Long-term tillage-rotation-N on crop response and soil health

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Overview

• Long-term rotation trial setup
• corn and soybean yield responses
• Soil health differences
• Red clover vs. corn yield
• Fertilizer N reqts for corn vs. soil health
Ridgetown Long-term Tillage-N-Crop Rotation

- Est. 1995
- 7 Crop Rotations
  - C-C, S-S, C-S, C-S-W, C-S-Wrc, S-W, S-Wrc
- 4 N rates in corn and wheat
- 2 tillage systems
- Technical: Mr. Scott Jay
No-Till Corn 1995-2011
Fall Strip-Till 2012-2014
Impact of diversity on corn yield?
Tillage x Crop Rotation on Corn Yields
Ridgetown 2009-14 using 120 lbs fertilizer N/ac

Note: Mean separation within tillage system (p=0.05)
Impact of crop rotation diversity on soybean yield?
Tillage x Crop Rotation on Soybean Yields
Ridgetown 2009-14

Grain Yield (bu/ac)

Plow

<table>
<thead>
<tr>
<th>Tillage</th>
<th>Crop Rotation</th>
<th>Grain Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-S</td>
<td>S</td>
<td>55.6b</td>
</tr>
<tr>
<td>C-S</td>
<td>S</td>
<td>57.6b</td>
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<tr>
<td>C-S-W</td>
<td>S</td>
<td>67a</td>
</tr>
<tr>
<td>C-S-Wrc</td>
<td>S</td>
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<tr>
<td>S-W</td>
<td>S</td>
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<tr>
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<td>65.7ab</td>
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<tr>
<td>S-S</td>
<td>C</td>
<td>60.3c</td>
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<tr>
<td>C-S</td>
<td>C</td>
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<tr>
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<td>C</td>
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<tr>
<td>C-S-Wrc</td>
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No-Till

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Note: Mean separation within tillage system (p=0.05)
Yield response vs soil health?
Crop rotation effects on CSHA across tillage at Ridgetown in 2009

Van Eerd et al
CJSS(2014)
Tillage effects on CSHA across crop rotations at Ridgetown in 2009

Van Eerd et al CJSS(2014)
Tillage effects on soil organic matter across crop rotations at Ridgetown in 2009

Van Eerd et al CJSS(2014)
Tillage effects on aggregate stability across crop rotations at Ridgetown in 2009

Van Eerd et al. CJSS(2014)
soil health vs. yield stability?
Higher SOC reduces corn yield variability (2002-2006)

Fig. 4  Relationship between the 5-yr. (2002–2006) average corn yield or the standard deviation of corn yield and the average soil organic C (SOC) or total N content (Mg ha\(^{-1}\)) within 5 cm intervals

Congreves et al.  
Plant and Soil (2016)
Impact of underseeded red clover on subsequent corn yields?
Corn Yields after Wheat +/- Red Clover
Ridgetown 2010-13

Grain Yield (bu/ac)

2010 +RC 186
2011 +RC 157
2012 +RC 175
2013 +RC 217
Ave +RC 190a

Fertilizer N applied to all plots @ 180 lbs N/ac
Impact of crop rotation diversity on fertilizer N requirements for corn?
Corn yield response to soil N capacity -- zero fertilizer N –
Ridgetown 2010-2014

Yield (bu/ac)

Tilled

No-Till

C-C 95c 91c 119b 148a
C-S 112c 139b 156a
C-S-W rc

n=16 observations per mean (4 reps x 4 years); MERN >173 lbs N/ac in “+173” values
Mean separation within tillage Fisher’s Protected LSD (0.05)

Gaudin et al.
Agriculture Ecosystems Environment (2015)
No-till + crop rotation reduces N fertilizer requirement

Ridgetown 2010-2013

Maximum Economic Rates of N in corn

(Tlbs N/ac)

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<tr>
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<th>C-S-W</th>
<th>C-C</th>
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<tr>
<td>No-Till</td>
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<td>158ab</td>
<td>+173a</td>
<td>139a</td>
<td>112ab</td>
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Mean separation within tillage Fisher’s Protected LSD (0.05)

Gaudin et al.
Agriculture Ecosystems Environment (2015)
Tillage effects on potential mineralized N across crop rotations at Ridgetown in 2009

<table>
<thead>
<tr>
<th>Treatment</th>
<th>mg kg$^{-1}$</th>
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<tbody>
<tr>
<td>MB Plow</td>
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</tr>
<tr>
<td>No-Till</td>
<td>11.1</td>
</tr>
</tbody>
</table>

Van Eerd et al. CJSS(2014)
Crop rotation vs. PMN* across tillage at Ridgetown in 2009

**mg kg⁻¹**

- C-C: 10.4 ab
- C-S: 7.45 b
- S-S: 7.57 b
- S-W: 11.1 a
- C-S-W: 10.3 ab

*potentially mineralizable N

Van Eerd et al CJSS(2014)
Crop rotation take-aways from Ridgetown

- Wheat ^ corn yields +10 bpa
- Wheat ^ soybean yields +5 bpa
- Red clover alone ^ corn yield +6 bpa
- Wheat ^ NUE thereby less reliance on N fert
- Crop responses reflect soil health measures
- Proposed 2018 assessment?
QUESTIONS?

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