Impact of Soil Aeration on Runoff Characteristics in Dual Purpose No-Till Wheat Systems

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Dual Purpose Wheat Systems (graze and gain)

- 6 million wheat acres managed as dual purpose in Texas, Oklahoma, and New Mexico (Taylor, 2010).

- Southern Great Plains:
  - 5% No-till
  - 80% Conventional Till

- No-till adoption in graze and grain systems lower than grain only systems
Grazing and Compaction

- Grazing can:
  - Increase soil compaction
  - Increase the potential for soil erosion
  - Decrease water infiltration
  - Increase Runoff (71% vs 12% of received precip.)
  - Increase losses of N and P via runoff

- Texas High Plains
  - Grazing no-till reduced soil water storage and depressed wheat and sorghum yields.
Questions/Objective

- Does grazing no-till wheat result in increased compaction, decreased infiltration, increased runoff?

- Should long-term no-till wheat be tilled to alleviate compaction concerns?

- Evaluate the impact of tillage, specifically soil aeration, on long-term no-till dual-purpose wheat systems on runoff water quantity and quality.
Materials & Methods

- Smith-Walker Research Unit near Vernon

- Tillage Systems
  - Conventional Till (disking)
  - No-Till
  - Aeration at roller angles of:
    - 0, 5, and 10 degrees

- Grazing System
  - Graze and Grain
  - Graze out
Site History and Grazing

- Clay loam soil
- Converted to no-till wheat in 2001
- Study took place 2009-2011
- Grazing
  - 2009-2010
    - Graze/Grain = Jan 15 to March 1 (11,454 lb ac⁻¹)
    - Graze Out = Jan 15 to April 30 (26,172 lb ac⁻¹)
  - 2010-2011
    - Graze/Grain = Drought, no grazing
    - Graze Out = March 15 to April 30 (54,000 lb ac⁻¹)
Tillage and Rainfall Timing

- Tillage treatments implemented September each year
- Runoff events occurred:
  - Oct 2009 – 6 wks after tillage, 30 N, 10 P 5 wks prior
  - June 2010 – after wheat harvest, midseason N -18 lb
  - Sept 2010 – 20 days after tillage, immediately after N&P (18 lb)
  - June 2011 – after wheat harvest, midseason N -27 lb
Bulk Density (0-4”)

- **Jun 2010**
  - Graze Out: 1.3 g cm$^{-3}$
  - Graze/Grain: 1.5 g cm$^{-3}$

- **June 2011**
  - Graze Out: 1.7 g cm$^{-3}$
  - Graze/Grain: 1.6 g cm$^{-3}$
Date of simulated rainfall

Runoff volume (L)

---|---|---|---
Graze out | | | |
Graze/Grain | | | |

Date of simulated rainfall

Runoff volume (L)
Date of simulated rainfall

NO\textsubscript{3} (mg L\textsuperscript{-1})

0% Roller angle
5% Roller angle
10% Roller angle
No tillage
Conventional tillage

Date of simulated rainfall

<table>
<thead>
<tr>
<th>Date</th>
<th>NO\textsubscript{3} (mg L\textsuperscript{-1})</th>
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<tr>
<td>Oct 2009</td>
<td>0.0</td>
</tr>
<tr>
<td>Jun 2010</td>
<td>0.5</td>
</tr>
<tr>
<td>Sep 2010</td>
<td>1.5</td>
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<tr>
<td>June 2011</td>
<td>2.0</td>
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</tbody>
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**Diagram**

- **Y-axis**: NO\textsubscript{3} (mg L\textsuperscript{-1})
- **X-axis**: Date of simulated rainfall
- **Legend**:
  - Graze out
  - Graze/Grain

The diagram shows the variation in NO\textsubscript{3} concentration over different dates of simulated rainfall, with notable spikes in September 2010.
Conclusions

• Tillage and grazing did not significantly affect bulk density.
• Aeration was most effective in reducing runoff and nutrient losses when storm event occurred within 20 days of implementation, no longer effective at 6 weeks.
• Graze out plots had higher runoff rates, higher nutrient losses, and lower infiltration rates than graze and grain system.
• Overall, tilling of no-till wheat had a short term effect on runoff characteristics and not all tillage treatments improved these characteristics compared to no-till.
• No-till can increase infiltration and withstand the effects of proper grazing intensities compared with mechanical aeration and disking.
• Economic considerations must also be taken into account prior to tilling no-till wheat systems.
Questions?

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