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. Conventional tillage, chisel + disking or disking are the most common seedbed preparation methods used on these acres. However, tillage increases the erosion potential. No-tillage and paraplow are two possibly viable reduced tillage systems for growing wheat in North Mississippi. The objectives of this study were 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 1988 on the same site of an Atwood silt soil with a 3% slope at the

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The experimental design was a randomized complete block with treatments arranged as a split plot with four replications. Wheat planting dates were whole plots (Table 1) and production systems (tillage-row spacing combinations) were subplots. The tillage treatments were (1) fall chisel + disk, (2) fall paraplow, and (3) no-tillage. The chisel + disk treatments were used with three wheat row spacings: planting in 4- and 8-in rows, and a broadcast 2x seeding rate incorporated 1 to 2 inches deep with a disk. The paraplow treatment was compared at two tillage depths. No-till was compared with two fertilizer application methods. Seven tillage-row spacing combinations were planted on each of three planting dates about 15 October, 1 November, and 15 November. Data were subjected to analyses of variance and means were separated using least significant differences at th 5% statistical probability level.

Each September plots were chiseled 6 to 8 in. deep with a double-gang chisel plow. The shanks on the front and rear tool bars were offset with 12-in. shank spacings. These plots were disked 3 to 4 in. deep and the soil was smoothed at planting with a do-all, an implement with a rolling cutter-bar and a drag-harrow. The paraplow is a reduced tillage implement which initially looks similar to a moldboard plow but lifts the soil vertically and causes minimum surface disturbance. The paraplow tillage treatment depths were 7 to 8 and 14 to 15 in. The soil surface was smoothed with a do-all before planting wheat in 8-in rows. The no-tillage wheat was planted in 8-in. rows with two fertilizer application methods: fall injected liquid N and surface applied N as granular urea.

Plot management in preparation for fall wheat planting involved mowing, applying fertilizer, and tillage. In late August of each year the whole study was mowed to a height of about 5 to 6 in. with a rotary mower. In mid-September of each year, 450 lb/acre of 0-20-20 ($N-P_20_5-K_20$) was applied surface broadcast before the tillage treatments chisel + disk and paraplow were applied. In early October, before planting wheat, granular urea fertilizer at 50 Ib N/acre was surface broadcast to all treatments except the no-tillage injected N treatment. The no-tillage injected N treatment received 50 lb N/acre as a liquid urea solution injected at planting with a Marliss no-till drill equipped with colters spaced 16 in. apart between wheat rows as one-pass operation. A solid core nozzle trailing each colter applied liquid N solution as a solid stream to the colter penetration depth of about 2 in. Another 80 lb N/acre of granular urea was surfaced broadcast to all wheat treatments in mid-February of each year.

Herbicides were used for weed control. Roundup at 1.5 lb ai/acre was applied as a burndown application on all no-tillage and paraplow treatments about 5 October of each year. Hoelon at 1 lb ai/acre was applied postemergence in the fall to all treatments for annual ryegrass control. In mid-February to mid-March one application of Harmony + surfactant at 0.025 lb ai/acre + 0.25% v/v was made 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.

Table 1. Wheat cultivars and planting dates at the Pontotoc Branch Experiment Station, 1985-87.

Year	Planting Dates			Cultivar
1985	Oct. 18	Nov 6	Nov 20	Florida302
1986	Oct 17	Nov 1	Nov 17	Pioneer 2551
1987	Oct 25	Nov 3	Nov 16	Florida302

Each year three wheat plantings (Table 1) were made on about 15 October, 1 November, and 15 November. All 8-in. wheat row spacings were planted with a Marliss no-till drill. The 4-in. row spacing was planted with 1 conventional 4-in. Marliss drill. All row spacings were planted with 30 seeds per sq ft except the chisel + disk broadcast (B'cast) treatment. The chisel + disk broadcast treatment was seeded on the soil surface at 60 seeds per sq ft (2x rate) with the Marliss no-till drill. Seeds were incorporated with a disk. Wheat cultivars and planting dates for all 3 yr are listed in Table 1.

Field data was collected in mid-March and at maturity. Wheat population was determined in mid-March of each year. Stand counts were determined by randomly selecting one 8-in. linear sample per row of 6 randomly selected rows within a 10 ft wide plot. Plants were excavated from the soil, separated, and counted. These data were converted to plants per sq ft. At maturity, wheat plant height and spike date were collected. Wheat plant heights were determined by randomly selecting a site in each of 6 randomly selected rows. The first 3 consecutive plants at each site were measured from the soil surface to the top of the spikes. Wheat spike date were determined by randomly selecting an 8-in. linear sample in each of 6 randomly selected rows and counting the number of spikes per sample. The total number of spikes per 6 samples were averaged for each plot and converted to spikes per sq ft.

Wheat plots were harvested with a plot combine harvesting a 6- by 35-ft area on 16 June 1986, 28 May 1987, and 10 June 1988. Plot seed samples were weighed, and seed moisture and test weight were determined with a Dickey John electronic grain analysis computer (GACII). Wheat yields were adjusted to 13 percent seed moisture.

Results and Discussion

Wheat yields, averaged over treatments, ranged from 39 bu/acre in 1986 to 63 bu/acre in 1988. There was no planting date x system interaction. However, there was a planting date x year interaction (Table 2). The 1 November planting yields of 44 and 67 bu/acre in 1986 and 1988, respectively, were higher than the 15 October planting date both years. In 1987, however, there was no difference between 1 November and 15 October planting dates. The yield for the 15 November planting was significantly higher than 15 October in 1986 and significantly lower than 15 October in 1987 with no difference in 1988. The results indicated that about 1 November is the best planting date to maximize yield in North Mississippi.

Wheat yield response differed among production systems (Table 3) and interacted with years. The paraplow treatments with 8-in. rows produced yields equal to chisel + disk with 4-inch rows all three years. The paraplow 14 - to 15-in. depth of tillage did not yield more than paraplow 7- to 8-in. tillage

Table 2. Effect of wheat planting date on yield averaged over system at the Pontotoc Branch Experiment Station, 1986-88.

P. Dates	Years 1986	1987	1988	AV
	bu/acre			
Oct 15	34	51	59	48
Nov 1	44	52	67	54
Nov 15	40	43	63	49
AV	39	49	63	

LSD 0.05 Year 5 LSD 0.05 Years within P dates 7
LSD 0.05 P. dates 5 LSD 0.05 P. dates within year 4

Table 3. Wheat yield response to production systems averaged over planting dates at the Pontotoc Branch Experiment Station, 1986-88.

Production System Tillage	Row Spacing (in)	Years 1986	1987	1988	AV
		Bu/acre			
Chisel + Disk	B'Cast	37	44	64	48
Chisel + Disk	4	42	53	68	54
Chisel + Disk	8	38	45	64	49
No-tillage*	8	38	48	58	48
No-tillage	8	38	48	57	48
Paraplow 7	8	42	51	65	53
Paraplow 14	8	41	51	65	52
AV		39	49	63	

*Fertilizer injected
LSD 0.05 Years 5 LSD 0.05 Years within production system 7
LSD 0.05 P. System 2 LSD 0.05 Production systems within year 4

depth. Although not always significant, both chisel + disk 4-in. row spacing and paraplow treatments with 8-in. wheat row spacing produced higher yield than chisel + disk broadcast seeding, chisel + disk 8-in. rows, and both no-tillage treatments. In contrast no-tillage produced yields equal to chisel + disk with 8-in. wheat row spacing in 1986 and 1987 but was lower than chisel + disk in 8-in. wheat row spacing in 1988. With no-tillage, both surface applied urea and urea injected as a liquid produced similar yields all three years.

Production system had no effect on plant height at maturity. However, planting date influenced plant height. In 1986 the 15 October planting was shorter in height than 1 November and 15 November planting dates. The 15 November planting was shorter in height than 15 October and 1 Novemberplanting in 1987 with no height differences in 1988.

Generally, plant population and number of spikes per sq ft were not affected by planting date and system. However, the chisel + disk 4-in. row spacing all three years had more plants per sq ft and spikes per sq ft than other systems on all planting dates.

Summary

The 1 November planting date for North Mississippi produced the highest yield 2 or 3 yrand had the highest 3 yr average for all 3 planting dates. The chisel + disk in 4-in. rows and both paraplow treatments had significantly higher yield than both no-tillage and chisel + disk with the 8-in. row spacings in 2 of 3 yr. These treatments also had the highest 3 yr average yield of all treatments. No-tillage in 8-in. rows and chisel + disk with a broadcast 2x seeding rate had significantly lower yields than all other treatments 2 of 3 yr and the lowest 3 yr average. Averaged over 3 yr, no-tillage wheat with 8-in. rows produced yield equal to conventional chisel + disk with both 8-in. rows and broadcast 2x seeding rate incorporated with a disk. Paraplow tillage depth of 7 to 8 in. was adequate to maximize wheat yield. Both paraplow 8-in. rows and chisel + disk 4-in. row treatments produced about 10% higher yield (3 yr average) than chisel + disk with 8-in rows.

The study indicated that the reduced tillage paraplow system not only has the advantage of reduced soil erosion potential but also enhanced wheat yields. The no-tillage system has the advantage of reduced soil erosion potential and yields were equivalent to the conventional chisel + disk production system. Studies need to be continued long-term on different soil types with full economic analysis in order to more fully assess the potential of these reduced tillage systems for wheat production in Mississippi.