Stubble height effects on microclimate and yield of spring wheat

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## Introduction

- In the semiarid region of the Prairies, direct seeding into standing cereal stubble is gaining popularity.
- What is the effect of the height of the standing stubble on spring wheat when there are no differences among treatments in spring soil water?

## Objective

- To determine the effect of stubble height treatments on the microclimate during the growing season and on the grain yield of spring wheat.

## Methods

- Three stubble treatments - cultivated, short (about 15 cm high), and tall (>30 cm high) - were imposed in the spring on plots that had been tall stubble since the previous harvest. There were no differences between treatments in spring soil water levels. The experiment was designed as a randomized complete block with 3 replicates for grain yield determination using a plot combine; one replicate was used for microclimate measurements.
- Duration of study: 1992, 1993, 1994, 1995. Location of study: SPARC, Swift Current, SK.
- Plot size: 40 x 40 m. Lancer spring wheat seeded with minimal disturbance using a no-till disc drill.
- Microclimate measurements from each treatment: wind speeds and air temperatures at 15 cm and 100 cm above the soil surface, incoming solar energy levels penetrating the stubble to about 7.5 cm above the soil surface, albedo at 2 m above the soil surface, soil temperatures at 5 cm and 30 cm below the soil surface.

## Results

- Microclimate results reported here were collected when the seedlings were small (i.e., before the 3.5-leaf stage).
- However, treatment effects on microclimate were apparent well beyond the time when the crop first grew above the tall stubble.
- The short and tall stubble reduced the daily wind run near the soil surface by about 15% and 70%, respectively, compared to the cultivated stubble (bare soil) (Figure 1).
- Tall stubble reduced the daily wind run at 100 cm above the soil surface by about 10% compared to both the short and cultivated stubble treatments.
- Daytime accumulated air temperatures (heat units) near the soil surface were greater in the tall stubble compared to the short and cultivated stubble. Temperatures at 100 cm above the soil surface were not affected by treatment (Figure 2).
- Air temperatures accumulated during the night were highest at 15 cm and at 100 cm above the soil surface for the cultivated treatment compared to the short and tall stubble

treatments

- Tall stubble reduced solar radiation measured approximately 7.5 cm above the soil surface by 10% compared to the short and cultivated treatments (Figure 3).
- Short and tall stubble treatments increased albedo by about 25% compared to the cultivated treatment (Figure 3).
- Soil temperatures accumulated throughout the entire day (soil heat units) were greater at 5 cm and at 30 cm below the soil surface for the cultivated treatment compared to the short and tall stubble treatments (Figure 4).
- Averaged across years, seeding wheat into tall stubble increased grain yield by about 12% compared to wheat seeded into cultivated stubble (bare soil) (Figure 5).

## Conclusions

- Standing stubble changes the microclimate in which wheat seedlings grow. The changes were dependent upon the height of the stubble.
- Standing stubble increases the grain yield of wheat. There was a tendency for grain yield to increase as stubble height increased.
- Because there were no differences among treatments in spring soil water levels at seeding, nor in the amount of rain received during the growing season, treatment differences in grain yield were a direct result of the effects of stubble height on microclimate.
- Compared to cultivated stubble, we suggest standing stubble reduces potential evaporation by reducing solar radiation and wind speeds near the soil surface; the differences would be more pronounced in the earlier growth stages.

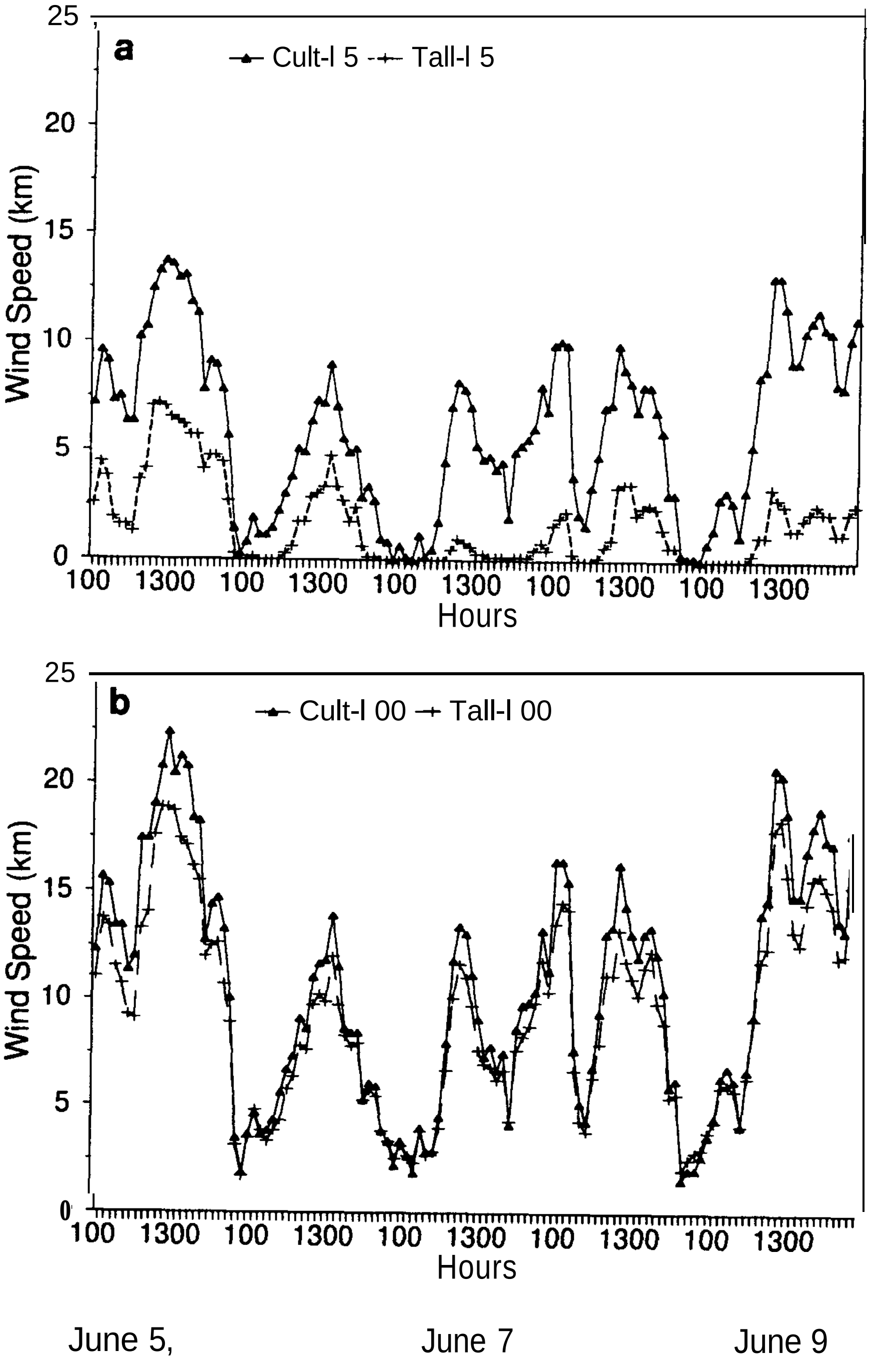


Figure 1: Hourly wind speeds 15 cm (a) and 100 cm (b) above the soil surface for cultivated and tall stubble treatments before the 3.5-leaf stage for Julian days 157 through 161 (June 5 through June 9) in 1992.

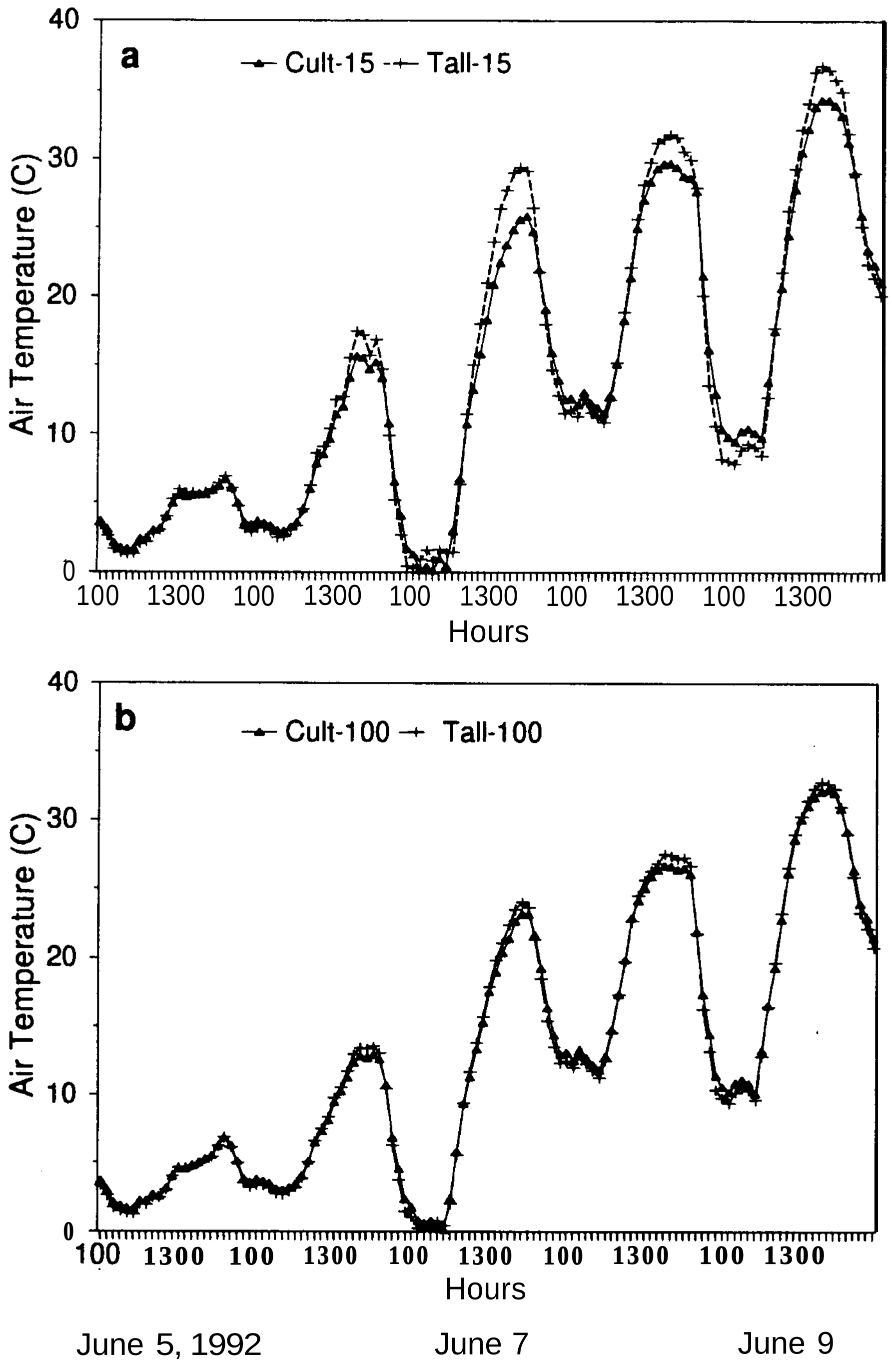


Figure 2: Hourly air temperatures 15 cm (a) and 100 cm (b) above the soil surface for cultivated and tall stubble treatments before the 3.5-leaf stage for Julian days 157 through 161 (June 5 through June 9) in 1992.

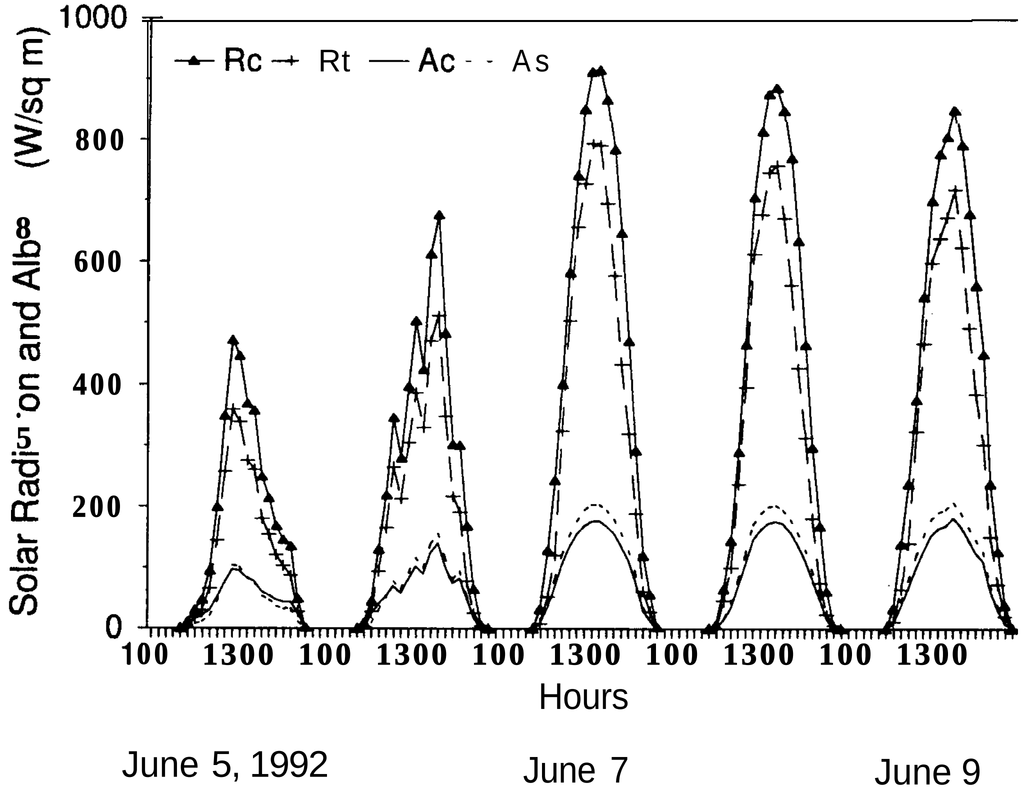


Figure 3: Hourly incoming solar radiation measured about 7.5 cm above the soil surface for cultivated (Rc) and tall stubble (Rt) treatments, and hourly albedo for cultivated (Ac) and short stubble (As) treatments before the 3.5leaf stage for Julian days 157 through 161 (June 5 through June 9) in 1992.

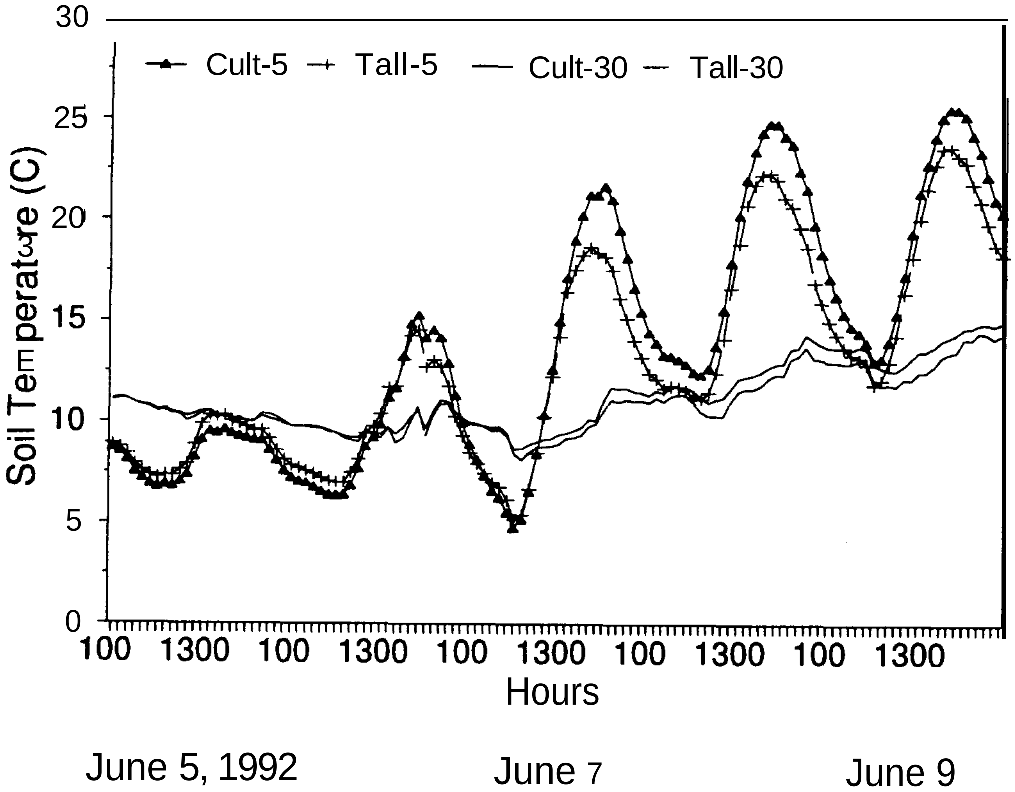


Figure 4: Hourly soil temperatures 5 cm and 30 cm below the soil surface for cultivated and tall stubble treatments before the 3.5-leaf stage for Julian days 157 through 161 (June 5 through June 9) in 1992.

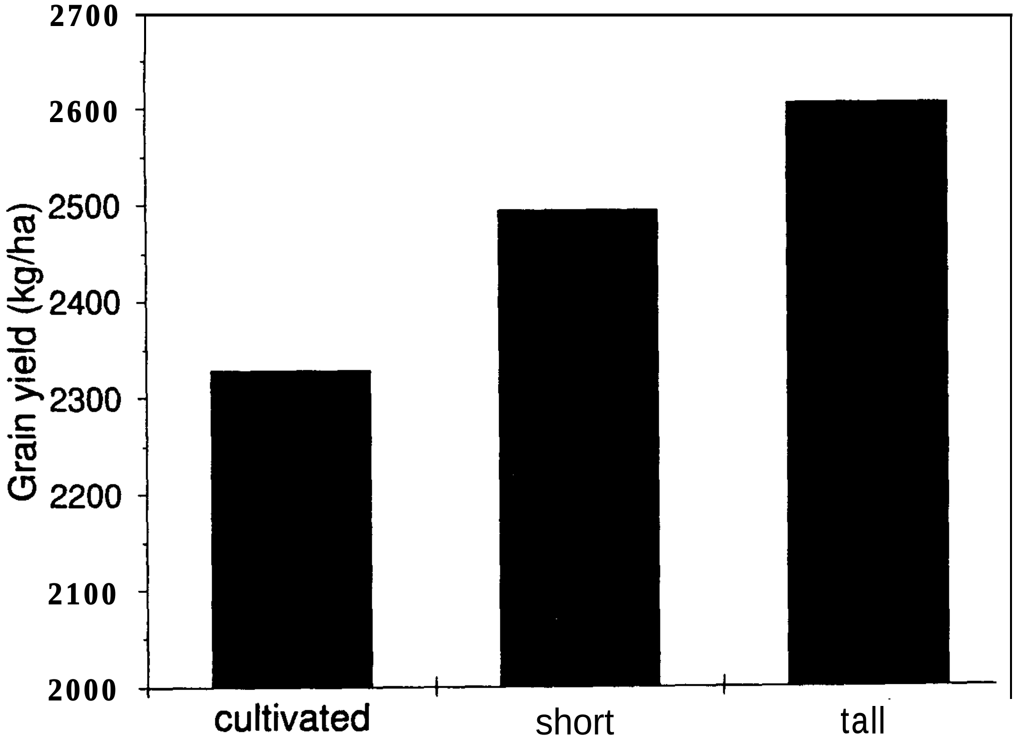


Figure 5: Average grain yields for cultivated, short and tall stubble treatments.