Modified Ridge Tillage vs. Conventional Tillage For Soybean Production

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Ridge tillage is a crop production system intermediate between no-till and conventional pre-plant tillage systems. It generally is used for row crops and is characterized by three tillage operations per year: in-row tillage at planting time, cultivation for weed control, and late season cultivation for rebuilding the ridges. Ridge tillage reduces spring field work compared to conventional seedbed preparation where several pre-plant tillage operations usually occur.

Farmers who rotate small grains with soybean have not used ridge tillage because the semi-permanent (multi-year) ridges fit best in a continuous row crop system such as a corn-soybean rotation. A production system that modified the multiple-year use of ridges would be necessary for a small grain-soybean farmer to utilized ridges for planting soybeans. Modified ridge tillage utilizes a rotation of planting soybeans on ridges one year and using conventional seedbed preparation to plant small grains on the field the second year. Ridges are built 7 to 8 inches high in the fall and the following spring soybeans are planted on the tops of the ridges without further soil preparation. Modified ridge tillage requires that new ridges be built in the fall prior to growing row crops the following year. In the second year of the modified ridge tillage system, small grains are grown on the field without the use of ridges. Advantages of modified ridge-tillage production systems include reduced spring tillage operations, creation of micro relief within fields to create zones of drained, warmer soils to enhance earlier planting, snow trapping in furrows between ridges and reduced wind erosion potential from increased field roughness created by the ridges.

Farmers who fall apply incorporated herbicides such as trifluralin increase the potential for wind erosion on the fine-textured soils of eastern North Dakota by reducing surface residue and stubble during the winter months when the soil is exposed to the wind. Exposed fine-textured soils become highly susceptible to wind erosion due to the formation of stable, sand-sized aggregates by repeated wet-dry and freeze-thaw cycles. In a modified ridge tillage system, fall formation of ridges in small grain stubble allows for incorporation of herbicide as well as positioning of crop residue in the summit of the ridges, enhancing resistance to wind erosion.

Effects of ridge-tillage on soybean yields have been studied at several locations in the midwestern soybean growing region of the United States. In an evaluation of five tillage systems, Erbach (1982) found no differences in soybean yield between ridge tillage, spring disk, till-plant, fall moldboard plow,and fall chisel plow systems. Hummel et al. (1985) found no soybean yield differences in a corn-soybean rotation when conventional, sweep plow, subsoil and ridge, disk, no-till, and a rotation of no-till and conventional tillage systems were evaluated.

Utilization of a ridge system of planting soybeans limits seeding to at least 30-inch minimum row spacings. In an Illinois study, Wax et al. (1977) reported that a 7-inch row spacing out-yielded the 30-inch row spacing of soybean when weeds were adequately controlled. Lehman and Lambert (1960) found that a row spacing of 20 inches yielded more than rows spaced at 40 inches at Waseca, Minn., but the two row spacings yielded the same at St. Paul. In Canada, Ablett et al. (1984) evaluated six soybean cultivars at five row spacings and found a significant cultivar by row spacing interaction in one experiment. Five cultivars yielded more when seeded in 7-inch rows compared to 28-inch rows, but one cultivar had similar yields at the narrow and wide row spacings. Spilde et al. (1980) reported that a 12-inch row spacing outyielded a 36-inch row spacing in North Dakota.

The objective of this research was to compare soybean yields when planted in both 12-inch and 30-inch row spacing using conventional soil preparation to 30-inch row spacing using modified ridge tillage.

MATERIALS AND METHODS

This experiment was conducted from 1988 through 1990 at one location near Casselton and a second location near Prosper on a Bearden silty clay loam soil (fine-silty, frigid Aeric Calciaquolls). The crops grown prior to soybean were: hard red spring wheat at both locations in 1987; winter wheat at Casselton and hard red spring wheat at Prosper in 1988; hard red spring wheat at Casselton and durum Wheat at Prosper in 1989.

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The conventional tillage treatment consisted to applying trifluralin (Treflan) herbicide in October and incorporating to a depth of 2 to 3 inches with one pass of a tandem disk set at a 4-inch depth. A spring tooth harrow was used in the spring, immediately prior to planting.

The modified ridge tillage treatment consisted of applying trifluralin herbicide in October and incorporating the herbicide to a depth of 2 to 3 inches with one pass of a tandem disk. Ridges on 30-inch centers were then made in the fall using a ridging implement with shanks spaced 30 inches apart. Ridges were 6 to 8 inches high after construction. Soybeans were planted directly onto the ridge in the spring without seedbed preparation. A piece of angle iron was mounted in front of the double disk openers on John Deere 71 planting units. The angle iron removed the top 1 to 2 inches of soil from the ridge. Soybeans were planted at a depth of 1.5 inches.

Herbicide treatments are shown in Table 1. Ridge tillage and conventional tillage treatments received the same preplant and post emergence herbicide treatments at a given location and year. Plots were not cultivated or hand-weeded. Weed control was good on all plots at all locations in all three years. In addition, 180 pounds of 11-52-0 fertilizer was applied and incorporated at the Prosper location in 1988 at the same time the fall herbicide treatment was applied.

The experimental design was a randomized complete block with six replications per location for each cultivar used. McCall (early maturing) and Evans (late maturing) cultivars were grown in two separate but adjacent experiments with identical treatments to give a range in soybean responses to the tillage and planting variables. Plots were 10 feet wide and 40 feet long. The plots were end-trimmed to a length of 30 feet prior to harvest and a 5-foot wide strip was harvested from the center of each plot. Soybean stand establishment was adequate at all locations and for all treatments.

RESULTS AND DISCUSSION

No differences were found between 12-inch and 30-inch row spacing under convention tillage and also the 30-inch ridge tillage for grain yield or date of physiological maturity in either the McCall or Evans experiments (Table 2). Grain yield varied considerably among environments (Table 3). There was no tillage treatment by environment interaction.

The results of this experiments are consistent with other studies (Erbach, 1982; Hummel et al., 1985) in finding that soybean grain yield with conventional tillage and 30-inch row spacing was not different from ridge tillage using 30-inch row spacings. In our experiment, soybeans planted in 12-inch and 30-inch spacing between rows yielded the same. However, other published reports (Wax et al., 1977; Lehman and Lambert, 1960; Ablett et al., 1984; Spilde et al., 1980) found that 12-inch row spacings usually outyielded 30-inch row spacings. The low yield levels in our experiment, due to dry conditions, may explain the lack of response to the 12-inch row spacing.

Table 1. Herbicide treatments used in the modified ridge tillage.

Year	Location	Herbicide	Rate	Application Method
			lb ai/A	
Fall 1987	Casselton	Trifluralin	1	Fall soil incorporated
	Prosper	Trifluralin	1	Fall soil incorporated
Spring 1988	Casselton	Bentazon	1	Post emergence
		Sethoxydim	0.10	
	Prosper	Bentazon	1	Post emergence
		Sethoxydim	0.10	
Fall 1988	Casselton	Trifluralin	0.83	Fall soil incorporated
	Prosper	Trifluralin	0.83	Fall soil incorporated
Spring 1989	Casselton	Bentazon	0.75	Post emergence
		Acifluorfen	0.19	
	Prosper	Bentazon	0.75	Post emergence
		Aciflurofen	0.19	
Fall 1989	Casselton	Trifluralin	1	Fall soil incorporated
	Prosper	Trifluralin	1	Fall soil incorporated
Spring 1990	Casselton	None	-	-
	Prosper	Bentazon	0.75	Post emergence

CONCLUSION

Soybean growers of the northern Great Plains may be able to reduce spring tillage needs by using conventional tillage practices for small grain production while rotating with a modified ridge tillage system for soybeans. If a wet spring delays planting, reduced spring seedbed preparation because of fall build-up of ridges may permit more timely planting of soybeans. Soybean growers who fall apply herbicides will increase field roughness by building ridges in the fall. The 6- to 8-inch height of the ridges can reduce wind erosion during the winter and spring compared to the smooth and pulverized field condition using conventional tillage. In addition, increased field roughness can trap snow, which can further reduce susceptibility to wind erosion. The results of this experiment show that yields of soybeans grown in a ridge tillage system are similar to soybean yields grown under conventional tillage.

LITERATURE CITED

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Table 2. Grain yield and days to physiological maturity (P.M.) for three production methods and two cultivars averaged over six environments.

Production Method	Row Spacing	Cultivar	Days to P.M.	Soybean Grain Yield
	(inches)		(from Aug. 1)	(bu/A)
Conventional	12	McCall	31	14.5
Conventional	30	McCall	33	13.5
Ridge	30	McCall	30	13.0
LSD (0.05)			NS	NS
Conventional	12	Evans	52	17.2
Conventional	30	Evans	53	16.2
Ridge	30	Evans	52	16.3
LSD (0.05)			NS	NS

Table 3. Grain yield of six environments for each of two cultivars averaged over three production methods.

Location	Year	Cultivar	Soybean Grain Yield
			(bu/A)
Casselton	1988	McCall	6.4
Prosper	1988	McCall	7.0
Casselton	1989	McCall	10.1
Prosper	1989	McCall	15.2
Casselton	1990	McCall	18.7
Prosper	1990	McCall	24.6
LSD (0.05)			6.0
Casselton	1988	Evans	8.9
Prosper	1988	Evans	7.0
Casselton	1989	Evans	8.3
Prosper	1989	Evans	17.4
Casselton	1990	Evans	27.5
Prosper	1990	Evans	30.3
LSD (0.05)			8.5