Nitrogen fixation varies between and within pulse crops

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At Swift Current, Saskatchewan, faba beans fixed 60 pounds of nitrogen (N) per acre followed by field pea at almost 50 lbs., chickpea at 46 lbs., lentil at 44 lbs., and dry bean lagging behind at 8.3 lbs. But there were varietal differences within each pulse crop.

Pulses play a significant role in nitrogen cycling as they fix atmospheric \( \text{N}_2 \) through symbiosis. However, it is unknown whether there are differences in biological nitrogen fixation (BNF) among pulse species and individual varieties.

A total of 25 species/variety combinations of chickpea, dry bean, faba bean, field pea, and lentil were tested in 2008–2010 at Swift Current, Saskatchewan to assess their BNF capabilities. To quantify BNF by pulses, barley (AC Metcalfe) was used as a reference crop.
Treatments included eight market classes of the pulse crops, each with two or three varieties, and one variety of dry bean and faba bean:
- Green pea: CDC Cooper, CDC Striker, and Venture
- Yellow pea: CDC Golden, CDC Handel, and CDC Meadow
- Desi chickpea: CDC Anna, CDC Nika, and CDC Vanguard
- Kabuli chickpea: Amit, CDC Frontier, and CDC Luna
- Large green lentil: CDC Glamis, Laird, and CDC Sedley
- Small green lentil: CDC Meteoor, CDC Richlea, and CDC Viceroy
- Extra small red lentil: CDC Imperial and CDC Robin
- Small red lentil: CDC Blaze, CDC Impact, and CDC Rouleau
- Dry bean: Pintium
- Faba bean: Blitz

The pulse crops were seeded into standing wheat stubble and inoculated with commercial inoculants. All plots received a blanket application of 11-51-0 fertilizer applied with the seed to supply a total of 8.5 lbs. N per acre (9.5 kg N) and 17.8 lbs. P per acre (20 kg P/ha). Soil tests were conducted each year for major nutrients and soil pH. Soil test nitrate N was 37 lbs. in 2008, 8 lbs. in 2009, and 20 lbs. in 2010.

**Nitrogen fixation differences**
There were significant variations among pulse species for the proportion of the crop N derived from atmospheric N\(_2\) (%Ndfa) and the amount of BNF over the years. Among the pulses, faba bean had significantly higher %Ndfa. Field pea, lentil, and chickpea were statistically similar, while dry bean showed the lowest %Ndfa.

<table>
<thead>
<tr>
<th>Pulse Crop</th>
<th>%Ndfa</th>
<th>N fixed (lbs./ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chickpea</td>
<td>51.56</td>
<td>46.0</td>
</tr>
<tr>
<td>Dry Bean</td>
<td>26.31</td>
<td>8.3</td>
</tr>
<tr>
<td>Faba Bean</td>
<td>67.48</td>
<td>60.0</td>
</tr>
<tr>
<td>Field Pea</td>
<td>53.95</td>
<td>48.5</td>
</tr>
<tr>
<td>Lentil</td>
<td>53.53</td>
<td>43.9</td>
</tr>
</tbody>
</table>


The amount of N fixed showed a wide range and the variation was statistically significant in all three years. Dry bean fixed the lowest amount of N over the three years while faba bean fixed the highest
amount. The amount of N fixed by the pulse crops was lower than in previous studies, possibly due to the lower yield under the semi-arid conditions at Swift Current.

The low %Ndfa and N fixed by dry bean supports the finding that they are relatively poor at fixing N and require starter N and fields with moderate N fertility. However a low yield in 2008 dragged down the three-year average. For example, the %Ndfa in 2008 was 0.72% compared to 45.76% in 2010.

**Variety differences**

At the variety level, %Ndfa of chickpea cultivars did not differ significantly. Variation among lentil cultivars was observed, with Laird, CDC Meteor, and CDC Rouleau having the highest %Ndfa, while the lowest was in CDC Sedley (36.45%).

For field pea, significant variation in %Ndfa was observed only in 2009, where all the varieties were superior to CDC Golden. In general, field pea had the most consistent biological nitrogen fixation ability, fixing almost 50 lbs. N per acre with highest seed yield of 36 bushels per acre (2418 kg/ha) across years, suggesting that field pea is more suitable for cultivation in the semi-arid region than other pulses evaluated.

At the variety level, considering biological nitrogen fixation ability and seed yield, the chickpea variety Amit, pea variety CDC Meadow, and lentil variety CDC Meteor were more preferable to other varieties in each of the pulse classes for a semi-arid environment.

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