CONSERVATION TILLAGE APPLICATIONS FOR A DOUBLE-CROPPING SYSTEM

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INTRODUCTION

Conservation tillage is a generic term that includes many different soil management practices. It is generally defined as being any tillage system that reduces soil or water loss in comparison with conventional tillage methods (Lal, 1989). Conservation tillage systems are receiving increasing acceptance as effective methods for reducing erosion (Berg et al., 1988). The effectiveness of any tillage system for controlling erosion is dependent upon the amount of crop residue left on the soil surface. Previous research has shown that for each 10% increase in ground cover from crop residue, erosion may he reduced by as much as 40%. In a study by Moldenhauser et al. (1983), the greatest reduction in erosion occurred between 0 and 20% soil surface coverage. A 65% reduction in soil loss was achieved at a 20% soil surface coverage level.

Some success in controlling nonpoint-source pollution from agricultural practices have also been attributed to conservation tillage management methods (Baker and Laflen, 1983; Dao and Nguyen, 1989).

Double-cropping and other multiple-cropping practices have had a resurgence in the United States over the last two decades. Unstable crop market prices have influenced many producers to look for additional ways to reduce production costs. Double-cropping is one of those practices. Sanford (1982) suggested some advantages of double cropping are: (1) increased profits resulting from more fully utilized climate, land, and other resources; (2) reduced soil and water losses from having the soil covered during most of the year with a plant canopy; and (3) the opportunity to enhance utilization of soil, water, and energy conserving tillage methods. Other researchers' findings coincide with those of Sanford (Lewis and Phillips, 1976; Howard and Lessman, 1991; Coale and Grove, 1991).

Double-cropping systems provide excellent opportunities to apply conservation tillage methods. Time is a critically important factor in the success of a douhle-cropping system. An adequate number of growing-season days must be available to produce two crops a year on the same field. Reduced- or no-till methods can decrease tbe time between harvesting the first crop and planting the second crop of a double-cropping system.

The objective of this study was to evaluate the effects of several tillage regimes on a soybean-winter wheat double-cropping system.

MATERIAIS AND METHODS

This study was conducted at the Langston University Research Station in central Oklahoma on a tine sandy loam soil.

Tillage Treatment Levels

No-tillage	------	Direct drilling of seeds
Reduced-tillage	......	Disking only
Conventional tillage	......	Moldboard plowing + disking

Two conservation tillage systems were compared with each other and with conventional tillage in a soybean-winter wheat douhle-cropping system. Three nitrogen levels were applied to the winter wheat crop. Nitrogen was topdressed in the spring as ammonium nitrate (34-0-0) at 0, 100, and 200 lb/A. The experimental design was a split-plot with main plots consisting of tillage systems. Individual plots were 5 x 12 ft. Soybeans were planted in 20-inch rows. Winter wheat was subsequently planted in the same rows formerly occupied by soybeans to take advantage of available residual nitrogen left by soybeans. Soybeans were harvested for grain. Winter wheat was harvested once for above-ground biomass.

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RESULTS AND DISCUSSION

The summer drought of 1988 reduced dryland soybean yields (Table 1). Soybean yields were low, regardless of the tillage regime. However, during the 1988 drought, conventionally tilled soybeans out-yielded no-tilled soybeans by 71% and reduced-tilled soybeans by 65%. In the winter wheat component for 1988-1989, both reduced-tilled and conventionally tilled winter wheat produced significantly higher biomass levels than no-tilled winter wheat (Table 2).

Dryland soybean yields for 1989 were noticeably higher than in 1988 (Table 1). Yields for conventionally tilled soybeans were 12% better than no-tilled and 44% better than reduced-tilled soybeans. Yields for 1989-1990 winter wheat showed conventionally tilled wheat yielding slightly better than the two conservation tillage systems.

Conventionally tilled soybeans and winter wheat produced slightly higher yields than reduced- or no-tilled under a double-cropping system. Nitrogen applications did not have a significant effect on winter wheat yields. Based upon field observations, conventionally tilled soybeans and winter wheat were more weed-free than reduced- or no-tilled plots. Less weed competition may have contributed to yield advantages by conventional tillage. However, since time is such a crucial factor in double cropping, especially in temperate climates, the time saved by using reduced- or no-till methods may outweigh possible yield advantages gained by using conventional tillage.

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Table 1. Effect of tillage regime and residual nitrogen (N) fertilizer on double-cropped soybeans.

Tillage Regime	Residual Nitrogen Fertilizer Level/A*	1988 Yield (bu/A)	1989 Yield (bu/A)
No-Tillage	0	9.0	22.0
	100	9.8	25.0
	200	10.0	23.0
Mean		9.6	23.3
Reduced Tillage	0	11.1	18.0
	100	8.0	20.0
	200	10.9	16.0
Mean		10.0	18.0
Conventional Tillage	0	13.3	23.0
	100	15.4	27.0
	200	20.9	28.0
Mean		16.5	26.0

* Refers to nitrogen applied to winter wheat but with possible residual levels remaining for soybeans.

Table 2. Effect of tillage regime and nitrogen fertilizer on double-cropped winter wheat.

Tillage Regime	Nitrogen Fertilizer Level/A	1988-1989 Yield (ton/A)	1989-1990 Yield (ton/A)
No-Tillage	0	0.81	0.52
	100	0.48	0.74
	200	0.59	1.01
Mean		0.63a*	0.76
Reduced Tillage	0	1.89	0.60
	100	2.45	0.70
	200	2.13	0.95
Mean		2.16b	0.75
Conventional Tillage			
	0	2.28	0.86
	100	1.56	0.92
	200	1.66	0.66
Mean		1.83b	0.81

* Means in a column followed by the same letter are not significantly different by LSD at $\alpha = 0.05$.