Winter Crop Effect on Double-Cropped Cotton Grown With and Without Irrigation

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ABSTRACT

Flax *(Linum usitatissum)* is a potential winter crop for production in the southeastern USA. Both the seed and the straw of flax are harvested; thus, fewresidues are left after flax harvest to protect the soil surface. Our objective was to compare conservation tillage cotton *(Gossypium hirsutum)* production following flax to production following winter wheat *(Triticum aestivum)*, with and without supplemental irrigation. Adjacent irrigated and rainfed experiments were conducted on a Goldsboro sandy loam soil. Wheat and flax were planted in November 1992 and 1994. Spring N rate treatments applied to the winter crop were 0. 20, 40, and 60 lb N/ a. Cotton was planted immediately after winter crop harvest in June 1993 and 1995. Supplemental irrigation was applied with a traveling gun system to the irrigated study when tensiometers at the 9-in. depth in the irrigated plots reached -30 centibars. Rainfed cotton yields averaged 557 lb lint/a, and neither year nor winter crop had a significant impact on yield. Irrigated cotton yield was greater in 1994 (893 lb lint/a) than in 1996 (617 lb lint/a). In the irrigated experiment, cotton following wheat yielded 84 lb lint/a more than cotton following flax. Innovative production strategies are needed to improve the yield of double-cropped cotton produced with conservation tillage, especially when it is double-cropped with low residue crops like flax.

INTRODUCTION

The long growing season and mild winters in the southeastern USA allow growers to produce two crops per year in the same field. Currently, much of the soybean *(Glycine max* [L.] Merr.) production in the area is grown following winter wheat *(Triticum aestivum* L.) harvest. The development of double-crop systems for cotton *(Gossypium hirsutum* L.) would allow growers more flexibility in matching cropping systems with economic situations. Low yields (Baker, 1987; Hunt et al., 1997; Smith and Varvil, 1982) and even crop failures (Hunt et al., 1997) have resulted when cotton was double-cropped with wheat.

In full-season production, adequate residue cover reduces some of the risks involved in cotton production with conservation tillage on sandy Coastal Plains soils (Bauer and Busscher, 1996). Since wheat is the major winter crop in the region, adequate surface residues for no-till double-cropped cotton production are obtained from the straw left after wheat harvest. An alternative winter crop, flax *(lilum usitatissimum* L.), is currently being evaluated in the area. Since both the seed and the straw are removed at harvest, there are no residues remaining on the soil surface following flax harvest. Information is needed on using conservation tillage when double-cropping cotton with low residue winter crops like flax.

One of the benefits of adequate residue cover in conservation tillage production is increased rainfall infiltration. Supplemental irrigation may negate this benefit by providing adequate soil water through the season, and irrigation may be necessary for cotton double-cropped with low residue winter crops. Our objective was to determine the effect of winter cash crop on double-cropped cotton lint yield when cotton was grown with and without supplemental irrigation.

MATERIALS AND METHODS

The experiment was conducted at Clemson University's Pee Dee Research and Education Center near Florence, SC. Treatments were winter cash crop (flax or wheat) and spring N rate. Wheat (cv. NK Coker 9835) and flax (cv. Natasja) were planted in the fall of 1992 and 1994. Seeding rates were 90 lb/a for the wheat and 100 lb/a for the flax. At planting, 20 lb N/a was broadcast applied to both crops. The following spring, N was applied at rates of 0, 20, 40, or 60 lb/a. Each irrigated and rainfed experiments were conducted simultaneously and adjacent to one another. Soil water levels were monitored with tensiometers that were placed 9-in deep, and a traveling gun irrigation system was used to apply water to the irrigated study when tensiometers averaged -30 centibars. Wheat was planted on 19

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November 1992 and 20 November 1994. Flax was planted on 3 November both yr. Experimental design for both studies (irrigated and rainfed) was randomized complete block with treatments in a split-plot arrangement. Winter crops were the whole plots, and spring N levels applied to the winter crops were the subplots. There were four replicates in each study each yr.

After winter crop harvest, cotton (cv. Stoneville 453) was planted after in-row subsoiling on 11 June 1993 and 31 May 1995. Subplot size was four 38-in.-wide cotton rows that were 30 ft long. At planting, all cotton plots received 40 lb N/a. Another 40 lb N/a application was made approximately one mo after planting. Three tensiometers were placed to a depth of 9 in. in each subplot of the irrigated study. Supplemental water was applied when tensiometers averaged -30 centibars. Weeds were controlled with a combination of herbicieds and handweeding. Plots were scouted regularly, and insecticides were applied at recommended rates when insect pest thresholds were reached.

A two-row spindle picker was used to harvest the cotton twice in 1993 (16 Nov. and 30 Nov.) and once in 1995 (13 Nov.). At harvest, a grab sample from the harvest bags was collected for ginning to determine lint percent.

All data were subjected to analysis of variance. Linear, quadratic, and deviation from quadratic single degree-of-freedom contrasts were made for the N analysis of the winter crops. Years were analyzed separately for the winter crop yields. For cotton yield, data were combined over yr.

RESULTS *AND* DISCUSSION

The seed yield responses to N of the wheat and flax and the straw yield response to N of the flax are shown in Table 1. Seed yield increased linearly with N rate for both crops under rainfed and irrigated conditions both years. There were no differences between N rates for flax straw yield under rainfed conditions in 1995. Flax strawyield increased with increasing N levels under rainfed conditions in 1993 and under irrigated conditions both years.

Rainfall during the growing season in 1993 was about one-half the amount received in 1995. In 1993, 12.8 in. of precipitation fell between planting and the end of Sept. In 1995, 24.1 in. of precipitation fell during the same time period. Irrigation was applied eight times in 1993 total 9 in. applied). Application dates ranged from 18 June to 13 Sept. In 1995, there was adequate rainfall early and late in the season, but from late July through Aug., rain was scarce and temperatures were high. Six water applications (9 in. applied) were made from 17 July to 25 Aug.

Cotton lint yields were greater in 1993 than in 1995 in the irrigated experiment (Table 2). In the rainfed experiment, yields did not differ between years. Even though N fertilization had a large impact on the winter crops the amount of N applied to the winter crops had no impact on cotton yield in either yr of the study. Averaged over both yr of the study, cotton following wheat had higher yield than cotton following flax ($P<0.10$) when irrigated (Table 2). In the rainfed experiment, cotton yield following the two winter crops did not differ when averaged over the 2 yr.

Yields in this study were not very high with irrigation in 1995 or without irrigation in both yr, suggesting that innovative production strategies are needed to improve the yield of double- cropped cotton produced with conservation tillage. Since cotton yields following wheat were higher than those following flax when irrigation was supplied, there is an apparent need for new strategies for those winter crops that produce or leave few residues on the soil surface. The ability to successfully produce a summer crop following flax would be an important, positive factor in the adoption of flax as a winter cash crop.

LITERATURE CITED

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Table 1. Wheat and flax seed yield and flax straw yield response to N fertilizer.

		Rainfed			Irrigated		
		Seed		Straw	Seed		Straw
Year	N	Wheat	Flax	Flax	Wheat	Flax	Flax
	lb/a	--------- bu/a --------		ton/a	---------- bu/a --------		ton/a
1993	20	40.5	7.1	0.72	41.0	11.6	1.00
	40	53.9	11.3	1.01	57.0	15.4	1.29
	60	64.4	17.2	1.40	77.4	20.0	1.52
	80	70.9	17.9	1.32	87.7	24.0	1.64
	Contrast'	L**	L**	L**	L**	L**	L**
1995	20	42.7	8.7	0.73	51.2	12.3	1.00
	40	48.6	11.2	0.85	59.9	16.3	1.25
	60	51.0	11.7	0.84	67.1	21.2	1.37
	80	55.1	12.3	0.81	71.6	24.6	1.41
	Contrast	L**	L**	NS	L**	L**	L**,Q*

t L= linear, Q=quadratic
*,** indicates contrast significant at P=0.05, 0.01, respectively

Table 2. Effect of winter cash cmp on double-cropped cotton yield under irrigated and rainfed conditions in 1993 and 1995.

	Rainfed			Imgated		
Winter Crop	1993	1995	Mean	1993	1995	Mean
	---------- lb/a ----------					
Flax	584	495	539	846	580	713
Wheat	663	485	574	940	654	797†
Mean	623	490		893**	617	

† indicates cotton yield following wheat was greater than yield following flax at $P \leq 0.10$.

** indicates yield in 1993 higher than 1995 at $P \leq 0.01$