The net contributions of fixed N by crop legumes in low rainfall farming systems

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Background

Legume crops deliver significant break crop benefits in the Southern Australian low rainfall zone (275 -350 mm)

- Field Pea - Wheat - 2.4 t/ha
- Oats - Wheat - 1.8 t/ha
Aim

To provide low rainfall farmers with local information on productivity and N2 fixation capacity of grain legume crops
Methodology

- Replicated trials comparing a range of break crops undertaken at Mildura (2013 and 2014) and Loxton (2015)
- Each trial located on sandy loam - loam soil type
- Each trial was sown into a moist seedbed in the first week of May
- Growing season rainfall 130 - 145 mm which is less than average (175 mm)
- Peak biomass and N$_2$ fixation was measured for selective treatments within each trial
- Pulse crops represented included: Chickpea, Field Pea, Lentil, Lupin, Faba Bean and Vetch
Grain Legume Productivity

Shoot Dry Matter

Grain Yield
Grain Legume Productivity

### Shoot Dry Matter

- **Chickpea**
- **Field Pea**
- **Lentil**
- **Lupin**
- **Faba bean**
- **Velch**

**Range:** 2 - 5 t/ha

### Grain Yield

- **Chickpea**
- **Field Pea**
- **Lentil**
- **Lupin**
- **Faba bean**
- **Velch**

**Range:** 0.5 - 1.5 t/ha
Shoot N Fixed

- Average of 16.3 kg N/t shoot DM fixed
- Shoot \( N_2 \) fixed by chickpea lower than all other crops
- Percent of shoot N fixed \((\%Ndfa)\) by chickpea was 50% compared to 61-83% for other crops
- Shoot \( N_2 \) fixed by field pea also less than the other crops except chickpea
- Lentil, lupin, faba bean and vetch generally fixed 15 - 20 kg N/t shoot DM
Shoot N Fixed

- Total shoot N fixed by chickpea relatively less than other crops
- Higher production by field pea compensated for low shoot N₂ fixed/t DM
- Variation in total shoot N₂ fixed greater between seasons than between species within a season
Shoot N Fixed

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Net inputs of fixed N

- Total fixed N inputs (shoots + roots) estimated using published root factors
- Grain N removal estimated using grain N percentage from previous trials

<table>
<thead>
<tr>
<th>Soil</th>
<th>Root Factor</th>
<th>Grain N %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chickpea</td>
<td>2.06</td>
<td>3.8</td>
</tr>
<tr>
<td>Field Pea</td>
<td>1.46</td>
<td>4.3</td>
</tr>
<tr>
<td>Lentil</td>
<td>1.48</td>
<td>4.5</td>
</tr>
<tr>
<td>Lupin</td>
<td>1.33</td>
<td>5.6</td>
</tr>
<tr>
<td>Faba Bean</td>
<td>1.52</td>
<td>4.3</td>
</tr>
<tr>
<td>Vetch</td>
<td>1.56</td>
<td>5.0</td>
</tr>
</tbody>
</table>
Net input of fixed N

- The average net input of fixed N was approximately 50 kg/ha.
- 12 out of 15 crop x season combinations contributed agronomically significant (>10 kg/ha) fixed N inputs.
- There is a high probability (95%) of a positive net fixed N input when total fixed N input (shoots and roots) is 39 kg/ha.

![Net input of fixed N graph](https://via.placeholder.com/150)
Conclusions

- Grain legume crops are a viable mechanism to maintain or improve N fertility of cropping soils in low rainfall Mallee farming systems.
- However, based on an average cereal yield of 1.6 t/ha and N removal of 32 kg/ha, a grain legume crop would need to be grown for every 1-2 cereal crops.
- Therefore, further work is required to investigate a wider range of options to be used in conjunction with grain legume crops to maintain a positive N balance including:
  - Legume pastures
  - Forage or manure crops
  - N fertiliser strategies
Thankyou

Grains Research and Development Corporation (GRDC)

South Australian Grains Industry Trust (SAGIT)