Effect of Row Spacings on Yields of Spring and Winter Wheats in Central and Northern Saskatchewan

[1]S.A. Brandt; [2]A.T. Wright; [2]D. Tompkins and [3]H.M. Austenson

1. Agriculture Canada, Experimental Farm, Scott, Sask.
2. Agriculture Canada, Research Station, Melfort, Sask.
3. Dept. of Crop Science and Plant Ecology, University of Saskatchewan, Saskatoon, Saskatchewan.

Acknowledgement

The authors wish to acknowledge the funding provided under the Canada-Saskatchewan Subsidiary Agreement for Agriculture under the Economic and Regional Development Agreement (ERDA), which facilitated conduct of these studies.

Abstract

The effect of row spacings on yields of Hy-320 and Neepawa spring wheats and Norstar and Norwin winter wheats was investigated at several locations in Central and Northern Saskatchewan. These results, although preliminary, indicated that yields increased as row spacings decreased. The effect of row spacing appeared to be greatest where yields were highest although significant row spacing effects were also noted at those sites where yields were lower. Data from a limited number of sites where counts of head numbers per M^2 were made indicated that much of the difference in yields between row spacings could be accounted for by increased numbers of heads being produced at narrower spacings.

Introduction

Row spacings for production of grain crops on the Canadian prairies have traditionally not received much attention. It has generally been accepted that spacings of 15 to 20 cm. were satisfactory to maximize yields and provide support for the swath of mature grain. With the trend towards increased stubble cropping and reduced tillage for seedbed preparation on stubble, the tendency has been to increase row spacings to improve trash clearance and opener penetration. From a manufacturing standpoint, seeding equipment costs can be reduced by increasing row spacings and reducing the numbers of openers required. However, recent studies with canola (Christensen and Drabble, 1984) indicated that yield responses could be obtained by decreasing row spacings to as narrow as 7.5 cm. The studies reported here were initiated to evaluate the effect of seeding spring and winter wheats at several row spacings and seeding rates on grain yields, yield parameters, crop quality and maturity at several locations in Central and Northern Saskatchewan.

Materials and Methods

Studies were conducted at Melfort and Scott in 1985 using Neepawa HRS wheat and HY-320 Prairie Spring wheat. In 1986, several additional locations were used in NE Saskatchewan and at Saskatoon and studies were initiated with winter wheat. Row spacings used in these studies are summarized in table 1. The studies were conducted using varieties as main treatments, seeding rates androw spacings as sub-treatments in a split plot factorial design. For the spring wheats at Scott seeding rates of 40, 80, 120 kg/ha were used and at Melfort, Carrot River and Saskatoon rates of 40, 80, 120, 160 and 200 kg/ha were used. For winter wheat at Aylsham and Melfort seeding rates of 35, 70, 105 and 140 kg/ha were used. Seeding was done using small plot seeders

equipped with double-disc openers in all studies except Melfort in 1985 where a hoe drill with narrow hoe openers was used. Studies at Scott in both 1985 and 1986 were conducted on summerfallow and phosphate fertilizer was placed with the seed at rates indicated by soil tests. Soil tests indicated that additional N fertilizer was not required at Scott.

TABLE 1 Description of Treatments used in Row Spacing Studies.

Location and wheat type		Row spacing (cm)
Scott 1985	spring wheat[1]	11.5, - 23.0, - 46.0
Melfort 1985	spring wheat	11.5, - 23.0
Scott 1986	spring wheat	11.5, - 23.0, - 46.0
Melfort 1986	spring wheat	9, - 18, - 27, - 36
Saskatoon 1986	spring wheat	9, - 18, - 27, - 36
Carrot River 1986	spring wheat	9, - 18, - 27, - 36
Melfort 1986	winter wheat[2]	9, - 18, - 27, - 36
Alysham 1986	winter wheat	9, - 18, - 27, - 36

[1] Spring wheat varieties used - Neepawa and Hy-320
[2] Winter wheat varieties used - Norstar and Norwin

Studies where Neepawa and Hy-320 were grown at Melfort in 1985 and 1986 and at Carrot River in 1986 were conducted on barley stubble. Nitrogen and phosphate fertilizers were broadcast and incorporated on the plot area at rates based on soil test recommendations. No fertilizer was placed with the seed. At Saskatoon in 1986 all nitrogen and phosphate fertilizer was deep banded at rates based on soil tests. The study was conducted on wheat stubble.

The winter wheat studies at Melfort and Aylsham in 1986 were conducted on canola stubble with phosphate fertilizer and nitrogen fertilizer broadcast at rates based on soil tests.

Results and Discussion

At Scott yields were increased significantly by decreasing the row spacing from 46 to 23 cm. and from 23 to 11.5 cm. in both 1985 and 1986 (table 2). Hy-320 yielded significantly more than Neepawa in both years and the 40 kg/ha

seeding rate gave lower yields than the 80 and 120 kg/ha seeding rates (data not shown). However, the interactions of varieties and seeding rates with row spacings were not significant (table 3), indicating that the effect of row spcing was similar regardless of variety or seeding rate used.

TABLE 2 Mean yields of 2 spring wheat varieties (Hy-320 and Neepawa) sown at 3 row spacings at Scott in 1985 and 1986.

	yield (kg/ha)		
Row spacing (cm)	1985	1986	2 yr mean
11.5	3527	4495	4011
23.0	3039	4220	3629
46.0	2407	3705	3056
LSD (P = 0.05)	208	103	74

TABLE 3 Summary of statistical analyses performed on yield data from row spacing studies at Scott.

Scource of variation	1985	1986
Varieties (V)	* *	*
Row spacing (RS)	* *	* *
V X RS	N.S.	N.S.
Seed rate (SR)	*	* *
V X SR	*	* *
RS X SR	N.S.	N.S.
V X RS X SR	N.S.	N.S.

N.S. - not significant
* - significant at P = 0.05
* * - significant at P = 0.01

Plant counts were made at Scott at 10 days after emergence of the crop and indicated that plant densities were higher where narrower row spacings were used (table 4). Because the same seeding rates were used with each row spacing, differences in plant densities must have been due to fewer seedlings becoming established. As row spacing is increased, the spacing between plants or seeds within the row decreased, thereby increasing inter-plant competition

within the row. It is likely that the increased competition accounted for lower plant densities where wider row spacings were used. The increase in plant densities with narrow rows led to increased numbers of heads produced.

TABLE 4 Plants and head densities of spring wheat sown at three row spacings at Scott (means for 2 varieties; Hy-320 and Neepawa, over 2 years 1985 and 1986.

Row spacing (cm)	Plant* per M^2	Heads per M^2
11.5	171	227
23.0	136	191
46.0	107	162
LSD (P = 0.05)	8.2	8.6

* plant counts made at 10 days after emergence

Volume weights and 1000 kernel weights also tended to be higher at the narrow (11.5 cm) row spacing (table 5).

TABLE 5 Volume weight and 1000 kernel weight of spring wheat sown at three row spacings at Scott (means for 2 varieties; Hy-320 and Neepawa, over 2 years 1985 and 1986.

Row spacing (cm)	Volume weight (kg/hl)	1000 kernel weight (g)
11.5	80.1	41.9
23.0	79.6	41.0
46.0	77.6	41.2
LSD (P = 0.05)	0.57	0.62

At Melfort in 1985, yields of Hy-320 and Neepawa wheats were also increased by seeding at a 11.5 cm row spacing compared with a 23 cm row spacing (table 6). Here, as at Scott significantly greater numbers of heads were produced where the narrow row spacing was used.

TABLE 6 Yield and head densities of spring wheat sown at two row spacings at Melfort, 1985. (Means for Hy-320 and Neepawa).

Row spacing (cm)	Yield (kg/ha	Head density #/m^2
11.5	4985	447
23.0	4099	377

In 1986 at Melfort, yields of Hy-320 and Neepawa tended to increase as row spacing decreased although differences between spacings of 9, 18 and 27 cm were quite small (table 7). At Carrot River, yields also increased as row spacings decreased, with 9 cm row spacing giving significantly higher yields than wider spacings. At Saskatoon, however, the 18 cm row spacing gave higher yields than other spacings used. The widest spacing (36 cm) gave significantly lower yields than the narrower spacings.

TABLE 7 Summary of statistical anaylyses performed on yield data from row spacing studies conducted at Melfort, Carrot River and Saskatoon in 1986.

Source of Variation	Melfort	Carrot River	Saskatoon
Varieties (V)	* *	* *	* *
Row spacings (RS)	*	* *	* *
V X RS	N.S.	N.S.	N.S.
Seeding rate (SR)	* *	* *	N.S.
V X SR	N.S.	* *	*
RS X SR	* *	*	N.S.
V X RS X SR	N.S.	N.S.	N.S.

In 1986, identical studies were conducted at Melfort, Saskatoon and Carrot River. Row spacing had a significant effect on yields at all locations (table 7) as did varieties. However, the variety X row spacing interaction was not significant for any of the locations, indicating that both Hy-320 and Neepawa responded to row spacings in the same manner. Seeding rates had a significant effect on yields at Melfort and Carrot River as did the inter-

action of row spacing with seeding rates. The variety X seeding rate interaction was significant at Carrot River and Saskatoon.

At Melfort, and Carrot River, the general trend was for yields to decrease as row spacing increased (table 8). At Saskatoon, the effect of row spacing was somewhat different, as yields peaked at a row spacing of 18 cm. and declined with narrower or wider spacings.

TABLE 8 Yield of spring wheat sown at 4 row spacings at 3 locations in 1986 (Means yields for 2 varieties and 5 seeding rates).

Row spacing (cm)	Yield (kg/ha			
	Melfort	Carrot River	Saskatoon	3 loc. mean
9	2354	2335	2670	2453
18	2338	2076	2880	2431
27	2310	2025	2702	2346
36	2213	1852	2556	2207
LSD (P = 0.05)	104	104	170	90

At the two locations where the row spacing with seeding rate interaction was significant (Melfort and Carrot River) yields increased substantically as seeding rates were increased and a 9 cm row spacing was used (figure 1). Where 18 cm or 27 cm row spacings were used yields also increased as seeding rates increased but not as much as with the 9 cm spacing. With a 36 cm row spacing yields increased with seeding rates over the lower range of rates but tended to decline at the highest rates of seeding. The general trend was for yields to increase with increases in seeding rate but the magnitude of the increases declined as row spacing increased. Highest yields were obtained where the narrowest row spacing was used to place seed at the highest rate of seeding.

Where winter wheat was grown in row spacing studies at Melfort and Aylsham in 1986, row spacing had a significant effect on yields at both

locations as did rates of seeding (table 9). Norstar was significantly higher yielding than Norwin at Aylsham but not at Melfort. At Aylsham the variety X seeding rate and row spacing X seeding rate interactions were significant.

At both locations, yields increased as row spacing decreased (table 10).

At the 9 cm row spacing at Aylsham, yields were quite low where a 35 kg/ha seeding rate was used but increased dramatically with higher rates of seeding (figure 2). As row spacings were increased, yield increases due to increases in seeding rates tended to decline. Yields at the 105 kg/ha seeding rate for row spacings of 9, 18, 27 cm did not appear to fit the same pattern as yields from other rates of seeding.

The interaction of variety with row spacing at Aylsham indicated that yields of Norwin declined as row spacing increased over the entire range of row spacings used (figure 3). Yields of Norstar declined as row spacing increased from 9 to 18 to 27 cm but then increased at the 36 cm row spacing.

TABLE 9 Summary of statistical analyses performed on winter wheat yield data from row spacing studies conducted at Melfort and Aylsham in 1986.

Source of variation	Melfort	Aylsham
Varieties (V)	N.S.	* *
Row spacing (RS)	* *	* *
Seeding rate (SR)	* *	* *
V X RS	N.S.	*
V X SR	N.S.	N.S.
RS X SR	N.S.	* *
V X RS X SR	N.S.	N.S.

N.S. - not significant
* - significant at P = 0.05
* * - significant at P = 0.01

Figure 1. Average Yields of 2 Spring Wheat Varieties at 2 Locations (Melfort and Carrot River) Using Several Rates of Seeding and Row Spacings, 1986

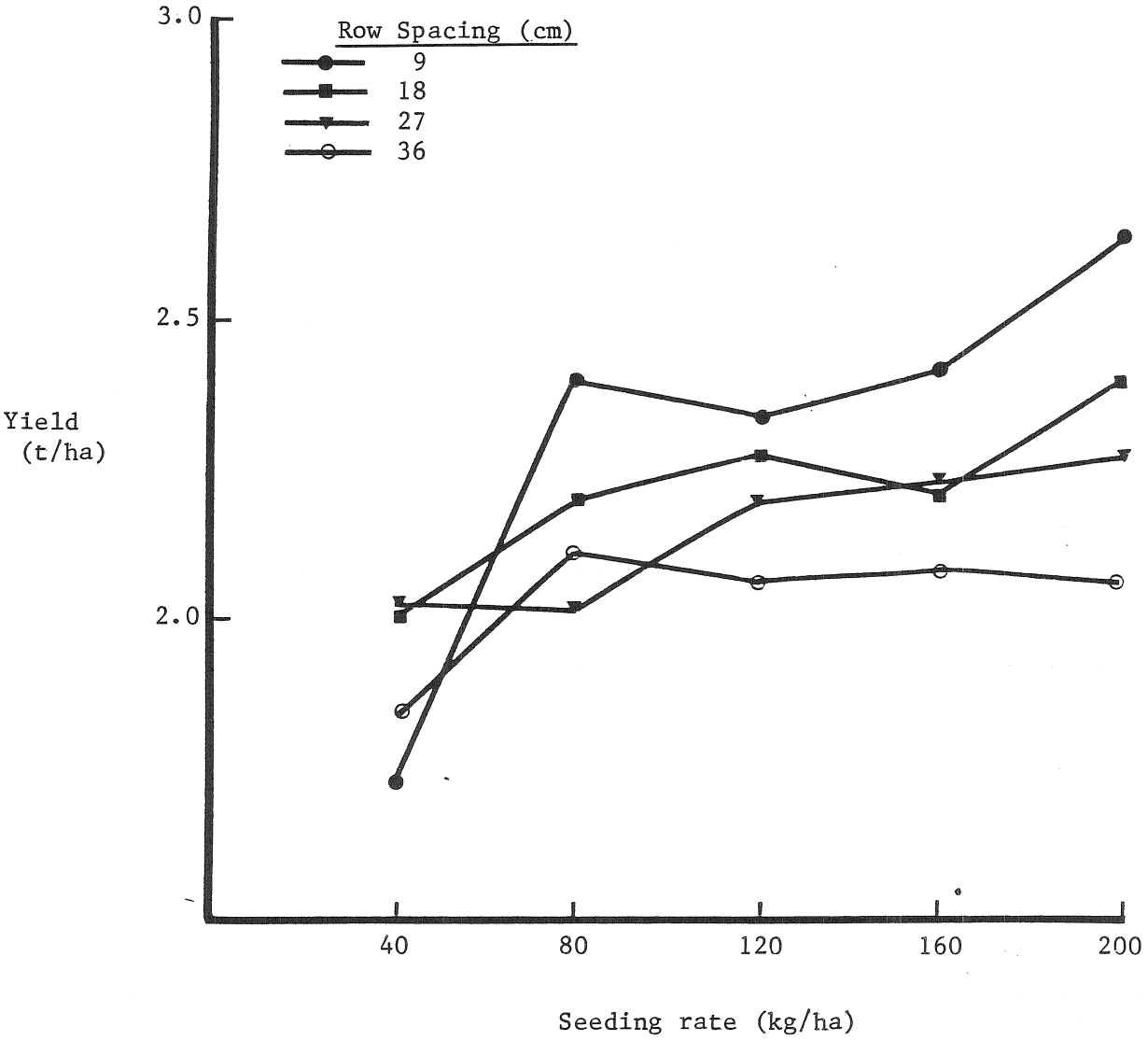

Figure 2. Average Yields of 2 Varieties of Winter Wheat at Several Row Spacings and Rates of Seeding at Aylsham, 1986.

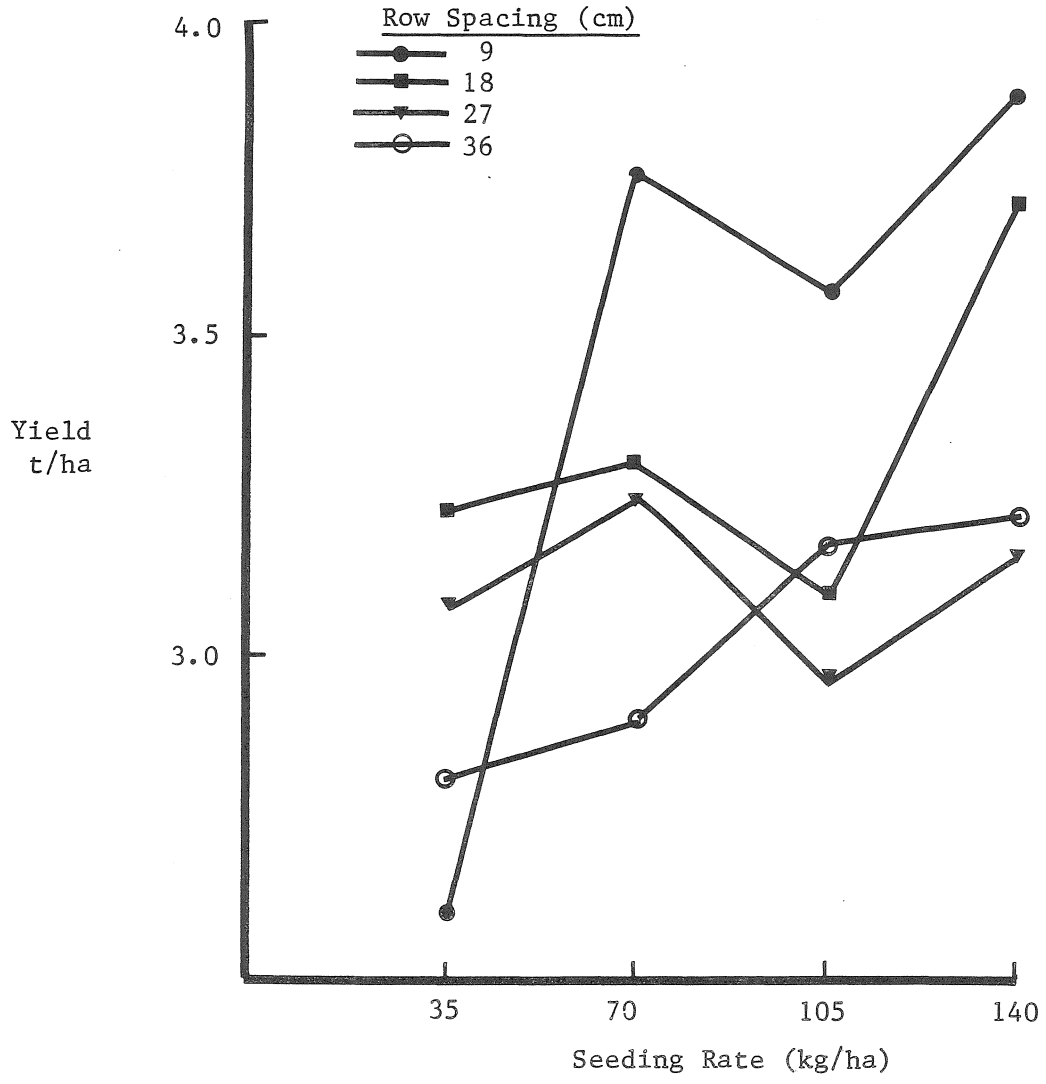

Figure 3. Yields of Norstar and Norwin Winter Wheat with Several Row Spacings at Aylsham, 1986.

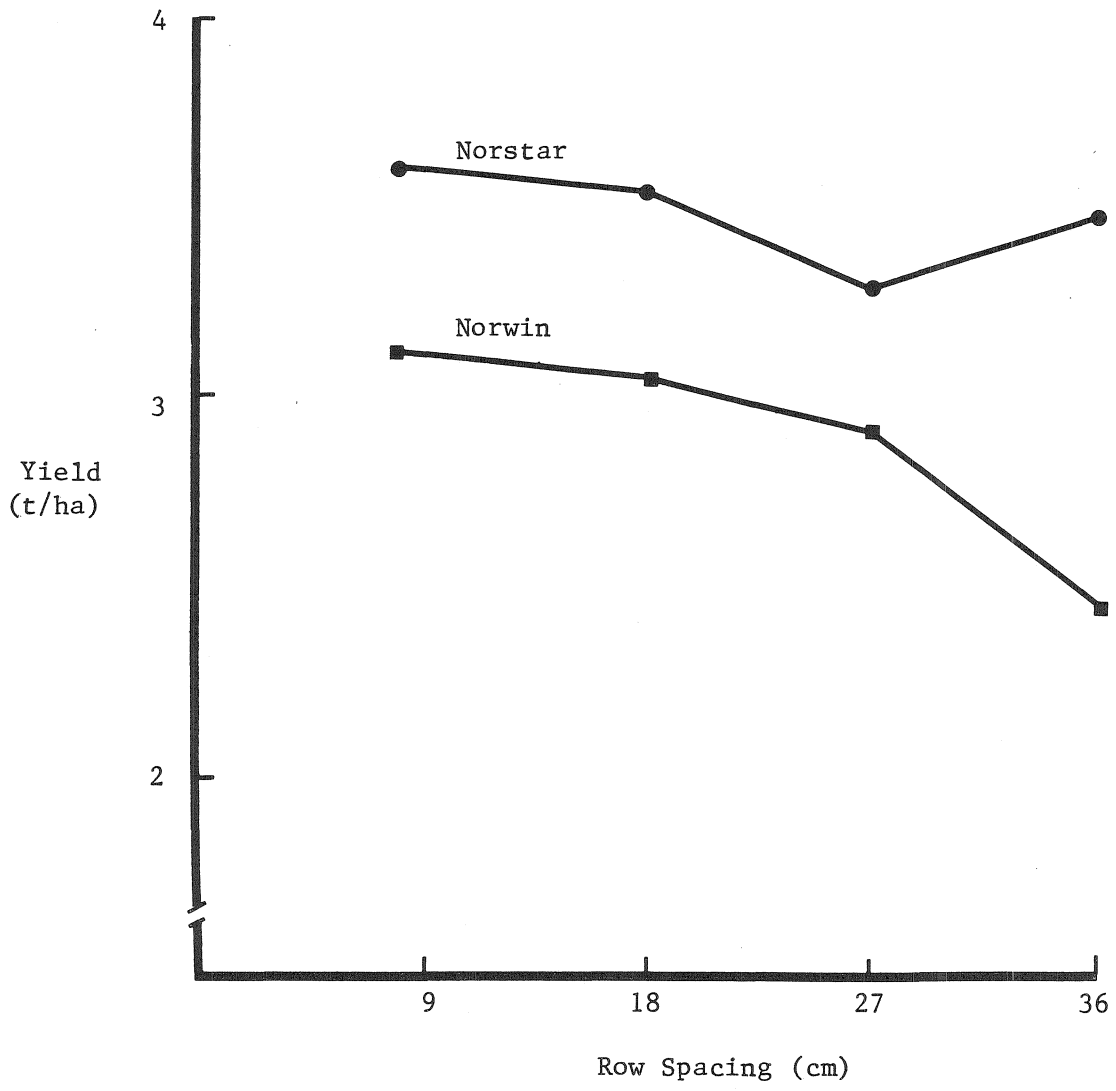

TABLE 10 Yield of winter wheat sown at 4 row spacings at Melfort and Aylsham in 1986. (Means for 2 varieties; Norstar and Norwin, at 4 rates of seeding).

Row spacing (cm)	Yield (kg/ha)		
	Melfort	Aylsham	2 loc. means
9	3662	3440	3551
18	3498	3557	3428
27	3118	3125	3122
36	3059	3120	3090
LSD (P = 0.05)	228	178	145

Summary

In general, decreasing the row spacing used to seed spring and winter wheats in these studies resulted in increased yields. The effect of row spacing on yields tended to be greatest at those locations where yields were highest (figure 4), but significant row spacing effects were observed even where yields were low. The effect of row spacing on yields tended to follow the same trend with both the spring and winter wheats.

At 2 sites, increasing the seeding rate at a 9 cm. row spacing increased spring wheat yields substantially, whereas responses to seeding rates at wider spacings were not as large (figure 1). A similar interaction of row spacing with seeding rates was not observed at other sites, however at some sites a narrower range of spacings and rates was used.

At Scott in 1985 and 1986 head counts per M^2 were made and it appeared that increased heading accounted for much of the yield response as row spacing decreased. Decreasing row spacing from 46 cm to 23 or 11.5 cm increased yields by 19 and 31 percent respectively. Increases in heads per M^2 for the same row spacings were 18 and 40 percent respectively.

To date, these results must be considered preliminary and further investigations are planned in 1987. These results do suggest that equal plant

spacing both within rows and between rows is desireable. Where wide row spacings are used, competition between crop plants within the row is increased particularly where the seed is placed in a narrow band as is the case with double-disc drills. Where wide row spacings are used, devices that increase the width of the band of seed are likely to be beneficial. Devices such as seed scatter boots on some air seeders and row splitters on some hoe drills are effective for this purpose.

Figure 4. Yields of Spring and Winter Wheats with Several Row Spacings at Several locations in Central and Northern Saskatchewan.