Cover Crops and Nitrogen Management

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Why Cover crops?

• Cover crops have been used to enhance the sustainability of cropping systems (Lu et al. 2000)
  – Improving soil quality and health
  – Reducing environmental pollution
    • Soil erosion
    • Nutrient leaching
    • Nutrient runoff, etc.
  – Enhancing nutrient cycling
    • Reducing N losses
Determine how legacy effects of legume and non-legume summer and winter cover crops between wheat and sorghum impact:

- N availability in the cropping system
- Yield response of sorghum to N fertilization
Crop rotation

- Chemical Fallow (CF)
- Double Crop Soybean (DSB)
- Summer non-legume (SL) – sorghum-sudan
- Summer legume (SNL) – forage soybean
- Winter non-legume (WL) – winter canola, radish
- Winter legume (WNL) – winter pea, crimson clover
Material and Methods

N fertilizer management
-0, 40, 80, 120, & 160 lbs N ac\(^{-1}\)
- 28% UAN subsurface banded
-Straight flat-coultter liquid fertilizer applicator
-Following sorghum planting
Cumulative $\text{N}_2\text{O}$ emissions (lbs $\text{N}_2\text{O}$-N ac$^{-1}$)

0.0
0.5
1.0
1.5
2.0
2.5

Cover crop planting
SNL termination
DSB harvest
First frost

Soil nitrate concentration (ppm)

0
20
40
60
80

Chemical fallow
Double-crop soybean
Summer non-legume
Winter non-legume
<table>
<thead>
<tr>
<th>Cover crop</th>
<th>Dry matter (ton ac(^{-1}))</th>
<th>N content (lb ac(^{-1}))</th>
<th>C:N ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer legume</td>
<td>0.6 b(\dagger)</td>
<td>42.3 b</td>
<td>14:1b</td>
</tr>
<tr>
<td>Summer non-legume</td>
<td>2.6 a</td>
<td>60.3 a</td>
<td>39:1a</td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer legume</td>
<td>1.5 b</td>
<td>88.5 a</td>
<td>16:1b</td>
</tr>
<tr>
<td>Summer non-legume</td>
<td>2.7 a</td>
<td>67.3 b</td>
<td>39:1a</td>
</tr>
<tr>
<td>Winter legume</td>
<td>1.3 bc</td>
<td>70.9 b</td>
<td>18:1b</td>
</tr>
<tr>
<td>Winter non-legume</td>
<td>1.1 c</td>
<td>37.7 c</td>
<td>24:1c</td>
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<td>2015</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer legume</td>
<td>3.4 b</td>
<td>256 a</td>
<td>14:1b</td>
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<tr>
<td>Summer non-legume</td>
<td>6.0 a</td>
<td>147 b</td>
<td>45:1a</td>
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<tr>
<td>Winter legume</td>
<td>1.3 c</td>
<td>73.5 c</td>
<td>17:1b</td>
</tr>
<tr>
<td>Winter non-legume</td>
<td>0.7 c</td>
<td>28.7 c</td>
<td>17:1b</td>
</tr>
</tbody>
</table>
Sorghum Response to Cover Crops
(8-year average, 2009 to 2016)

\[ y = -0.0017x^2 + 0.4731x + 82.54 \]

 Nitrogen fertilizer (lb/a)  Yield (bu/a)  L.S.D. (0.05)

- Chemical Fallow
- Double-crop Soybean
- Summer Legume
- Summer Non-legume
- Winter Legume
- Winter Non-legume

Both DSB and SL

Knowledge for Life
### N Fertilizer Replacement Value

<table>
<thead>
<tr>
<th>Cover crop treatment</th>
<th>Mean grain yield at 0 N rate (bu ac(^{-1}))</th>
<th>Fertilizer N equivalent value (lb N ac(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical fallow</td>
<td>88 b</td>
<td>-</td>
</tr>
<tr>
<td>Double-crop soybean</td>
<td>91 b</td>
<td>8</td>
</tr>
<tr>
<td>Summer legume</td>
<td>100 a</td>
<td>30</td>
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<tr>
<td>Summer non-legume</td>
<td>64 c</td>
<td>-45</td>
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<tr>
<td>Winter legume</td>
<td>87 b</td>
<td>-1</td>
</tr>
<tr>
<td>Winter non-legume</td>
<td>87 b</td>
<td>-3</td>
</tr>
</tbody>
</table>

- Regression equation of grain yield for chemical fallow as a function of N fertilizer rate
- Solved the equation substituting the mean grain yield at 0-N for each cover crop treatment
Management Implications

• Cover crop selection and N management will impact sorghum productivity
  – Potential to replace a portion of cash crop N requirement with summer legume cover crops
    • 30 lbs N/acre contributed by late maturing soybeans
  – High C:N ratio cover crop such as sorghum-sudangrass, will required additional N input
Management Implications

• Although no significant improvement on N supply with winter cover crops, there may be other potential benefits
  – Reducing potential N losses

• Optimum N rate for sorghum (8-yr avg):
  – SNL: ~ 120 lbs N ac⁻¹
  – Other cover crops and DSB: ~ 80 lbs N ac⁻¹