EFFECT OF ZERO TILL, SNOW TRAPPING AND FERTILIZATION ON SPRING WHEAT AND WINTER WHEAT (1983-84)

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INTRODUCTION

In the past two years we have described and reported on the ongoing results of this study at this meeting. Therefore, the description of treatments will be very limited this year so as to spend more time on the results.

MATERIALS AND METHODS

Two experiments are carried out -- one on spring wheat and the other on winter wheat. In both experiments there are four test blocks for the current year's study and eight filler blocks carried with minimum fertilizer for the two subsequent years' studies. The test blocks are split into tall vs. short stubble treatments (main split). The latter is further split thrice more. In the case of spring wheat, this allows comparison of fall vs. spring application of N fertilizer, deep banded N vs. broadcast N, and finally, comparison of five rates of N and three rates of P. Urea is the N source. In winter wheat (Fig. 1) the second split also allows comparison of fall vs. spring applied N, the third split compares urea vs. ammonium nitrate sources of N and the final split allows comparison of the same rates of N and P as for spring wheat.

Soil temperatures are monitored in the winter wheat continuously and snow depth is measured during winter and soil moisture measured in fall, early spring, and at regular intervals during the growing season.

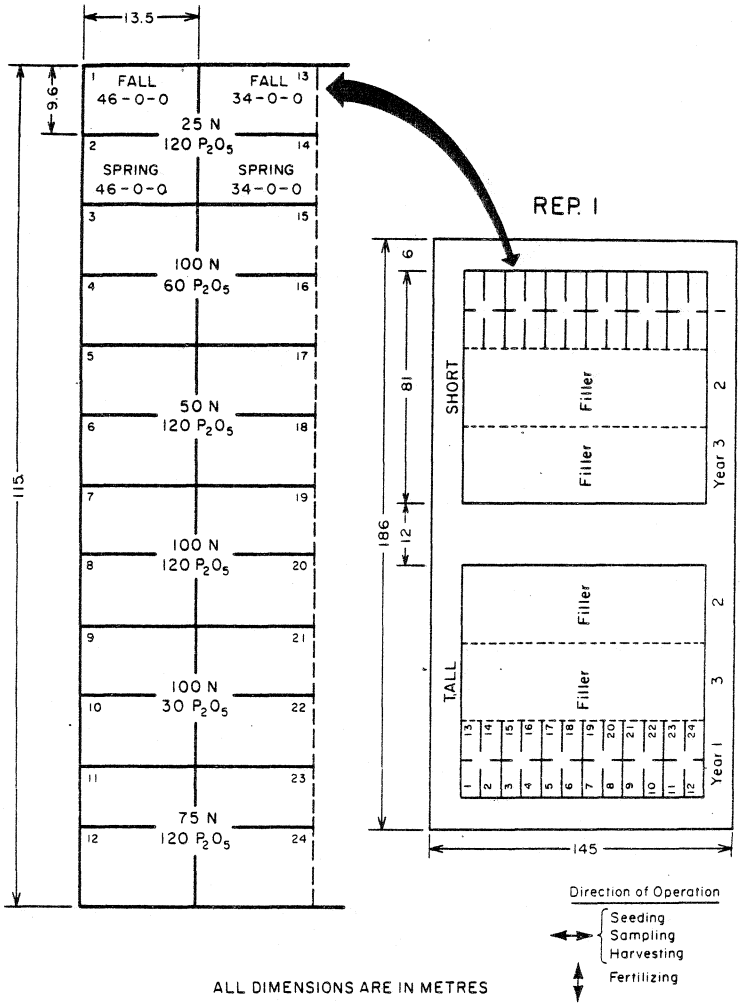

Fig. 1. General field plan for winter wheat test

RESULTS

Snow Conservation 1983-84

Winter precipitation in 1983-84 was only 7.2 cm, down 35% compared to the two previous years. But, as seen in Table 1, the efficiency of water entry into the soil from snowmelt was much higher than for the previous year. This was perhaps due to the generally warmer than average winter months that occurred in 1983-84 (Fig. 2). Moisture conserved by tall stubble exceeded that conserved by short stubble by 2.4 cm in spring wheat (5 times that conserved in 1982-83) and by one cm on winter wheat (the same as in 1982-83) (Table 1).

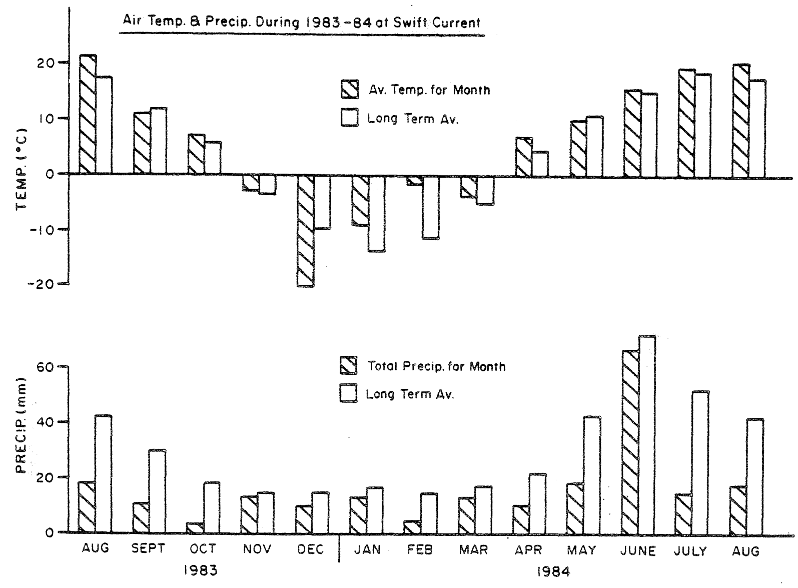

Fig. 2. Air temperature and precipitation at Swift Current for the period August 1983 - August 1984

Table 1. Soil Moisture Capture (1983-84)

	Tall Stubble			Short Stubble			Advtg. Tall over Short
Experiment	Fall-83	Spring-84	Cons.	Fall-83	Spring-84	Cons.	
	- - - Available water (cm/120 cm soil) - - -						
Spring wheat	1.4	5.8	4.4	2.2	4.2	2.0	2.4
Winter wheat	0.4	4.2	3.8	0.4	3.2	2.8	1.0

<u>Winter Wheat</u>

The winter wheat was seeded into very dry soil in early September. Although the seedbed was good, precipitation between August 1 and October 31, 1983, was down by 64% compared to the long-term average (Fig. 2), consequently there was no germination in the fall. Seeds dug out of the plots in late November and grown out in the growth chamber did not head, showing that no vernalization had taken place to that time. Soil temperatures even in December, which was colder than average, were always higher than the critical temperatures for Norstar survival, thus even if the winter wheat had germinated in the fall, it might not have winter killed. In fact, many farmers in this area grew good crops of winter wheat on conventional fallow last year. Precipitation in April and May, 1984, was well below average (Fig. 2) and winter wheat germination in the stubble-seeded plots was very poor and sporadic (Fig. 3). Consequently, the experiment had to be abandoned. In contrast, in a nearby area winter wheat that had been seeded with the same seed on the same day but into chemical-fallowed land grew well (Fig. 4) and eventually yielded 2700 kg/ha.

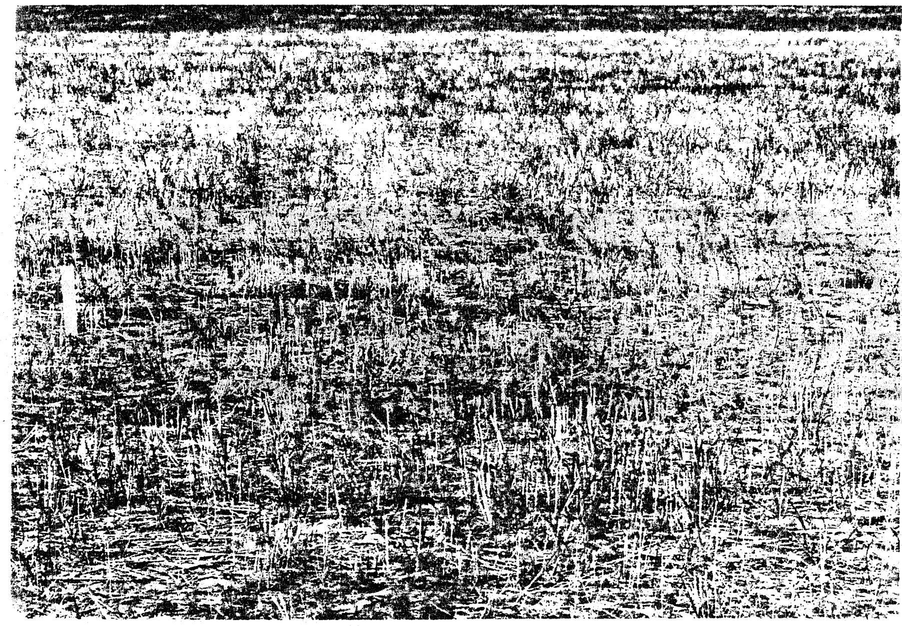

Fig. 3. Poor stand of stubbled-in winter wheat (July, 1984).

Fig. 4. Good stand of winter wheat in chemical fallow (July, 1984).

We have concluded that in the very dry Brown soils stubbling-in winter wheat might be chancey due to erratic fall soil moisture. Secondly, the economics of seeding winter wheat into chemical fallow should be researched. Alternately, a flexible approach could be adopted which depended on the precipitation received in late August to mid-September.

Spring Wheat

At the 3-leaf stage, moisture in the top 90 cm of soil was 4 cm less than at the same stage the previous year (Table 2) but moisture was still enough to ensure good germination. Unfortunately, growing season rainfall was only 10 cm, i.e., 40% below average (Fig. 2). Furthermore, no rain fell between June 18 and July 29 (stem extension and soft dough); consequently, spring wheat yields were very low.

Table 2. Soil moistures in top 90 cm of soil at various growth stages (spring wheat)

Sampling stage and date	Fert. application in	Stubble height	Soil moisture (cm) in top 90 cm* — N rate (kg/ha) 25	50	75	100	Rate of P_2O_5 (kg/ha) 30	60	120
					(based on yr. 3 test plots)				
**3-leaf (5/6/84)	Fall		15.2	14.3	15.3	15.3	14.6	14.6	15.3
	Spring		15.0	14.5	14.2	15.2	14.2	14.4	15.2
***Stem ext. (26/6/84)		Short	14.6	13.8	13.3	14.2	14.0	13.8	14.2
		Tall	15.4	15.1	15.6	15.3	16.2	16.7	15.3
****Heading (10-11/7/84)		Short	11.2	10.7	10.1	12.9	10.5	10.7	12.9
		Tall	11.0	11.0	11.5	11.5	11.5	12.2	11.5
**Milk dough (1-2/8/84)		Short	9.1	9.2	8.5	8.5	9.1	8.9	8.5
		Tall	9.7	8.9	9.5	9.0	9.1	9.3	9.0
**Maturity (31/8-5/9/84)		Short	8.5	8.1	8.4	8.5	7.9	8.3	8.5
		Tall	8.3	8.1	8.3	8.0	8.4	8.4	8.0

* Soil moisture held at the lower limit of availability was assumed to be that found at harvest, i.e., about 8 cm in top 90 cm of soil.

** No factor significant.

*** Stubble height almost significant ($P < 0.05$).

**** Fertilizer and the interaction of fert. x stubble height significant at P (0.001).

In contrast to the two previous years, filler plots with their low fertilizer rates outyielded all the test plots (Fig. 5). Furthermore, fertilizer treatments in the test plots had no effect on yield irrespective of rate, placement, or time of N application (Fig. 5). Yields were, however, significantly ($P < 0.01$) increased by tall stubble. For example, in the test plots, short stubble treatments yielded 475 kg/ha (7 bu/ac) while tall stubble yielded 678 kg/ha (10 bu/ac). On the filler plots, short stubble treatments yielded 625 kg/ha (9.3 bu/ac) while tall stubble treatments yielded 875 kg/ha (13 bu/ac). For comparison, note that spring wheat grown on conventionally tilled stubble yielded only 270 kg/ha (4 bu/ac) while wheat grown on conventional fallow yielded 1140 kg/ha (17 bu/ac).

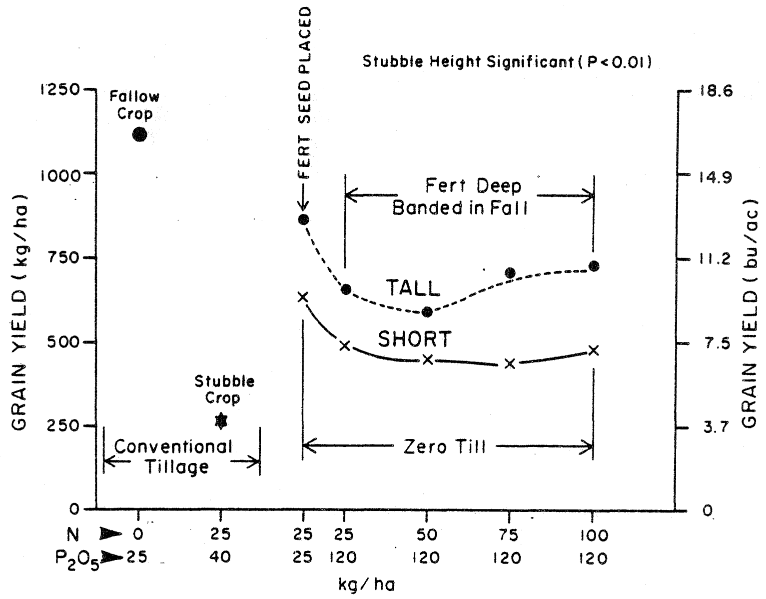

Fig. 5. Effect of trap strips and N fertilizer rate on yield of spring wheat grown on zero-till in 1984. Data from Swift Current long-term crop rotations on conventional tillage included for comparison.

The extra 2.5 cm of water conserved by tall stubble cannot account for all of the increase in yield caused by trap strips. We believe, as we have stated each year, that the zero till-trap strip combination is also increasing yield by reducing evapotranspiration (i.e., the standing tall stubble strips act as windbreaks during the growing season). In 1984, the latter effect was particularly obvious by comparing stubbled-in wheat on conventionally tilled land vs. wheat grown on zero-tilled land and on zero till-trap strip land in the midst of the drought. Crops in the zero till short stubble treatment remained green for at least two weeks longer than crops grown on conventionally tilled stubble and crops grown on zero till combined with tall stubble strips remained green for a further two weeks. This preservation of the crop during drought could make a large difference in some years when rains are not absent but only late in coming.

SUMMARY AND CONCLUSIONS

The twelve-month period, September, 1983 to August, 1984, was the third driest on record at Swift Current. It was therefore not surprising that wheat grown on stubble on conventionally-tilled land yielded only 4 bu/ac and wheat grown on fallow yielded 17 bu/ac. But, it was promising to note that wheat grown on zero tillage yielded 9 bu/ac, and when zero till was combined with cereal trap strips, yields as high as 13 bu/ac were obtained; i.e., 77% of yield on fallow. The leaves of crops grown on zero-tilled land remained green and turgid for at least two weeks longer than those of crops grown on conventionally-tilled stubble land during the drought. Furthermore, if the stubble trap strips were preserved during cropping, plant survival was prolonged by at least another week.

This study clearly shows that with the adoption of new water efficient management techniques, southern Saskatchewan farmers stand a good chance of intensifying their cropping system without losing their shirts at the same time.