Cover Crops and Crop Nutrients

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With input from Peter Tomlinson

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

Cover crops and nutrients

• Grow it: Legumes fix atmospheric N
• Bring it: On sandy soils especially, any cover crop can be used to scavenge N and keep it from leaching from the soil profile
• Keep it: Cover crops slow runoff, so this deters sediment-bound nutrients from leaving the field as easily
• Speed it: Will a healthier soil (more microbes, more diversity) lead to more rapid nutrient cycling?
Objective

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

Cover crop | Dry matter (ton ac\(^{-1}\)) | N content (lb ac\(^{-1}\)) | C:N ratio
---|---|---|---
| | | | 2013
Summer legume | 0.6 \(b\) | 42.3 \(b\) | 14:1\(b\)
Summer non-legume | 2.6 \(a\) | 60.3 \(a\) | 39:1\(a\)
| | | | 2014
Summer legume | 1.5 \(b\) | 88.5 \(a\) | 16:1\(b\)
Summer non-legume | 2.7 \(a\) | 67.3 \(b\) | 39:1\(a\)
Winter legume | 1.3 \(bc\) | 70.9 \(b\) | 18:1\(b\)
Winter non-legume | 1.1 \(c\) | 37.7 \(c\) | 24:1\(c\)
| | | | 2015
Summer legume | 3.4 \(b\) | 256 \(a\) | 14:1\(b\)
Summer non-legume | 6.0 \(a\) | 147 \(b\) | 45:1\(a\)
Winter legume | 1.3 \(c\) | 73.5 \(c\) | 17:1\(b\)
Winter non-legume | 0.7 \(c\) | 28.7 \(c\) | 17:1\(b\)

Sorghum Planting and Fertility

N fertilizer management
-0, 40, 80, 120, & 160 lbs N ac\(^{-1}\)
- 28% UAN subsurface banded
-Straight flat-coulter liquid fertilizer applicator
-Following sorghum planting
Soil total C (g kg⁻¹)

Nitrogen Response

Sorghum Response to Cover Crops
(8-year average, 2009 to 2016)

2012 Sorghum Response to Cover Crops

Grain yield (lb ac⁻¹)
N Fertilizer Replacement Value

<table>
<thead>
<tr>
<th>Cover crop treatment</th>
<th>Mean grain yield at 0 N rate (bu/ac)</th>
<th>Fertilizer N equivalent credit (lb N/ac)</th>
<th>Fertilizer N value @ $0.33/lb N ($/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical fallow</td>
<td>88 b</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Double-crop soybean</td>
<td>91 b</td>
<td>8 b</td>
<td>2.64</td>
</tr>
<tr>
<td>Summer legume</td>
<td>100 a</td>
<td>30 a</td>
<td>9.90</td>
</tr>
<tr>
<td>Summer non-legume</td>
<td>64 c</td>
<td>-45 c</td>
<td>-14.85</td>
</tr>
<tr>
<td>Winter legume</td>
<td>87 b</td>
<td>-1 b</td>
<td>-0.33</td>
</tr>
<tr>
<td>Winter non-legume</td>
<td>87 b</td>
<td>-3 b</td>
<td>-0.99</td>
</tr>
</tbody>
</table>

1Means with different letters within columns are significantly different (LSD=0.05)

- 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/ac contributed by late maturing soybeans
  - High C:N ratio cover crop such as sorghum-sudangrass, will required additional N input.

What are your main reasons for planting cover crops?

- To fix nitrogen
- To be more sustainable (such as less erosion, store carbon in soil, etc.)
- For grazing
- Weed control
- More than one of these reasons

K-State Research and Extension
Management Implications

- Although no significant improvement on N supply with winter cover crops, there may be other potential benefits.
  - Reduce potential N losses

- N rate to optimize sorghum yields (8-yr avg) after:
  - SNL: ~ 120 lbs N ac⁻¹
  - Other cover crops and DSB: ~ 80 lbs N ac⁻¹

EFFECTS OF LATE-MATURING SOYBEAN AND SUNN HEMP SUMMER COVER CROPS AND NITROGEN RATE IN A NO-TILL WHEAT-GRAIN SORGHUM ROTATION

https://newprairiepress.org/cgi/viewcontent.cgi?article=3381&context=kaesrr

Cover crops at Hesston

- From mid 1990’s to 2009, much research on legume cover crops done at Hesston Experiment Field by Dr. Mark Claassen
- Grew wheat-sorghum, with cover crops in between
- For 8 years he used hairy vetch, but changed because of cost, availability of seed, interference with control of volunteer wheat and winter annual weeds, and possibility of hairy vetch becoming a weed in wheat after sorghum
- Benefit of hairy vetch was large amounts of dry matter that produced 100 lbs of N

Hesston cover crops

- Wheat-no cover-sorghum
- Wheat-late soybeans as a cover-sorghum
- Wheat-sunn hemp as a cover-sorghum
- Soybean produced 3.68 ton/ac dry matter with N content of 2.64% or 195 lb/ac N
- Sunn hemp produced 4.13 ton/ac dry matter with N content of 1.78% or 146 lb/ac N
- Both provided 91-100% weed control
N rates

- There was also an N rate component of this study, with 0, 30, 60, and 90 lb N/ac applied to the grain sorghum.
- Late-maturing soybean increased grain sorghum yields at N rates of 60 lb/a or less, but generally had no yield benefit vs. no cover crop when N rate increased to 90 lb/a.
- Sunn hemp tended to increase yields of sorghum at all N rates, although to a lesser extent at the highest N level. When averaged over N rate, the 25 Harvey County Experiment Field long-term grain sorghum yield benefits from late-maturing soybean and sunn hemp amounted to 8.8 and 14.9 bu/a, respectively.

So does it pay?

- Does the N contribution of the cover crop save you from applying some N, and does that outweigh the cost of the cover crop seed?
- Depends on the cost of the cover crop seed and the price of N.
- And what’s available.
- And cost-share programs for planting cover crops.
- And other programs such as carbon markets which reward planting cover crops.
How many lbs of N do you think you have fixed with cover crops on your farm?

- 0
- 1-10 lbs per acre
- 11-25 lbs per acre
- 26-50 lbs per acre
- More than 50 lbs per acre
- I'm not really sure
N from legume cover crops

- 4: Cowpeas: 10-80 lbs
- 4: Sunn hemp: 20-120 lbs N
- 4: Sweetclover: 5-50 lbs N
- 4: Hairy vetch: 5-100 lbs N

N from legume cover crops

- 3: Mung beans: 10-80 lbs N
- 3: Red clover: 5-100 lbs N
- 3: Spring field pea: 5-50 lbs N
- 3: Winter pea: 5-60 lbs N
- 3: Soybeans: 10-75 lbs N
- 3: Chickling vetch: 5-50 lbs N
- 3: Common vetch: 5-50 lbs N

N from legume cover crops

- 2: Crimson clover: 5-70 lbs N
- 2: Guar: 2-120 lbs N
- 2: Spring lentils: 5-20 lbs N
- 2: Winter lentils: 5-20 lbs N

N release

- Decomposition of cover crops and nutrient release is still actively being researched
Sensors and decomp bags

Decomposition and N-release

- Clip cover crops right before we spray them out
- Stuff a known amount into the bag, stake them to the ground
- Pick them up every 2-4 weeks
- Samples are being analyzed for C, N, ash, etc. and along with the mass and the soil temperature and moisture data, will be used in the development/refinement of nutrient availability models

Please type in your favorite cover crops that you have used

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