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 (ET0) was retrieved from AgriMet Cooperative Agricultural Weather Network
  
  \[
  \text{ETc (mm)} = \text{ET}_0 \times K_c
  \]

- The Kc represents crop coefficient and was adopted from FAO Irrigation and Drainage Paper No. 56 (FAO-56)
- Water was supplied through a drip irrigation system
- 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

  ![Flour protein graph]

- 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) spectroscopy 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
  - 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

Rheological dough property

- The rheological dough properties were measured using mixograph

<table>
<thead>
<tr>
<th>Mixograph</th>
<th>Description</th>
<th>%</th>
<th>min</th>
<th>cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak</td>
<td>Time to optimum dough mix</td>
<td>0</td>
<td>4.8</td>
<td>7.7</td>
</tr>
<tr>
<td>Height</td>
<td>Strength of the dough</td>
<td>50</td>
<td>3.6</td>
<td>7.0</td>
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<tr>
<td>Tolerance</td>
<td>Tolerance to over-mixing</td>
<td>75</td>
<td>2.8</td>
<td>6.6</td>
</tr>
<tr>
<td>Absorption</td>
<td>Percent water added</td>
<td>100</td>
<td>3.1</td>
<td>6.6</td>
</tr>
</tbody>
</table>

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

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