Cover Crops and Crop Nutrients

DeAnn Presley
Soil Management Extension Specialist
deann@ksu.edu

With input from Peter Tomlinson
How many years have you planted cover crops?

- 0
- 1-5
- 6-10
- 11 or more years
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?
Crop rotation

- Chemical Fallow (CF)
- Double Crop Soybean (DSB)
- Summer non-legume (SL) – sorghum-sudan
- Summer legume (SNL) – forage soybean
- Winter non-legume (WL) – radish
- Winter legume (WNL) – crimson clover
<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>
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<td>39:1a</td>
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<tr>
<td>Winter legume</td>
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<td>70.9 b</td>
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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
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\(^{-1}\))

Soil depth (cm)

Soil total C (g kg\(^{-1}\))
Nitrogen Response
Sorghum Response to Cover Crops

(8-year average, 2009 to 2016)

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

L.S.D. (0.05)

Both DSB and SL

Yield (bu/a) vs. Nitrogen fertilizer (lb/a)
2012 Sorghum Response to Cover Crops

Grain yield (lb ac$^{-1}$)

- CF
- DSB
- SL
- SNL
- WL
- WNL

2012
### 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>
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1 Means 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
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</table>

1. Means 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
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
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.
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
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.
### Table 1. Effects of soybean and sunn hemp summer cover crops and nitrogen rate on no-till grain sorghum after wheat, Hesston, KS, 2009

<table>
<thead>
<tr>
<th>Cover crop¹</th>
<th>N Rate² (lb/a)</th>
<th>Forage N (ton/a)</th>
<th>Cover crop yield³ (bu/a)</th>
<th>Yield⁴ (lb/bu)</th>
<th>Test weight (1,000 s/a)</th>
<th>Stand (days)</th>
<th>Half-bloom⁵ (days)</th>
<th>Heads/plant</th>
<th>Leaf N⁶ (%)</th>
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</table>

LSD (0.05): 0.91, 45, 12.8, 1.0, 1.4, 1.9, 0.14, 0.22

**Means:**

- **Cover crop**
  - None: 100.4, 83.7, 56.4, 34.4, 61, 1.31, 2.42
  - Soybean: 3.68, 195, 117.0, 92.5, 57.1, 35.7, 60, 1.40, 2.49
  - Sunn hemp: 4.13, 146, 115.7, 98.6, 57.0, 36.0, 60, 1.35, 2.48
  - LSD (0.05): 0.46, 23, 6.4, 0.5, 0.7, 0.9, 0.07, NS

- **N rate**
  - 0: 4.10, 174, 100.6, 77.4, 56.5, 35.4, 61, 1.27, 2.30
  - 30: 3.70, 173, 112.2, 89.2, 56.9, 35.6, 61, 1.33, 2.51
  - 60: 3.92, 176, 115.3, 99.0, 57.0, 35.3, 61, 1.37, 2.45
  - 90: 3.91, 159, 116.0, 100.7, 56.9, 35.2, 60, 1.45, 2.59
  - LSD (0.05): NS, NS, 7.4, NS, NS, NS, 0.08, 0.13
Table 2. Residual effects of soybean and sunn hemp summer cover crops and nitrogen rate on no-till wheat after grain sorghum, Hesston, KS, 2009

<table>
<thead>
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<th>Cover crop¹</th>
<th>N rate²</th>
<th>Forage N</th>
<th>Forage N</th>
<th>Cover crop yield³</th>
<th>Sorghum yield 2008</th>
<th>Yield⁴</th>
<th>5-year avg</th>
<th>Test weight</th>
<th>Plant height</th>
<th>Plant N⁵</th>
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<tr>
<td></td>
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Means:

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<th>Cover crop</th>
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N rate²:

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<td>2.7</td>
<td>36.1</td>
<td>NS</td>
<td>1</td>
<td>0.10</td>
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</table>
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
MIDWEST COVER CROPS COUNCIL
SELECTOR TOOL

https://mccc.msu.edu/
Cover Crop Decision Tool

Start with where is your farm?
- Kansas
- Ellsworth

Tell us your goals
- Nitrogen Source

Add Goal

Show current cash crop options
Show drainage options

Cover crop type options
- Display cover crop
- Group cover crops by type

Available Cover Crops

<table>
<thead>
<tr>
<th>Cover Crop</th>
<th>Type</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
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</thead>
<tbody>
<tr>
<td>Clover Red</td>
<td>Legumes</td>
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</tr>
</tbody>
</table>
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
• Decomposition of cover crops and nutrient release is still actively being researched
Sensors and decomp bags
Decomposition and N-release models

- 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
DeAnn Presley
deannt@ksu.edu
Work cell: 785-313-4193
Twitter: @soilsdiva