Deficit Irrigation Affects Wheat (*Triticum aestivum* L.) End-Use Quality

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Introduction

- Deficit irrigation is defined as the application of water below the evapotranspiration (ET) requirements
- It reduces water consumption without losing yield potential and has been widely adopted for cereal production in arid and semi-arid regions
- Yield response to deficit irrigation has been extensively studied with wheat, but few research have evaluated how it affects wheat end-use quality

Objective

- Evaluate effect of deficit irrigation and N fertilization on grain characteristics and end-use quality of common wheat

Materials and Methods

- A field experiment was performed in 2016 at University of Idaho Aberdeen Research and Extension Center with hard white spring wheat (var. "Dayn")
- The experimental design was split plot design with four replications using randomized complete block arrangement
  - ❑ Main plot—Deficit Irrigation
    - ✓ 0, 50, 75, and 100% ETc
    - ✓ Reference ET (ET_0) was retrieved from AgriMet Cooperative Agricultural Weather Network

$$ETc\ (mm) = ET_0 \times Kc$$

- ✓ The Kc represents crop coefficient and was adopted from FAO Irrigation and Drainage Paper No. 56 (FAO-56)

Growth Stage	Kc
Emergence	0.3
Start of tillering	0.3
Early boot	1.1
Mid milk	1.1
Physiological maturity	0.2

- ✓ Water was supplied through a drip irrigation system

Drip irrigation

  - ❑ Sub plot—N rate
    - ✓ 56, 112, 168, and 224 kg N ha^{-1} as urea
    - ✓ Nitrogen was incorporated at seeding
- After harvest, end-use quality (e.g., whole grain and flour protein and loaf volume) was analyzed by Idaho Wheat Quality Laboratory
- Mix model methodology as implemented in SAS GLIMMIX was used to analyze the data

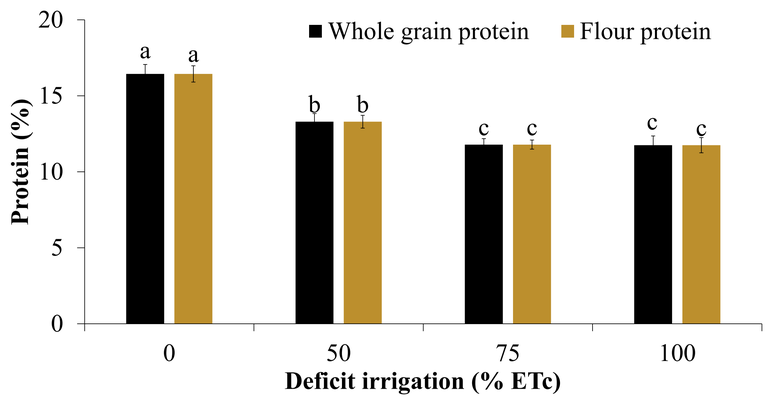
Results and Discussion

Overall analysis

- Most end-use-quality parameters were significantly affected solely by deficit irrigation ($P < 0.05$), rather than N or N × deficit irrigation interaction

Protein

- Flour protein was analyzed on a 12% moisture basis. Higher numbers are preferred for spring hard wheat



- Irrigation significantly decreased protein content relative to the non-irrigated control; however, no difference between 75 and 100% ETc was observed

Milling quality

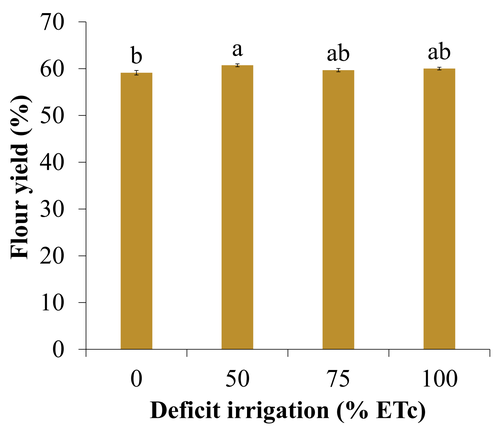
- Grain hardness analyzed by near infrared (NIR) spectroscope was similar among different irrigation treatments
- Break flour yield represents ease of milling, and higher numbers are preferred
- Irrigated wheat showed notably lower break flour yield compared to the control

ETc	Grain hardness	Break flour
%		%
0	78.3 a	31.7 a
50	74.6 a	29.0 b
75	75.3 a	26.3 c
100	75.6 a	27.0 c

- The 75 and 100% ETc was not different in milling quality

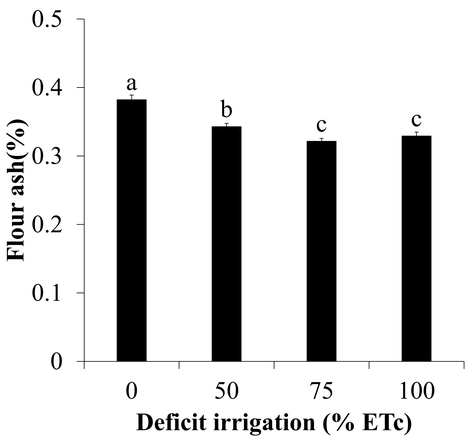
Flour yield

- The 50% ETc treatment produced the greatest amount of flour and was significantly higher than the non-irrigated control
- Flour yield did not significantly differ among the three irrigation rates



Flour ash

- The ash content represents the quantity of bran (outer layer of the kernel of wheat) remaining in the flour after the milling process
- Irrigation notably decreased ash content relative to the non-irrigated control
- There was no significant difference between the 75 and 100% ETc



Rheological dough property

- The rheological dough properties were measured using mixograph

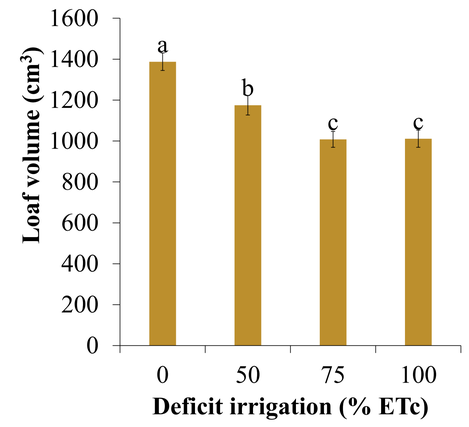
Mixograph	Description
Peak	Time to optimum dough mix
Height	Strength of the dough
Tolerance	Tolerance to over-mixing
Absorption	Percent water added

- Irrigation decreased mixograph peak, height, and absorption relative to non-irrigated control, whereas tolerance to over-mixing was not affected

ETc	Peak	Height	Tolerance	Absorption
%	min	cm		%
0	4.8 a	7.7 a	66.4 a	67.6 a
50	3.6 b	7.0 b	68.9 a	62.0 b
75	2.8 c	6.6 b	65.8 a	58.0 c
100	3.1 c	6.6 b	67.5 a	58.8 c

Loaf volume

- Loaf volume gradually decreased with increasing irrigation rate. No difference was observed between the 75 and 100% Etc treatment



Conclusion

- The 75 and 100% ETc did not differ in most evaluated end-use-quality.
- These results suggest that a lower amount of irrigation water may be used in wheat production without affecting end-use-quality

Acknowledgement

- Thanks to the support of USDA-NIFA Western SARE