Wheat Response to Tillage Systems and Planting Dates

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INTRODUCTION

Wheat *(Triticum aestivum* L.) is grown on approximately 400,000 acres in Mississippi. Two types of conventional tillage, chisel + disking or disking alone, are the most common seedbed preparation methods used. Increased tillage of the seedbed increases the erosion potential.

Research efforts during the past decade have been directed toward economizing the conservation-tillage system with specific soils and crops. Different tillage requirements among crops and soils are related to the compadability of the soil and sensitivity of the crop to compacted soils (Touchton et al., 1989).

Most soils in the South have a tillage pan that restrids root growth. In dry spring, this tillage pan may have a substantial influence on wheat yields. No-tillage and paraplow are two possible reduced-tillage systems for growing wheat in north Mississippi that can have a positive role in reducing soil erosion (Langdale et al., 1979; McDowell and McGregor, 1980; McGregor et al., 1985), increasing soil water storage capacity (Jeffers et al., 1973), lowering inputs of fossil fuels (CAST, 1977) and reducing labor and land preparation costs (Jeffers et al., 1973). The paraplow is similar in appearance to a moldboard plow but differs in that the plow-shank lifts the soil vertically and causes minimum surface disturbance. The objective of this study was to evaluate wheat growth and yield response to different production systems (tillage-row spacing combinations) and planting dates.

MATERIALS AND METHODS

The study was conducted from 1985 through 1990 on the same site on an Atwood silt loam (Fine-silty, mixed, thermic Typic Paleudalfs) with a 3% slope at the Mississippi Agriculture and Forestry Experiment Station (MAFES) Pontotoc Branch, Pontotoc, Mississippi. A randomized complete block design with treatments arranged as a split plot was utilized. Wheat planting dates (Table 1) were whole plots, and production systems (tillage-row spacing combinations) were sub-plots within planting dates (Table 2). Treatments were replicated four times, and individual plots were 10 x 35 ft. Seven tillage-row spacing combinations were planted on each of the three planting dates, about 15 October, 1 November and 15 November.

Plot management in preparation for fall wheat planting involved mowing, applying fertilizer and applying selected tillage treatments (Table 2). In late August of each year the entire experimental site was mowed to a height of 5 to 6 in. with a rotary mower. In mid-September of each year, 450 lb/acre of 0-20-20 (N-P_2O_5-K_2O) granular fertilizer was surface broadcast on the study area before tillage treatments were initiated. Tillage treatment dates were 13 Sep. 1985, 15 July 1986, 15 Sep. 1987, 23 Sep. 1988 and 19 Sep. 1990. Before planting wheat in early October, granular urea fertilizer was surface broadcast at a rate of **50** lb N/acre.

Three wheat plantings (Table 1) were made each year on about 15 October, 1 November and 15 November. The chisel + disk and paraplow plots were all smoothed with a row conditioner (implement with a rolling cutter bar and drag harrow) prior to planting each year. All 8-in. wheat row spacings were planted with a Marliss® no-till drill. The 4-in. row spacing was planted with a conventional 4-in. Marliss® drill. All row spacings were planted with **30** seed/ft^2 except with the chisel + disk broadcast treatment. This treatment was seeded on the soil surface at **60** seed/ft^2 (2x rate) with the no-till drill and incorporated with a disk. Wheat cultivars and planting dates for all years are listed in Table **1.** An additional **80** lb N/acre of granular urea was surface broadcast on all wheat treatments in mid-February of each year.

Herbicides were used for winter weed control. Glyphosate at **1.5** lb ai/acre was applied as a burndown application on all no-tillage and paraplow

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Table 1. Wheat cultivars and dantina dates in 1985-89.

Year	Plantina date			Brand/cultivar
1985	Oct 18	Nov 6	Nov 20	Florida302
1986	Oct 17	Novl	Nov 17	Pioneer Brand 2551
1987	Oct 25	Nov 3	Nov 16	Florida302
1988	Oct 14	Nov 7	Nov 18	Florida302
1989	Oct 17	Nov 2	Nov 20	Pioneer Brand 2555

Table 2. Wheat production systems for 1985-89.

Tillage	Primary tillage depth (inches)	Wheat row spacing (inches)
Chisel + Disk + Doall	6-8	Broadcast
Chisel + Disk	6-8	4
Chisel + Disk	6-8	8
No-tillage	---	8
Paraplow	7	8
Paraplow	14	8

treatments about 5 October of each year. Diclofop at 1 lb ai/acre was applied postemergence in the fall to all treatments for annual ryegrass control. One application of thiameturon + triton CS7 spreader-sticker at 0.025 lb ai/acre + 0.25% v/v was made in mid-February to mid-March to all treatments for winter annual broadleaf weed control. After wheat harvest in June, one application of 2,4-D amine + surfactant at 0.5 lb ai/acre + 0.25% v/v was applied in early July and August for summer annual broadleaf weed control.

Wheat population data were obtained during the wheat growing season, and plant height and spike data were obtained at maturity. Stand counts were made in mid-March at Feekes' 4 (Zodak et al., 1974) growth stage. Stand counts were determined by randomly selecting one 8-in. linear sample per row of six randomly selected rows within a 10-ft-wide plot. Plants were removed from each plot, hand separated and counted. Wheat plant height was determined by randomly selecting a site in each of six randomly selected rows. The first three consecutive plants at each site were measured from the soil surface to the top of the spikes. Wheat spikes per unit area were determined by randomly selecting an 8-in. linear sample in each of six randomly selected rows and counting the number of spikes per sample. The total number of spikes per six samples was averaged for each plot and converted to spikes/ft^2.

Wheat plots were harvested with a plot combine, harvesting a 6 x 35-ft area on 16 June 1986, 28 May 1987, 10 June 1988, 20 June 1989 and 6 June 1990. Wheat yields were adjusted to 13% seed moisture. Data were subjected to analyses of variance, and means were separated across years using least significant differences (LSD) at the 5% statistical probability level.

RESULTS AND DISCUSSION

The influence of wheat planting dates on yield averaged over production systems in 1986-90 is shown in Table 3. In all years production systems and planting dates had a significant effect on grain yield. However, there was no production system x planting date interaction. The yield of wheat planted 1 November was higher than that from the 15 October planting four of five years. Wheat yields for these two planting dates were equal in 1987. Wheat yield from the 1 November planting was higher than that from the 15 November planting three of five years with no differences between the dates in 1988 and 1990. The wheat yield for the 15 November planting was higher than that from the 15 October planting in 1986, 1989 and 1990 but lower than that from the 15 October planting in 1987 with no differences in 1988. These results indicate that about 1 November is the optimum planting date to maximize wheat yields in north Mississippi.

Averaged over planting dates, wheat yield response during the five-year study differed among production systems (Table 4). Both paraplow treatments with 8-in. rows produced yields equal to those from chisel + disk with 4-in. rows four of five years. The paraplow tillage depth had no effect on yield all five years. The paraplow treatments produced yields equal to no-tillage three of five years and greater than no-tillage two of five years. No-tillage 8-in. rows produced yields equal to chisel + disk with 8-in. rows in 1986, 1987 and 1989. However, in 1988 and 1990, chisel + disk 8-in. rows produced yields of 64 and 55 bu/acre, 7 and 13 bu/acre higher than no-tillage. Yields from chisel + disk 8-in. rows were equal to those of chisel + disk broadcast seeding four of five years while the chisel + disk 4-in. rows produced yields greater than chisel + disk 8-in. rows in three of five years with no differences in the other two years.

Production systems had no effect on plant height at maturity, but planting date did influence plant height. In 1986, the 15 October planting produced wheat plants that were shorter in height than those produced by the 1 November and 15 November planting dates. In 1987 and 1990, wheat planted on 15 October and 1 November planting dates was taller

Table 3. Effect of wheat planting date on yield averaged over production systems In 1986-90.

Planting date'	Yield 1986	1987	1988	1989	1990	LSD 0.05
	bu/acre					
Oct 15	34	51	61	40	44	3
Nov 1	44	52	66	57	60	3
Nov 15	41	44	64	57	50	3
			LSD 0.05			
Date within year	2	2	4	3	4	

'Planting dates were target dates. Actual planting dates are listed in Table 1 for each year.

Table 4. Wheat yield response to production systems averaged over planting dates In 1986-90.

Production systems Tillage	Row spacing	Yield 1986	1987	1988	1989	1990	LSD 0.05
	(in)	bu/acre					
Chisel + Disk	B'cast	37	44	64	48	49	5
Chisel + Disk	4	42	53	68	56	56	5
Chisel + Disk	8	38	45	64	50	55	4
No-tillage	8	38	48	57	50	42	4
Paraplow 7 in.	8	41	51	65	54	50	5
Paraplow 14 in.	8	41	51	63	51	55	4
				LSD 0.05			
Systems within year	3	3	5	4	5		

than wheat planted on the 15 November planting date. Planting date had no effect on plant height in 1988. However in 1989, wheat planted on the 15 November planting date was taller than wheat planted on 15 October and 1 November.

Plant population and number of spikes/ft² were not affected by planting dates. The chisel + disk 4-in. row spacing all years had more plants/ft² and spikes/ft² than other systems across planting dates and years. The chisel + disk 8-in. rows and both paraplow systems had higher plant populations than chisel + disk broadcast and no-tillage. However, chisel + disk broadcast had a higher number of spikes/ft² when compared to no-tillage paraplow and chisel + disk 8-in. rows. There were no differences among chisel + disk 8-in. rows, no-tillage and both paraplow systems.

SUMMARY

The 1 November planting date produced grain yields higher than the 15 October planting four of five years and higher than the 15 November three of five years. Paraplow treatments produced wheat grain yields equal to chisel + disk 4-in. rows four of five years. The paraplow tillage depth of 7-in. was adequate in this study on this soil type to maximize wheat yields. The paraplow treatments produced yields equal to no-tillage three of five years and greater than no-tillage two of five years. Wheat grain yields for Chisel + disk 8-in. rows produced yield equal to the chisel + disk 2X seeding rate and higher than no-tillage two of five years.

Results of this study indicate that the reduced tillage paraplow system not only has the advantage of reducing soil erosion potential but also can produce wheat grain yields equivalent to conventional chisel + disk.

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