the advantages of conservation tillage.

Introduction

Conservation tillage can conserve natural resources and optimize crop productivity through controlled soil erosion, reduced soil compaction, increased water use efficiencies, and reduced energy costs. However, adoption of conservation tillage in a particular physiographic region requires that the practice fit the soils and cropping systems of that region (Campbell et al., 1984a and 1984b). A rotational system of corn, small grain, and soybean has been studied extensively in the Eastern Coastal Plain; but investigations of rotational systems that include cotton and conservation tillage are limited (Bauer and Busscher, 1993). A study was conducted to investigate the influence of conservation tillage on a two-year rotation with corn, wheat, and cotton grown on a Norfolk loamy sand.

Materials and Methods

Conventional and conservation tillage plots that were 23 meters wide and 61 meters long were established in 1979 in a randomized complete block design with five replications on a Norfolk loamy sand soil (*Typic Kardiudult*) near Florence, SC. Conventional tillage consisted of multiple diskings and cultivations. Surface tillage was eliminated for conservation tillage. Continuous corn and a two-year corn-wheat-soybean rotation were grown until 1986. In 1988, a two-year corn-wheat-cotton rotation was initiated on the site. Recommended rates of lime, fertilizer, and pesticides were used for all crops.

The site was divided into two equal segments. In segment A, the crop rotation was corn-wheat-cotton beginning in 1988. In segment B, the crop rotation was cotton-corn-wheat beginning in 1988. These rotations were continued for five years.

Corn (Pioneer 3165) was planted in April at the rate of 62,000 seeds/hectare. Wheat (Coker 9227) was planted in November at the rate of 100 kg seeds/hectare. Cotton (Delta Pine 20, Delta Pine 41, Delta Pine 50, Delta Pine 90, PD 1, and PD 3) was planted in June at the rate of 136,000 seeds/hectare.

Yields for corn, wheat, and all six cotton cultivars were taken from 200 feet of row in each plot and evaluated by use of analysis of variance and least significant difference (SAS, 1990).

Results and Discussion

Tillage systems did not significantly affect corn or wheat yields (Table 1). Plant stand and dry matter yields were similar for both tillage systems. Soil moisture conditions at planting, heat units in the growing season, and number of frost-free growing days are extremely important when late planting (June) of cotton occurs. Planting date, heat units, precipitation, and frost-free growing days for the five cotton growing seasons are presented in Table 2.

Average rainfall was 63 cm and average heat units for the five years were 1214 during the cotton growing season. Even though rainfall and heat units in 1988 and 1992 were similar to previous years, an early season freeze occurred, and this resulted in crop failure because the cotton bolls had not opened prior to the freeze. Although cotton lint and seed yields varied from year to year, there was a positive tillage effect observed. In 1989 through 1992, both lint and seed yields were significantly higher with conservation tillage (Tables 3 and 4). The grand means for all years were also significantly different with tillage.

All cultivars, with the exception of PD 1, had higher lint and seed yields with conservation tillage (Tables 5 and 6). Delta Pine 20, 50 and 90 had higher lint and seed yields than the other cultivars with conservation tillage. Generally, the Delta Pine cultivars yielded higher than the PD cultivars with conservation tillage. However, this effect was not observed with conventional tillage.

Conclusions

These studies showed that cotton lint yields in a two-year rotation with corn and wheat in the southeastern Coastal Plain were higher with conservation tillage. When the cotton was planted in early June and freezing temperatures did not occur in early October, lint yields of 550 to 850 kg/ha (1.0 to 1.6 bales/ac) were obtained.

The study also showed that some cultivars performed better than others with conservation tillage. Selection of early maturing cotton and wheat cultivars will be important for this crop rotation.

Conservation tillage allows earlier planting of cotton and conserves soil moisture. Further studies are needed to capitalize on these advantages.

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References

1. Bauer, P. J., and W. J. Busscher. 1993. Effect of winter cover on soil moisture content in conventional and strip tillage cotton. Proceedings of the 1993 So. Conserv. Tillage Conf. for Sustainable Agriculture, Monroe, LA, 15-17 June, LA AES #93-86-7122, pp. 8-10.

2. Campbell, R. B., D. L. Karlen, and R. E. Sojka. 1984a. Conservation tillage for maize production in the U.S. southeastern Coastal Plain. Soil Till. 4:511-529.

3. Campbell, R. B., R. E. Sojka, and D. L. Karlen. 1984b. Conservation tillage for soybeans in the U.S. southeastern Coastal Plain. Soil Till. 4:531-541.

4. SAS Institute. 1990. SAS/STAT Users Guide, Version 6, Fourth Edition, SAS Institute, Inc., Cary, NC.

Table 1. Yield, plant population, and dry matter of corn and wheat at harvest as influenced by conservation and conventional tillage in a two-year rotation.

Crop	Tillage	Yield (Mg/ha)	Plant Number	Plant Weight (Mg/ha)
Corn	Conserv.	6.16	18,005	14.50
	Convent.	6.03	18,179	13.08
LSD 0.05		NS	NS	NS
Wheat	Conserv.	1.85	--	4.41
	Convent.	1.93	--	4.48
LSD 0.05		NS	--	NS

Table 2. Planting date, heat units, precipitation, and frost-free growing days during cotton growing season for five years.

Year	Planting Date	Heat Units C°	Precipitation (cm)	Frost-Free Days
1988	June 13	1245	53.1	123
1989	June 15	1128	60.6	155
1990	June 11	1247	66.2	160
1991	June 7	1248	51.1	151
1992	June 18	1203	86.4	124

*Frost-free days are the number of days between planting and the first day with a minimum temperature of 0 C°

Table 3. Cotton lint yield as influenced by conservation and conventional tillage in a two-year rotation.

Year	Conservation Tillage *	Conventional Tillage	LSD (0.05)
	--------Yield (kg/ha)--------		
1988	0	0	NS
1989	541	499	S
1990	420	369	S
1991	853	750	S
1992	44	32	S
Mean	378	335	S

* bale/ac = 538 kg/ha

Table 4. Cotton seed yield as influenced by conservation and conventional tillage in a two-year rotation.

Year	Conservation Tillage	Conventional Tillage	LSD (0.10)
	--------Yield (kg/ha)--------		
1988	0	0	NS
1989	811	748	S
1990	631	554	S
1991	1279	1125	S
1992	66	48	S
Mean	567	502	S

Table 5. Cotton lint yield (1989-1991) as influenced by cultivar with conservation and conventional tillage in a two-year rotation.

Cultivar	Conservation Tillage	Conventional Tillage	LSD (0.10)
	--------Yield (kg/ha)-------		
PD 1	522	639	NS
PD 3	574	527	NS
DP 20	721	588	S
DP 41	525	496	NS
DP 50	678	565	S
DP 90	626	442	S
LSD (0.10)	94	91	

Table 6. Cotton seed yield (1989-1991) as influenced by cultivar with conservation and conventional tillage in a two-year rotation.

Cultivar	Conservation Tillage	Conventional Tillage	LSD (0.10)
	--------Yield (kg/ha)--------		
PD 1	783	958	NS
PD 3	860	791	NS
DP 20	1083	881	S
DP 41	788	744	NS
DP 50	1017	847	S
DP 90	939	663	S
LSD (0.10)	141	137	