Introduction

- Double cropping – is the management of planting a second crop immediately after harvest of the first, and includes harvesting two crops from the same field in one year (Nafziger, 2015)
  - Has potential to benefit grain cropping (Martens et al., 2001, 2005)

Green manure cover crops:
- Improve soil properties, add organic matter, addition of N, disrupt disease cycles, weeds, and insects (Fageria, 2007)

Importance of Nitrogen
- In the United States 20% of N supplied to crops is from biological fixation or crop residues (Havlin, 2014)
  - N is most limiting factor in plant production (Ta et al., 1989; Redmon et al., 1995)

Cowpea
- *Vigna unguiculata* L. Walp
- Widely adapted, stress tolerant
- Grown on about 14 million ha in warm regions from Africa, Asia and the Americas with a total of grain harvest of 7 million tons
- More than 100 countries grow cowpea
- Seed yield can vary from 1000 - 4000 kg ha\(^{-1}\)
- Can fix up to 160 kg ha\(^{-1}\) of N in 60 days

Objective

- (1.) Evaluate rye forage yield, as impacted by cowpea green manure cover crop
- (2.) Measure soil N contributions from cowpea in combination with different N fertilizer rates

Methods & Materials

- Experiment located at the Texas A&M AgriLife Research and Extension Center at Overton Texas.
- Duration: 2 full cropping seasons
  - Summer 2014, 2015: green manure (cowpea)
  - Winter forage 2015, 2016: forage (rye)
Methods & Materials

- Split plot design
- Three summer treatments (main plots)
  - Late maturity cowpea, ‘Iron and Clay’; early maturity cowpea, ‘Combine’; summer fallow
- Four N fertilizer rates (sub plots)
  - 0, 34, 67, 101 kg ha⁻¹
- Plot size: 6 x 12 m
- Before planting cowpea inoculated with Bradyrhizobium spp.

Methods & Materials

*2014-2015*
- Cool season forage: ‘Elbon’ rye
  - Planted: October 3
  - Planting Rate: 112.5 kg ha⁻¹
  - Fertilizer Applied: October 31

*2015-2016*
- Cool season forage: ‘Maton’ rye
  - Planted: October 28
  - Planting Rate: 112.5 kg ha⁻¹
  - Fertilizer Applied: December 15, February 26

Methods & Materials

- Soil type: Darco loamy fine sand
- Land Preparation: rototilled, pre-emergent trifluralin
- Fertilization of 0-20-20 applied before cowpea planting
- **Soil Sampling:**
  - Before: May 2014
  - After: May 2016

Methods & Materials

- Data collection on cowpeas:
  - Weekly heights, biomass harvest, and leaf stem separations

Methods & Materials

- Data collection on rye:
  - Heights, biomass harvest and percent cover
Results

N rate by rye biomass for 2015

\[ y = 16.616x + 963.22 \]
\[ R^2 = 0.797 \]

Results

N rate by rye biomass for 2016

\[ y = 14.871x + 338.54 \]
\[ R^2 = 0.9742 \]

Results Soil Differences (2016-2014)

<table>
<thead>
<tr>
<th>Depth</th>
<th>Treatment</th>
<th>Carbon Diffs ppm</th>
<th>Nitrogen Diffs ppm</th>
<th>C:N ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12 cm</td>
<td>COMB</td>
<td>487a</td>
<td>36a</td>
<td>11a</td>
</tr>
<tr>
<td></td>
<td>IAC</td>
<td>228a</td>
<td>25a</td>
<td>13a</td>
</tr>
<tr>
<td></td>
<td>FAL</td>
<td>137a</td>
<td>15a</td>
<td>11a</td>
</tr>
<tr>
<td>12-24 cm</td>
<td>COMB</td>
<td>228a</td>
<td>35a</td>
<td>10a</td>
</tr>
<tr>
<td></td>
<td>IAC</td>
<td>194a</td>
<td>32a</td>
<td>10a</td>
</tr>
<tr>
<td></td>
<td>FAL</td>
<td>97a</td>
<td>41a</td>
<td>9a</td>
</tr>
</tbody>
</table>

Data presented as 2016 values – 2014 values
IAC = ‘Iron and Clay’ cowpea
COMB = ‘Combine’ cowpea
FAL = fallow

Results: 2016 Soil N

<table>
<thead>
<tr>
<th>Depth</th>
<th>Treatment</th>
<th>Nitrogen ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12 cm</td>
<td>IAC</td>
<td>4698a</td>
</tr>
<tr>
<td></td>
<td>COMB</td>
<td>4607a</td>
</tr>
<tr>
<td></td>
<td>FAL</td>
<td>4428a</td>
</tr>
<tr>
<td>12-24 cm</td>
<td>IAC</td>
<td>95a</td>
</tr>
<tr>
<td></td>
<td>COMB</td>
<td>95a</td>
</tr>
<tr>
<td></td>
<td>FAL</td>
<td>95a</td>
</tr>
</tbody>
</table>

IAC = ‘Iron and Clay’ cowpea
COMB = ‘Combine’ cowpea
FAL = fallow

Nitrogen budget

- Inputs: Cowpea + Fertilizer N
- Outputs: Rye

<table>
<thead>
<tr>
<th>2015-2016 double cropping system (kg ha⁻¹)</th>
<th>IAC</th>
<th>IAC</th>
<th>IAC</th>
<th>IAC</th>
<th>COMB</th>
<th>COMB</th>
<th>COMB</th>
<th>COMB</th>
<th>FAL</th>
<th>FAL</th>
<th>FAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil N gains (calculated)</td>
<td>92</td>
<td>26</td>
<td>89</td>
<td>37</td>
<td>127</td>
<td>60</td>
<td>84</td>
<td>70</td>
<td>-11</td>
<td>73</td>
<td>55</td>
</tr>
</tbody>
</table>

Conclusion

- At this location:
  - On this Darco soil no significant impact on soil N from the green manure cowpeas
  - No impact on rye biomass from summer treatment
  - Rye biomass had positive response from N application
  - Soil N slightly raised after 2 years of cropping in all plots except for fallow plots with no fertilizer N added