Soil Water Extraction Patterns in Skip Row Corn, Sorghum, and Sunflower

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ABSTRACT

Growing crops in planting configurations that increase row spacing while maintaining field plant populations (skip row) has been proposed as a means to stabilize dryland crop yields under the erratic and sometimes very low precipitation conditions that frequently exist in the Great Plains. Doing so should force plants to undergo increased water stress (and restricted vegetative development) early in the season as higher in-row populations increase competition for soil water near the row. More soil water stored farther away from the row (in the skipped row area) should be available during the more critical reproductive stage compared with conventional 76 cm row spacing, leading to lower water stress during flowering and greater yield. This study compares the soil water extraction patterns and stomatal conductance in skip row corn, sorghum, and sunflower at Akron, CO planted in three row spacing configurations (uniformly spaced 76 cm rows, plant one skip one, and plant two skip two). Results indicated that all three crops were able to extract the stored soil water in the skip (76 and 114 cm from the planted row) resulting in lower water stress in corn (P1S1, P2S2) and sunflower (P2S2) during reproductive and grainfilling growth stages. There was no planting configuration effect on water stress in sorghum. Water extraction 76 and 114 cm away from the planted row in P2S2 declined with distance from the row in corn and sorghum, but not in sunflower. All three crops should be able to use skip row planting configuration to stabilize grain yields in dryland production situations.

Introduction

- Erratic and low growing season precipitation in the Great Plains result in variable and low crop yields
- Skip row planting configurations (skipping one or two rows between planted rows while maintaining plant populations) may force plants to undergo increased water stress during vegetative development while making more soil water available (and lower water stress) during reproductive and grainfilling growth stages

Objectives

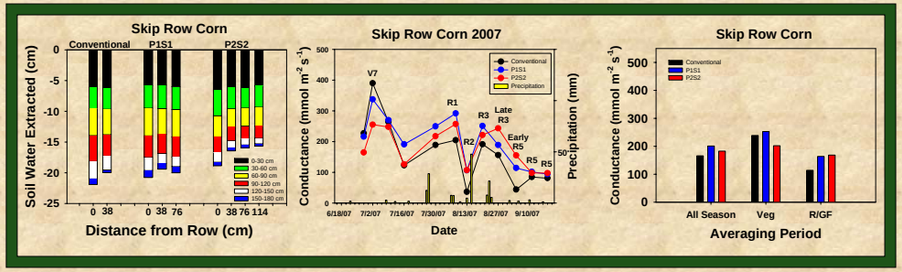
- Determine if soil water in the interrow skip area is extracted by skip row corn, grain sorghum, and sunflower
- Determine if skip row planted crops are under lower water stress during reproductive and grainfilling growth stages than conventionally planted crops (by stomatal conductance measurements)

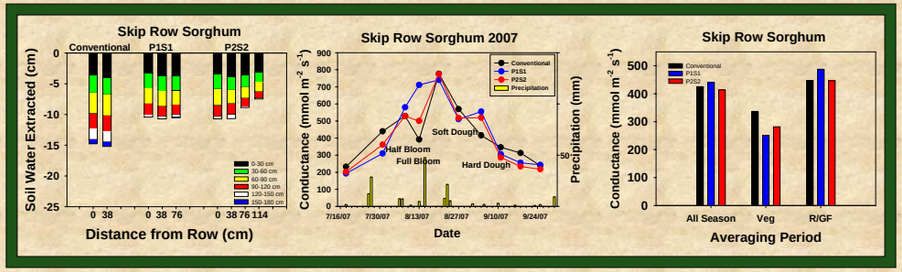
Materials and Methods

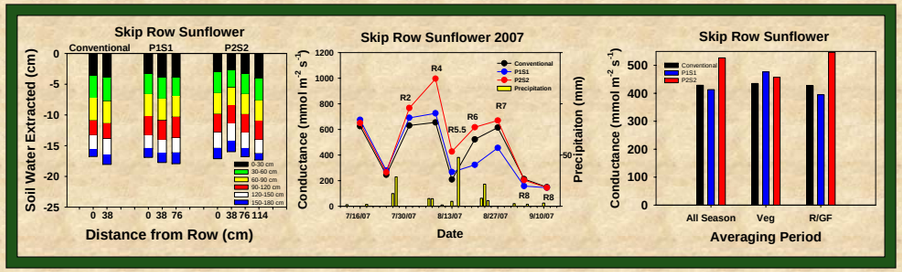
- Location: Akron, CO
- Crops: corn (planted 5/25/07), grain sorghum (planted 6/11/07), sunflower (planted 6/7/07)
- Randomized complete block design with four replications of three planting configurations (conventional 76 cm row spacing, plant one skip one, plant two skip two)
- Soil water measurements at planting and physiological maturity.
- Soil water measurements by neutron probe (0-30, 30-60, 60-90, 90-120, 120-150, 150-180 cm) reported as volumetric water content
- Weekly stomatal conductance measurements (abaxial surface)

Soil water readings by neutron probe in Plant 2 Skip 2 corn

Stomatal conductance measurements in sunflower







- Corn has the capacity to extract water from the skip row area in both P1S1 and P2S2 configurations
- Water extraction in P2S2 declines slightly as distance increases from the row
- Previous year's data (not shown) did not show soil water extraction at 30" or 45" from planted row, so rooting patterns may be variety dependent
- Higher stomatal conductance during reproductive and grainfilling growth stages indicates lower water stress in skip row configurations than in conventional planting

- Sorghum has the capacity to extract water from the skip row area in both P1S1 and P2S2 configurations
- Less soil water extraction by sorghum than by corn
- Lower stomatal conductance in skip row plantings during vegetative development, but no consistent differences in stomatal conductance due to planting configuration during reproductive and grainfilling stages

- Sunflower has the capacity to extract water from the skip row area in both P1S1 and P2S2 configurations
- Water extraction in P2S2 did not decline as distance increased from the row
- More soil water extraction by sunflower than by sorghum
- Higher stomatal conductance during reproductive and early grainfilling growth stages indicates lower water stress in P2S2 configuration than in conventional planting, but not in P1S1
- Lower stomatal conductance during seed filling (R6, R7) in P1S1 than other configurations is anomolous

Discussion

Corn, grain sorghum, and sunflower exhibit the ability to extract soil water from distances as far away as 114 cm from the planted row. This suggests that a cropping strategy of skip row planting can be used to improve or stabilize dryland crop yields when precipitation is limited.

In skip row planting, plant populations are maintained by planting more seeds in the planted row to make up for the rows not planted. This should increase competition for soil water within the row and close to the row during vegetative development, which should result in more early season water stress than in conventionally planted systems with uniform row spacing. That increased early season water stress should limit leaf area development so that demand for water is lower later in the growing season compared with plants grown in conventionally planted systems.

As the plant approaches the critical reproductive/flowering growth stage, roots grow into the skip area and soil water stored there becomes available to the plant, lowering water stress. Yields should therefore be higher in skip row configurations than in conventional uniform row spacing.

The results of this research suggest that all three crops should be able to use skip row planting configuration to alter the water use pattern such that yields are improved. Yield results from previous skip row research have been inconsistent, and may be a function of varietal differences in rooting capacity and variability in timing and amount of precipitation.

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