Performance of Soybean Tillage Trials in the Brown Loam Region of Mississippi

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Introduction

No-till (NT) soybean production offers producers savings in time, labor, equipment, and fuel. Reduction in soil erosion, improvement in soil organic matter, increases in surface residue, and more earthworm activity are beneficial aspects of NT for soil improvement and maintaining sustainability. Decrease in rainfall runoff, less soil evaporation, and higher soil water holding capacity are aspects of NT that are beneficial for crop production. Yet, the one aspect of NT soybean production that draws the most attention is yield performance.

In the early NT soybean research at the North Mississippi Branch Experiment Station (NMBES), yields were the primary focus of each study comparing NT with conventional-till (CT) practices. Most of these studies were located on different sites each year and very seldom did NT plots have a previous history of NT soybean production. Benefits of continuous NT soybean production were not recognized or did not develop because of poor stands and weed control. However, when researchers moved from measuring yields to other aspects of continuous NT production, yield benefits from long-term NT soybean production were discovered.

Summary of Soybean Tillage Trials Since 1978

All the studies discussed in this report are part of Mississippi Agricultural and Forestry Experiment Station (MAFES), USDA Agricultural Research Service (ARS), or joint MAFES-ARS research plots at NMBES during the past 20 years. All the studies in this report are planted in a randomized complete block design with at least four replications. Two treatments (NT and CT) were common to all studies. The CT plots involved considerable tillage that destroyed all the surface residue. The NT plots were planted using NT planters that were applicable and acceptable for NT planting at that date and time. Planters, coulters, press wheels, etc. have changed over the past 20 years and planting precision is more accurate today than when some of the early studies were conducted. In this report, we will try to highlight where past planting and weed control technology, even though best for the time, affected yields in studies.

In the early stages of NT soybean research at NMBES, sites were selected for research to try to duplicate conditions associated with high erosion in the Brown Loam areas of Mississippi. Field sites were selected that had slopes up to 12% and represented many fields that had gone from pasture to soybeans. Other field sites were selected that had moderate to severe erosion to represent conditions that existed in many longer-term soybean fields of that time. Where johnsongrass or bermudagrass was present, as was usually the case when old pastures were turned into soybean fields, producers were warned not to attempt NT soybean production. The early NT studies at NMBES were planted on sites that would be hard to manage even today with advanced production techniques, equipment, and chemicals.

Summarizing 21 first-year tillage trials that were conducted between 1978 and 1987 in old soybean fields where CT practices were used the previous year, average yields of NT plots were 21% less than the CT plots (Table 1). Fourteen percent of the one-year studies had NT yields that equaled or exceeded the CT plots. Twenty-four percent of the studies were documented as having poor or skippy stands in the NT-planted plots. Thirty-eight percent of the studies were documented as having weedy or grassy NT plots that probably further contributed to lower yields.

When site selection was considered (Table 2), the studies conducted on the steeper slopes (6-12%) experienced a higher reduction in NT yields, 44%, than the flatter slopes (2-6%), 29%, compared with CT. When previous erosion was a factor, the studies conducted on sites that were moderate to severly eroded had a higher reduction in NT yields, 32%, when compared to CT than the noneroded or slightly eroded sites, 24% when compared to CT.

Table 1. Summary of yield performance of 21 soybean tillage trials conducted at the NMBES from 1978 to 1987 where the area was in CT soybean production the previous year before the trial.

Tillage practice	Average yield of soybeans
	bu grain/acre
CT	29.35
NT	23.25

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Since pastureland was being converted into soybean fields, six studies were conducted in old pasture sites (Table 3). All of the NT plots were infested to some degree with bermudagrass and johnsongrass. The inability to control these grasses partially accounted for the 30% reduction in yields from NT plots. Doublecropping with soybeans was explored, where soybeans were planted into ryegrass fields after winter grazing was terminated, and in soybeans following wheat. Yield reduction percentages in NT soybeans compared to CT soybeans in ryegrass fields were equivalent to the 20% yield reduction in old soybean fields. A more favorable NT yield resulted with wheat-soybean doublecropping. There was only a 6% reduction in the NT yields compared to CT when soybean tillage studies were conducted after **a** wheat crop was harvested.

A change in row pattern from wide rows (36-40 inches) to narrow rows (7-10 inches) resulted in the least difference between CT and NT. The average NT yield for narrow-row soybeans was within *2* % of the CT narrow-row planted soybeans. These results were the main factors for encouraging producers to start using soybean drills for planting NT into old wheat stubble, resulting in yields comparable to CT with less time, labor, tillage, and equipment, and without sacrificing soil moisture due to tillage at a critical time.

Up until 1980, all the MAFES tillage trials at the NMBES were located on a different site each year. Consequently, the previous history of NT production was not taken into account. Since 1980, nine soybean studies have been continued for 3 years on the same sites and the NT plots have been located on the previous year's NT plots. The average of these studies showed NT planting in wide rows reduced soybean yields 20% the first year, 9% the second year, and 4% the third year when compared to CT (Table 5).

There were two soybean tillage studies that retained the same site for 5 years or longer where tillage plots maintained the same identity throughout the duration of the studies. When good weed control practices prevailed, average soybean yields in NT plots after 5 years of previous NT production exceeded the CT yields by an average of 6% (Table 5). It is important that weeds be closely monitored and herbicide programs thoroughly reviewed for efficacy if long-term production of NT soybeans are to be sustained. Factors causing a reduction in the NT yields during the first years of these studies had less of a yield-limiting effect after 3 years continuous NT.

Conclusion

When planting NT soybeans in wide rows into old soybean stubble, a yield reduction was observed if the previous field history was CT. The possible yield reduction was moderated by assuring proper planting practices to achieve a good stand and by using proper weed control techniques. Drilling soybeans NT into old soybean stubble has been best planting procedure for attaining the smallest yield reduction when compared to wide rows. Planting soybeans NT after wheat resulted in a 6% reduction in yield. The saving of time, fuel, labor, moisture, and equipment by no-till may more than offset this small yield loss.

In a monocropping system, planting soybeans NT for several consecutive years has resulted in NT yields similar to the CT yields. However, care must be taken to avoid a static weed control program. The rotation of an effective herbicide program for weed control is essential to maintaining long-term NT soybean production.

Table 2. Site selection influence on yield performance of soybean tillage trials at NMBES from 1978 to 1987.

Tillage practices	Site selection of trials			
	2-6% slow	6-12% slope	Noneroded site	Eroded site
	bu grain/acre			
CT	34.18	31.20	31.31	27.91
NT	24.42	18.13	23.80	18.84

Table 3. Summary of previous cropping history influence on soybean tillage trials conducted at the NMBES from 1978 to 1987.

Tillage practice	Previous crop grown on the land			
	Pasture	Ryegrass	Wheat	Soybeans
	bu grain/acre			
CT	21.80	35.31	31.90	29.35
NT	15.25	28.21	29.83	23.25

Table 4. Summary of row pattern influence on soybean tillage trials conducted at the NMBES from 1987 to 1993.

Tillage practices	Row Width	
	Wide rows (36-40 in)	Narrow rows (7-10 in)
	bu grain/acre	
CT	24.50	22.55
NT	19.35	22.20

Table 5. Summary of tillage trial performance in consecutive years of study.

Tillage practice	Years of study plots on same site			
	First year	Second year	Third year	Fifth year
	bu grain/acre			
CT	27.82	22.24	27.73	26.50
NT	21.63	20.33	26.53	28.00