YIELD AND WATER USE OF PAIRED-ROW VERSUS CONVENTIONALLY SEEDED SPRING WHEAT AT SWIFT CURRENT

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ABSTRACT

From 1986 to 1989 at the Swift Current Research Station, a hard red spring wheat (cv. Leader) was planted in north-south rows with row spacings of: a) 25 cm (conventional seeding - CS), and b) two rows 10 cm apart with 50 cm between the centre of each paired-row (paired-row seeding - PR). Seed and fertilizer were applied at recommended rates for stubble seeding in the Brown soil zone. There were no differences in grain yield, water use or days to maturity between CS and PR seeding. The data suggest that under the environmental conditions of the Brown soil zone in southwest Saskatchewan paired-row seeding would have no agronomic advantage over conventional seeding.

INTRODUCTION

Paired-row seeding is a relatively new seed-fertilizer placement concept in conservation tillage that is being researched in the Pacific Northwest and the northern Great Plains of the United States (Papendick 1984), and in the western portion of the Canadian prairies (Bates 1985). The seeds are generally planted in pairs of rows spaced 10 to 18 cm apart with a space of 33 to 40 cm between the next pair, with a fertilizer band below the seed rows and midway between the narrow row separation (Papendick 1984). In the Pacific Northwest, paired-row planting appears to improve early seedling vigor, and provide substantial reductions in soil erosion when combined with conservation tillage practices (Papendick 1985). Also, paired-row wheat appeared to yield as well as, or slightly greater than conventionally planted wheat. However, under no-till conditions in north-central Montana (the northern Great Plains), there was no yield advantage for paired-row planted spring wheat under either irrigated or dryland conditions in 1987 (Benson et al. 1990).

Our objective was to compare the development rate, water use and yield of paired-row and conventionally seeded spring wheat when grown under environmental conditions of southwest Saskatchewan.

MATERIALS AND METHODS

From 1986 to 1989, Leader spring wheat (Triticum aestivum L.) was grown in a randomized complete block with 4 replications on a Swinton loam soil at Swift Current. The test was seeded on summerfallow in 1986 with subsequent years seeded on minimum till stubble. The plots measured 20 x 20 m and were fertilized to soil test recommendations. The seeding rate was 67 kg/ha with a seeding depth of 2 cm. North-south rows were spaced 25 cm for the conventionally seeded plots, with fertilizer bands every second midrow at a depth of 5 cm. For the paired-row plots, seed rows were placed 5 cm to each side of the fertilizer bands, which were also separated by 50 cm and were 5 cm deep.

Grain yields were obtained with a plot combine harvesting an area approximately 20 sq m per plot. Soil moisture to 120 cm depth was measured at seeding and every two weeks from approximately 4-leaf to ripe with a neutron moisture meter, except in 1986 when soil moisture was measured gravimetrically to 120 cm at seeding. For the conventionally seeded plots, moisture measurements were taken in the plant rows in 1986, and in and between the plant rows in 1987. In the paired-row plots, measurements were taken in the centre of and in between the paired-rows in 1986 and 1987.

For a given growth phase, water use was determined by adding rainfall to the difference in soil moisture to 120 cm at the beginning and end of the respective growth phase.

RESULTS AND DISCUSSION

Growing season evaporation and precipitation

Throughout this study, the monthly totals and the distribution of precipitation and evaporation varied markedly with year (Table 1). Total growing season precipitation (GSP) was slightly below normal in 1987 and 1988, and was slightly above and well above normal in 1986 and 1989. Growing season evaporation (GSE) was near to slightly below normal in 1986, 1987 and 1989, and well above normal in 1988. In 1986, May was wet while summer was relatively dry; in 1987, spring was dry and summer was relatively wet; and in 1989, except for July, spring and summer were relatively wet. Although GSP was only slightly below normal in 1988, the extremely high GSE was a severe detriment to production resulting in little harvestable yield (Table 4).

Water use

There were no differences between conventional and paired-row seeded spring wheat in amounts and pattern of water use throughout the growing season.

For a given year, total water used to 120 cm from seeding to ripe (harvest) (Table 2), and water used during various growth phases throughout the growing season were independent of row configuration (Table 2 and Figure 1). The distribution of water use during crop growth and development varied with year but not with row spacing (Figure 1).

For a given year, row configuration and growth phase, in-row and between-row water use were equivalent (Figure 2). The data suggest that for paired-row planting in-row soil moisture was not preferentially used earlier in the growing season resulting in a conservation of between-row soil moisture for later use.

For a given year, growth stage and soil depth, volumetric moisture contents were independent of row configuration (Figure 3). The pattern of water withdrawal from the soil profile was not altered by row spacing.

Development rate and grain yield

Similar to Papendick (1985) and Benson et al. (1990), visual observations indicated improved early seedling vigor for the paired-row treatments. However, these early visual indications of improved growth did not translate into measurable differences of development rate (Table 3). Within a given year, anthesis and maturity dates, and therefore, days to maturity were independent of row spacing.

The visual indications of improved early seedling vigor with paired-row seeding were not evident when final grain yields were harvested (Table 4). For a given year, grain yields were independent of row configuration although there tended to be a very slight yield advantage for paired-row. These results contradict those from the Pacific Northwest where yields appeared to favor paired-row planting when conservation tillage was practiced (Papendick 1985). Our results were similar to those from north-central Montana where yields from no-till equidistant-row plots were equal to or greater than yields from paired-row plots (Benson et al. 1990).

Our data indicate that in the Brown soil zone paired-row seeding offers no yield advantage over conventional seeding practices. However, environment may be an important factor in determining whether paired-row seeding is advantageous compared to conventional, or equidistant-row seeding. Environments less stressful than occurring in the Brown soil zone (such as the wetter parts of the Dark Brown and the Black soil zones) may favor paired-row seeding practices.

SUMMARY

During the course of our study we did not find any differences between paired-row and conventionally planted spring wheat in development rate, water use or grain yield. In north-central Montana, with a climate very similar to Swift Current's, Benson et al. (1990) found spring wheat seeded in equidistant rows yielded as much as or greater than paired-row spring wheat. Therefore, we concluded that under the environmental conditions of the Brown soil zone in southwest Saskatchewan, paired-row seeding offers no agronomic advantage compared with conventional (equidistant-row) seeded spring wheat. However, we also acknowledge that a longer cropping history (approximately 10 yrs) would provide a more comprehensive comparison of growth and yield for paired-row and conventionally seeded spring wheat.

Because there were no differences in yield or water use, water use efficiency of both cropping systems was identical, mainly due to the high potential evaporation and low precipitation typical of the Brown soil zone.

Visual observations during the course of our study indicated that paired-row cropping could result in elevated rates of soil erosion by water during rainstorms; mainly due to the large portion of soil devoid of crop cover for most of the growing season and the channeling effect of the paired rows. Contour seeding would help alleviate this problem. Also, weed infestations may be more severe under paired-row cropping because of lower crop competition in the exposed midrow area.

REFERENCES

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Table 1. Growing season precipitation and evaporation for the spring and summer at Swift Current from 1986 to 1989.

Year	Precipitation (mm)					Evaporation (mm)				
	May	June	July	August	Total	May	June	July	August	Total
1986	122	51	32	16	221	237	272	241	268	1018
1987	26	44	59	43	172	250	318	234	187	989
1988	35	73	35	30	173	339	380	366	292	1377
1989	62	118	31	72	283	192	222	281	226	921
Long-term average	43	71	52	42	208	217	249	2772	59	1002

Table 2. Water used (mm) under conventional (C) and paired-row (PR) seeded spring wheat.

Year	Row spacing	Water used (mm) seeding to anthesis	Water used (mm) anthesis to ripe	Total
1986	C	207	61	268
	PR	215	54	269
1987	C	168	71	239
	PR	165	75	240

Table 3. Phenological dates for seeding, anthesis and ripe (harvest). Julian days are in brackets.

Year	Phenological dates (Julian day)		
	seeding	anthesis	ripe (harvest)
1986	June 5 (156)	July 29 (210)	Sept 8 (251)
1987	May 8 (128)	July 5 (186)	Aug 16 (228)
1988	May 9 (130)	------	------
1989	May 18 (138)	------	Sept 14 (257)

Table 4. Grain yield (kg/ha) for conventional and paired-row seeded spring wheat.

Year	Grain Yield (kg/ha)	
	conventional	paired-row
1986	2360	2400
1987	1400	1450
1988	----	----
1989	1690	1870

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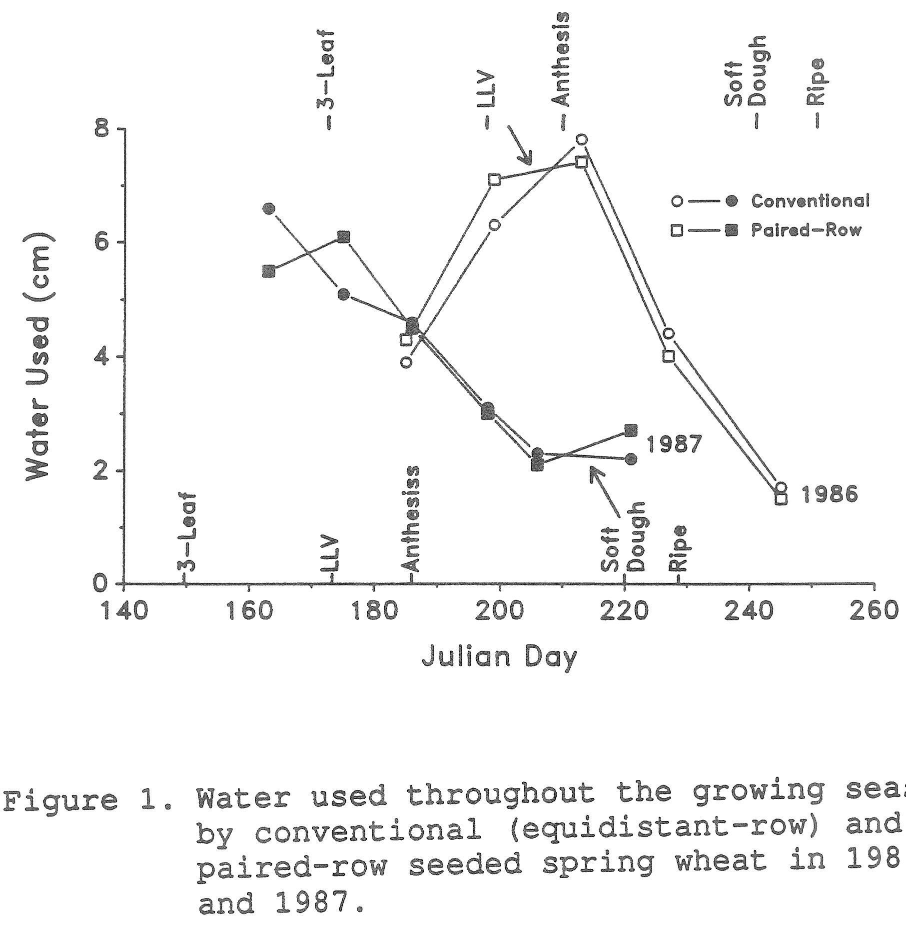

Figure 1. Water used throughout the growing season by conventional (equidistant-row) and paired-row seeded spring wheat in 1986 and 1987.

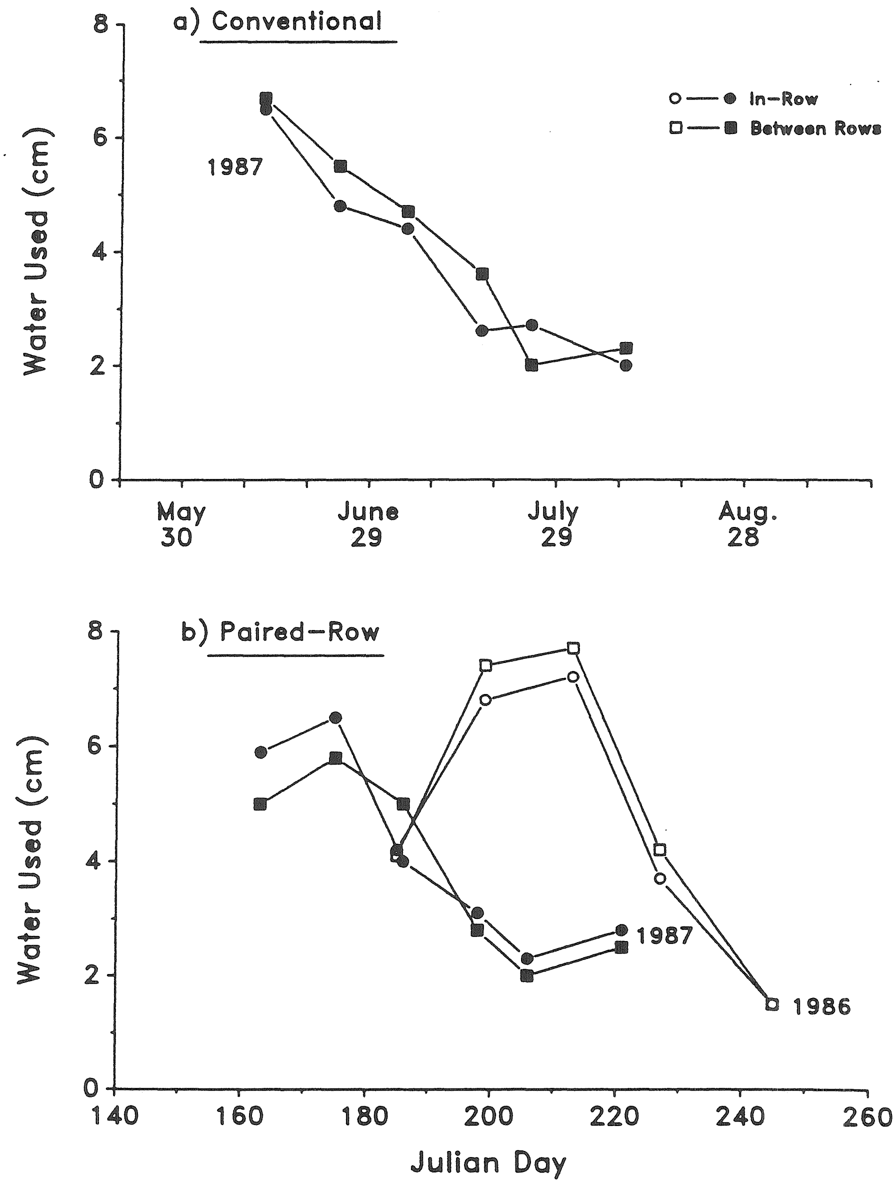

Figure 2. In-row and between-row water use by a) conventionally seeded spring wheat in 1987 and b) paired-row wheat in 1986 and 1987.

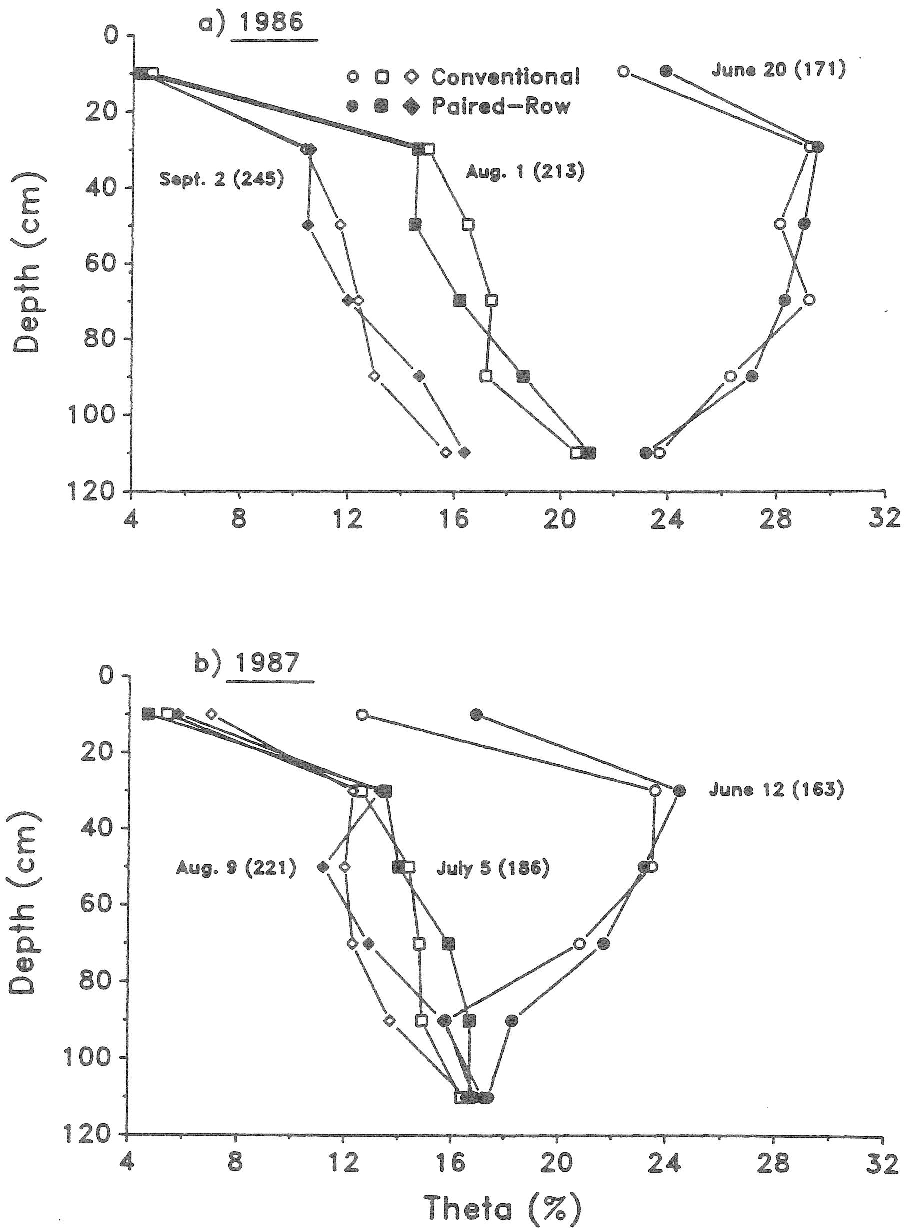

Figure 3. Volumetric soil moisture content under conventional and paired-row seeded spring wheat for various dates during crop growth in a) 1986 and b) 1987.