PULSE CROPS AND NITROGEN CREDITS
MT Pulse Growers, November 29, 2016

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MSU Soil Fertility Extension
N credit from pulse/legumes

- N Credit = Fertilizer N (lb/ac) to back off from a standard recommendation (e.g., lb N/bu of yield goal) when previous crop is a legume (ideally based on late fall to early spring nitrate)

- N benefit = Soil nitrate after pulse
  - soil nitrate after non-pulse
  + N released from pulse residue

- N benefit > N credit. This is important.
What affects amount of N contributed to soil?

- Total yield, i.e., species and year productivity
- High N removed by harvest leaves less in soil, e.g. chickpea harvest removes more N than lentil. Can’t use pulse grain yield to estimate N credit
- Low biomass plants (semi-leafless varieties) contribute less N
- Species differences. In dryland environment, N contributed by field pea > lentil > chickpea
- N contribution is cumulative - increases with increased # of rotations

(Walley et al., 2007)
How should pulses be managed to encourage N-fixation?

- Use granular inoculant
- Adequate P, K, S (and sometimes micros)
- Starter N only if crop shows poor nodulation
- No-till

(van Kessel and Hartley, 2000)
What affects rate that residue N becomes available?

- Slower in no-till than till, e.g., pea residue 43% (NT) vs. 55% (till)
- Faster with higher N and phosphorus (P) concentrations
- Pulse cover crop decomposes faster than pulse residue (Lupwayi et al. 2004, north-central Alberta)

BUT: rapid nutrient release is not necessarily desirable because potential loss from system before uptake by next crop
## Recommended N Credits in Montana

<table>
<thead>
<tr>
<th>Crop</th>
<th>N Credit (lb N/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse grain crop grown 1-2x</td>
<td>~10</td>
</tr>
<tr>
<td>Pulse grain crop grown 3+ times</td>
<td>~20</td>
</tr>
<tr>
<td>Pulse cover crop grown 1-2x</td>
<td>20-30</td>
</tr>
<tr>
<td>Pulse cover crop grown 3+ times</td>
<td>30-50</td>
</tr>
</tbody>
</table>
## Example N rate calculation
(Big Sandy study, Miller and Jones, unpub. data)

<table>
<thead>
<tr>
<th></th>
<th>Fallow</th>
<th>Grain pulse grown 1x</th>
<th>Legume cover crop grown 1x</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WW yield goal (bu/ac)</strong></td>
<td>45</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td><strong>Spring soil N (lb/ac)</strong></td>
<td>80</td>
<td>55</td>
<td>65</td>
</tr>
<tr>
<td><strong>Total soil N recommended (bu/ac x 2.6 lb/bu)</strong></td>
<td>45 x 2.6 = 117</td>
<td>35 x 2.6 = 91</td>
<td>40 x 2.6 = 104</td>
</tr>
<tr>
<td><strong>N credit (lb/ac)</strong></td>
<td>0</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td><strong>Fertilizer N (lb/ac)</strong></td>
<td>117-80-0 = 37</td>
<td>91-55-10 = 26</td>
<td>104-65-25 = 14</td>
</tr>
</tbody>
</table>
Are there situations when should not use a N credit?

2015 net revenue with low protein premiums at Big Sandy

**Sandy loam**
low organic matter (1.4%)

Taking a N credit (lowering avail N) would not increase net revenue

\[ X = \text{recommended MSU N rate for WW (2.6 lb N/bu yield)} \]

Miller & Jones unpub data
How decide whether to take an N credit, and if so, how much given every soil and farm different?

- **Pulse grown 1-2x:**
  Use general recommendation of ~10 lb N/ac for pulse grain and 20-30 lb N/ac for cover crop

- **Track wheat grain protein after pulse:**
  If consistently > 13.2% (spring wheat) or > 12.5% (winter wheat), then should keep taking N credit. Otherwise, likely should not b/c yield is compromised from insufficient N.

See Fertilizer Facts 21 and 34 for more info
Summary

- Manage pulses to encourage N-fixation
- Keep records of late fall to early spring soil tests and subsequent wheat grain protein to develop farm-field specific knowledge of N credits
- Pulse crop benefits don’t happen overnight
For additional information on pulses, cover crops and soil fertility http://landresources.montana.edu/soilfertility