Nitrogen Fertilizer Needs of Small Grains After Alfalfa

Collin Pound\textsuperscript{1}, Matt Yost\textsuperscript{1}, Earl Creech\textsuperscript{1}, and Grant Cardon\textsuperscript{1}
\textsuperscript{1}Utah State University, Logan, UT, and \textsuperscript{2}Colorado State University, Fort Collins, CO

Jody Gale\textsuperscript{1}, Deric Despain\textsuperscript{1}, Kevin Heaton\textsuperscript{1}, Boyd Kitchen\textsuperscript{1}, Mike Pace\textsuperscript{1}, Steven Price\textsuperscript{1}, Chad Reid\textsuperscript{1}, Matt Palmer\textsuperscript{1}, Mark Nelson\textsuperscript{1}, and Kathleen Russell\textsuperscript{2}
Three main ideas

Return on Investment

Prediction: Good
Alfalfa Nitrogen Credits

1. Alfalfa residue
2. N deposition
3. Soil quality improvements

“N credit”
Alfalfa

Corn

Small Grains
Literature

Lin and Putnam, 2013
Literature

- 2001, Kelling and Speth, Wisconsin - 50 lb N ac\(^{-1}\)
- 1989, Badaruddin and Meyer, North Carolina - 130 lb N ac\(^{-1}\)
- 1987, Bulman and Smith, Eastern Canada - 90 lb N ac\(^{-1}\)
2018

- 18 farms
- 13 forage - Green
- 9 grain - Blue
- Three 2nd year sites
- 15 1st year sites
## Plot design

<table>
<thead>
<tr>
<th>30</th>
<th>120</th>
<th>120</th>
<th>150</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>150</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>90</td>
<td>60</td>
<td>90</td>
<td>30</td>
</tr>
<tr>
<td>120</td>
<td>90</td>
<td>120</td>
<td>150</td>
</tr>
<tr>
<td>0</td>
<td>30</td>
<td>90</td>
<td>60</td>
</tr>
<tr>
<td>150</td>
<td>60</td>
<td>0</td>
<td>30</td>
</tr>
</tbody>
</table>
Soil Sampling
Fertilizer application
Harvest
Forage yield results

Forage yield

Small grain forage yield (tons DM ac\(^{-1}\))

N fertilizer rate (lb N ac\(^{-1}\))

23%
Grain yield results

Grain Yield

Small grain yield (bu DM ac\(^{-1}\))

N fertilizer rate (lb N ac\(^{-1}\))

Farm 1
Farm 2
Farm 3
Farm 4
Farm 5
Farm 6
Farm 7
Farm 13
Farm 18

44%
Application timing
Is split N worth it?

Extra 30 lbs N in fall

Spring fertilizer rate (lb N / acre)

Small grain yield (bu/acre)
Is split N worth it?

Extra 30 lbs N in fall

No Benefit of fall N application

Small grain yield (bu/acre)

Spring fertilizer rate (lb N / acre)

0 30 60 90 120 150 180
Is late N application beneficial?

Grain yield (bu/acre)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Late 60</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

4 Farms
Predicting response to N
Soil nitrate levels (top 12 inch)

Optimum N rate (lb N ac$^{-1}$)

Soil Nitrate in top 12 inch (ppm)

- Grain
- Forage
Soil nitrate levels (top 12 inch)
Leaf Chlorophyll data

Optimum N rate (lb N ac$^{-1}$) vs. Percent difference in SPAD
Leaf Chlorophyll data

Optimum N rate (lb N ac⁻¹)

Percent difference in SPAD

Needed N

65%

No N needed

60 65 70 75 80 85 90 95 100

0 20 40 60 80 100 120 140 160

Grain
Forage

65%
Preliminary Conclusions

1st year Added Nitrogen

Soil Nitrate SPAD
Limited accuracy
Additional analysis

Protein
Next step

- 15 fall sites set up for 2019
- At least 8 spring sites
- 2020
Thank you

Questions?