Row Width and Planting Rate Effects on Soybean Yields in Northeastern North Dakota

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Soybean production in North Dakota has historically been centered in the east central and southeastern regions of the Red River Valley. Acreage has increased in recent years to a 1984-1986 level of 570,000 acres annually. Northeast North Dakota constitutes 10-20 percent of this acreage with 92-96 percent of that being grown in the northern Red River Valley (3,4). An increasing number of higher yielding, earlier maturing varieties are being developed which are better adapted to the shorter growing season of Northeast North Dakota. This, along with the need for additional non-program crops under current government farm programs, will make soybean production more attractive to growers and should result in increased acreage in the northeast region of the state.

Extensive research has been conducted over the years dealing with planting rates and row widths. The majority of these studies have been performed in the traditional 'Soybean Belt' of the U.S. In their review of row width research across the U.S., Johnson et al. (1) concluded that in order to obtain optimum yields row widths should be narrow enough to close the soybean canopy by the time the plants have begun to flower. This would utilize more of the sun's energy during the critical pod formation and early grain filling and not waste it on the soil. They also suggested as a general rule that the farther north in the U.S. the narrower the optimum row width because the plants are smaller at flowering time.

Several studies have been conducted in southeastern North Dakota on row widths and planting rates. Swallers (7) studied four planting rates of 30, 60, 90, and 120 pounds per acre, five row widths between 18 and 42 inches at 6-inch increments, and two planting dates. He observed that the early planting had no yield differences among row widths while the wider rows yielded less at the late planting. No real differences in yield were observed between the four planting rates.

Irrigated trials conducted at Oakes indicated that 12-inch row widths had a 19 and 32 percent yield advantage over 24 and 36-inch row widths, respectively, when averaged over four varieties and two planting dates (5).

Spilde et al. (6) conducted trials at Casselton in 1975-1976 with row widths of 6, 12, 24, and 36 inches seeded at 60 pounds per acre. They reported a significant yield advantage for the 12-inch row widths in 1975 and for the 6 and 12-inch row widths in 1976 compared to the wider row widths. Similar trials in Fargo resulted in higher yields for the narrow row widths of 6 and 12 inches compared to the 24 and 30-inch row widths in 1976. No significant yield differences among row widths were noted in 1977 or when the 1976-1977 average was considered.

Muhamadali (2) examined 12 and 24-inch row widths and five planting rates of 45, 60, 75, 90, and 105 pounds per acre at Fargo in 1980-1981. No significant yield differences among the planting rates were observed. The 12-inch row width has an 11 percent yield advantage over the 24-inch row width across the four varieties studied.

Information on the effect of planting rates and row widths on soybean yields in northeastern North Dakota is lacking. Therefore, the purpose of this study was to determine if previously established cultural practices involving planting rates and row widths are adapted to the shorter growing season of northeastern North Dakota.

Methods and Materials

Trials were located across northeastern North Dakota at six locations in 1984, four in 1985, and two in 1986. Counties and their respective cities where trials were grown included: Cavalier-Langdon, Pembina-Walhalla, Walsh-Park River, Nelson-Lakota, Ramsey-Garske, and Towner-Rock Lake.

Trials were planted with a double disk plot seeder in a randomized complete block design replicated four times. Plots consisted of four 16-foot rows with row widths of 12 and 24 inches. Planting rates for target populations of 150,000 and 225,000 plants per acre were 57, 56, and 57 pounds pure live seed per acre and 86, 84, and 86 pounds pure live seed per acre for the years 1984, 1985, and 1986, respectively. Foundation grade 'McCall' soybean (Maturity Group 00) was used all three years. Planting dates ranged from May 24 to June 4 over the three-year period.

Rhizobium granular inoculum was applied with the seed in all trials. Soil test levels for nitrogen indicated that only Ramsey and Towner locations, in 1984, had less than 100 pounds of soil nitrogen at planting. Phosphorus soil levels tested very high at all locations except Nelson, Ramsey, and Towner in 1984, which had 27, 17, and 13 pounds per acre, respectively. Soil series and their classifications are listed in Table 1. Trials were kept weed free by the use of herbicides and hand weeding.

Harvest area consisted of the two center rows of each plot which were hand pulled and threshed with a small plot combine. Samples were dried, cleaned and weighed for yield and test weight.

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Results and Discussion

The first year of the study, 1984, was characterized by below normal rainfall at Rock Lake and Walhalla for June and July and slightly above normal at Langdon. The other locations had near normal rainfall. August had above normal temperatures and very little rainfall while September remained dry but temperatures fell below normal. The 1985 growing season had rainfall amounts in July ranging from 1.19 to 2.28 inches below normal across the four locations while August rainfall ranged from 1.87 to 3.48 inches above normal. Temperatures in 1985 were much below normal June through September. The 1986 growing season had Park River receiving below normal rainfall in May and June but 6.26 inches above normal in July. Langdon had above normal rainfall in July. Both locations had below normal temperatures in August and September. A summary of precipitation, growing degree days, and average soybean yields for each location are given in Table 2.

Results from the three-year study were analyzed by treating individual locations and years as separate environments. Yield responses to row widths were in general agreement with other studies conducted in North Dakota (2,6). The 12-inch row widths had a significant 3.2 bushel per acre or 13 percent yield advantage over the 24-inch row widths averaged over environments. The 12-inch row width always outyielded the 24-inch row width, but the magnitude of difference between the two varied, resulting in a significant environment•row interaction (Figure 1). When observing individual environments, the 12-inch row width was significantly higher than the 24-inch row width in six of 12 locations.

Planting rate effects on yield were nonsignificant across all environments, which agreed with earlier work done in North Dakota (2,7). Plant height and test weight data were recorded. Planting rates and row widths had no significant effect on either of these traits.

Table 1. Soil Series and Their Classification for Trial Locations in 1984, 1985 and 1986.

Soil Series	County	Year	Classification
Barnes-Svea loam	Cavalier	1984	Fine-loamy, mixed Udic Haploborolls
Svea loam	Nelson	1984	
Glyndon loam	Pembina	1984	Coarse-silty, frigid Aeric Calciaquolls
	Walsh	1986	
Hamerly loam	Ramsey	1984	Fine-loamy, frigid Aeric Calciaquolls
	Towner	1984	
	Cavalier	1986	
Beardon silt loam	Walsh	1984	Fine-silty, mixed, frigid Aeric
	Walsh	1985	Calciaquolls
Embden fine sandy loam	Pembina	1985	Coarse-loamy, mixed Pachic Udic Haploborolls
Emrick loam	Nelson	1985	
Fram loam	Nelson	1985	Coarse-loamy, mixed, frigid Aeric Calciaquolls
Fordville loam	Ramsey	1985	Fine-loamy, over sandy or skeletal, mixed Pachic Udic Haploborolls

Table 2. Summary of June thru August Precipitation, Growing Degree Days and Average Soybean Yield across Twelve Environments in Northeastern North Dakota for the 1984-1986 Growing Seasons.[1]

	1984			1985			1986		
Counties	Precip	GDD[2]	Avg. Yield	Precip	GDD	Avg. Yield	Precip	GDD	Avg. Yield
	in		bu/A	in		bu/A	in		bu/A
Walsh	6.86	1990	41.1	8.79	1657	32.3	11.52	1669	52.9
Pembina	7.56	1725	28.5	11.33	1229	26.4	—	—	—
Cavalier	7.20	1631	23.5	13.41	1324	0[3]	10.46	1394	13.1
Ramsey	5.82	1731	18.9	6.55	1474	23.2	—	—	—
Nelson	7.01	1572	18.4	9.02	1364	24.3	—	—	—
Towner	5.61	1557	12.0	13.80	1193	0[3]	—	—	—

1- Climatological Data of North Dakota. 1984-1986. National Oceanic and Atmospheric Administration. Precipitation and temperatures obtained from closest reporting station to each trial.

2- Growing Degree Days = Daily Max. temp (or 86°F) – Daily min. temp (or 50°F)/2 – 50 (base temperature) summed over June 1 to first frost date.

3- Plants did not mature before first frost.

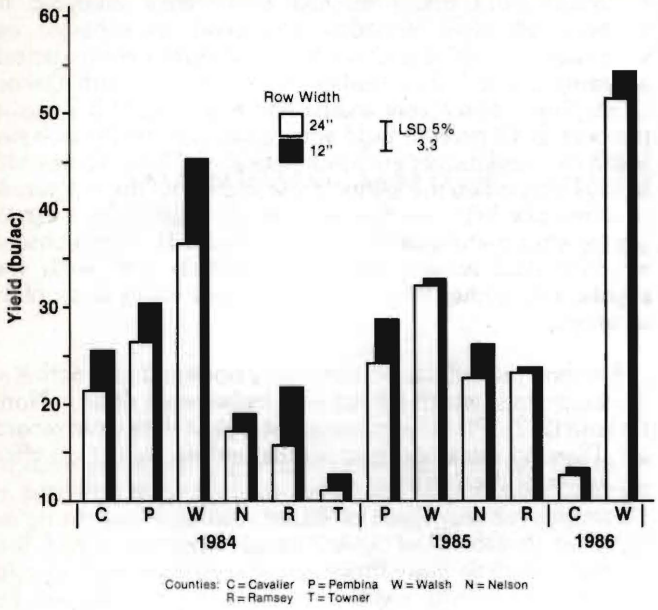

Figure 1. Effect of Two Row Widths Averaged over Planting Rates on 'McCall' Soybean Yields across Northeast North Dakota.

Summary

Results from this study were similar to other studies conducted in North Dakota. Twelve-inch row widths had a 3.2 bushel per acre or 13 percent yield advantage over 24-inch row widths. The 12-inch row width always outyielded the 24-inch row width with the differences between the two ranging from 0.3 to 8.9 bushels per acre across environments. No significant differences occurred between planting rates for the three-year study.

Acknowledgements

The authors wish to thank Dr. Jim Hammond for assistance in analyzing the data.

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the principle of comparative advantage. In the long run, the United States could have a comparative advantage over Canada in high-technology and service industries and Canada could have a comparative advantage in energy and forest industries.

Impacts of the FTA on the United States agricultural sector will be much smaller than those on the manufacturing and service sectors. There will be increases in United States exports of fresh fruits and vegetables, oilseeds (soybeans), vegetable oil, poultry products, and feed grains to Canada. On the other hand, Canada may be able to increase its exports of meat and grain, mainly oilseed, to the United States. Wheat producers in both countries will be neither winners nor losers form the FTA.