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Evaluation of Three Tillage Systems under a Corn and Soybean Rotation

Abstract
Soil productivity is one of the most important factors worldwide for agricultural production. Improving soil quality with the use of conservation tillage can preserve soil productivity. Tillage systems are used for many agricultural purposes ranging from weed control to the incorporation of crop residue and amendments, and ultimately are used to prepare a suitable seed bed for better seed germination. Conservation tillage conserves water, improves soil and water quality, lowers input costs, and reduces labor. Therefore, conservation tillage systems must be assessed and evaluated to control negative impacts on soil and water quality, while promoting soil productivity. The major objectives of the study are to evaluate the effect of tillage systems (strip tillage, chisel plow, and no-tillage) on soil quality indices and time of nitrogen application, and tillage systems on ground water quality and use efficiency.

Keywords
Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

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Evaluation of Three Tillage Systems under a Corn and Soybean Rotation

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Introduction

Soil productivity is one of the most important factors worldwide for agricultural production. Improving soil quality with the use of conservation tillage can preserve soil productivity. Tillage systems are used for many agricultural purposes ranging from weed control to the incorporation of crop residue and amendments, and ultimately are used to prepare a suitable seed bed for better seed germination. Conservation tillage conserves water, improves soil and water quality, lowers input costs, and reduces labor. Therefore, conservation tillage systems must be assessed and evaluated to control negative impacts on soil and water quality, while promoting soil productivity. The major objectives of the study are to evaluate the effect of tillage systems (strip tillage, chisel plow, and no-tillage) on soil quality indices and time of nitrogen application, and tillage systems on ground water quality and use efficiency.

Materials and Methods

The study started with fall tillage in 2000 at two locations, with 2001 being the first growing season. The treatments included:

- fall strip-tillage, fall fertilizer
- fall strip-tillage, spring fertilizer
- spring strip-tillage, spring fertilizer
- fall chisel plow, fall fertilizer
- no-tillage, fall fertilizer

Soil samples were collected from the 0–6, 6–12, 12–24, 24–36, and 36–48 inch depths before tillage each fall. Total carbon, total nitrogen, total phosphorus, and nitrate nitrogen were determined for the 0–6 inch depth increment. The lower depths were only analyzed for nitrate nitrogen. Soil temperature and soil compaction were recorded using a watchdog soil moisture logger and a CP-20 Rimik Penetrometer. Surface and profile soil moisture were determined volumetrically with a TRIME-FM, which uses time domain reflectometry technology. Water samples were collected from a 4-ft suction lysimeter. Plant samples were collected for V6, V12, VT, and R6 growth stages and analyzed for total carbon and total nitrogen. Plant emergence was determined following planting, and harvest population and yield were also determined. Grain samples were then analyzed for total carbon and total nitrogen.

Results and Discussion

In 2001, the plots at Nashua had significantly higher corn and soybean yields than at Ames. On the other hand, in 2002, both locations had similar corn yields (Table 1). A yield response to treatments was only observed at the Nashua site in 2002, with fall strip-tillage/fall fertilizer and fall chisel plow/fall fertilizer having significantly higher corn yields than the other three treatments.

The effect of different tillage treatments on soil moisture content at different depths was not significant prior to physiological maturity (Fig.1). However, soil moisture profiles at both sites show little difference between tillage treatments at the R5 growth stage.

Acknowledgments

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Table 1. Corn and soybean yields for Ames and Nashua by tillage and fertilizer timing for the 2001 and 2002 seasons.

Location	Treatment	Corn yield Mean	Soybean yield Mean
		- - - - - - bu/ac	- - - - - -
Ames, 2001	Fall strip tillage, fall fertilizer	181.1	33.8
	Fall strip tillage, spring fertilizer	178.4	33.8
	Spring strip tillage, spring fertilizer	179.3	33.8
	Fall chisel plow, fall fertilizer	192.5	36.7
	No-tillage, fall fertilizer	183.8	38.7
	$LSD*_{(0.05)}$	23.9	10.3
Ames, 2002	Fall strip tillage, fall fertilizer	226.8	40.6
	Fall strip tillage, spring fertilizer	219.4	41.8
	Spring strip tillage, spring fertilizer	234.4	42.1
	Fall chisel plow, fall fertilizer	220.2	48.7
	No-tillage, fall fertilizer	224.3	42.2
	$LSD_{(0.05)}$	11.8	7.2
Nashua, 2001	Fall strip tillage, fall fertilizer	220.7	45.5
	Fall strip tillage, spring fertilizer	214.0	44.4
	Spring strip tillage, spring fertilizer	211.9	43.3
	Fall chisel plow, fall fertilizer	212.1	44.8
	No-tillage, fall fertilizer	214.5	43.7
	$LSD_{(0.05)}$	20.7	5.2
Nashua, 2002	Fall strip tillage, fall fertilizer	238.2	46.3
	Fall strip tillage, spring fertilizer	213.4	47.0
	Spring strip tillage, spring fertilizer	211.6	46.8
	Fall chisel plow, fall fertilizer	237.1	48.5
	No-tillage, fall fertilizer	208.2	47.0
	$LSD_{(0.05)}$	21.1	2.9

*Least Significant Difference (LSD) was calculated for each location and year. Differences that are greater than the LSD are significantly different.

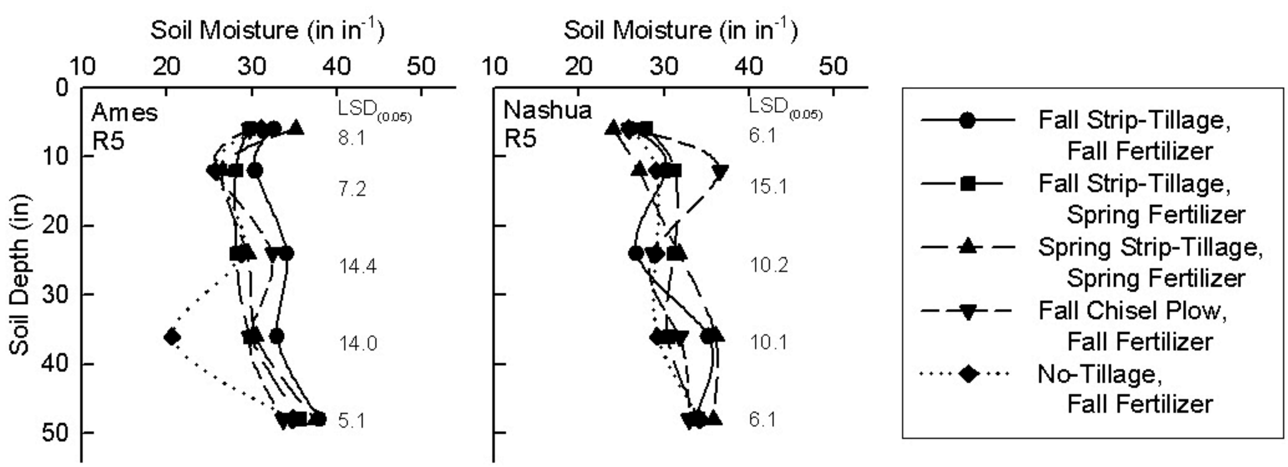

Figure 1. Soil moisture at the R5 corn growth stage (approximately the 3rd week in August) for five tillage and fertilizer timings at Ames and Nashua in 2002.