TRIAL RESULTS

SOYBEAN

BRAZIL (2015)
TRIAL OBJECTIVE
To evaluate soybean response to MOP and POLY4 in combination with P blends containing S, Ca and Mg under glasshouse and field conditions.

HIGHLIGHTS
8% HIGHER DRY MATTER BIOMASS
UP TO 29% IMPROVEMENT IN NUTRIENT UPTAKE
IMPROVEMENTS IN SOIL NUTRIENT LEGACY FOR K, Mg, Ca AND S
REMOVAL OF SSP IN FAVOUR OF POLY4 OFFERS ECONOMIC ADVANTAGES

TRIAL DESIGN
PARTNER: UNIVERSITY OF SÃO PAULO
LOCATION: BRAZIL
YEAR: 2015

• Soybean production is worth US$38 billion to the Brazilian economy.
• Brazil is the world’s 2nd largest producer of soybeans after the US – accounting for 82Mt of soybean in 2013.
• 15 out of the 26 states grow soybeans covering 27.9 million ha.
• Achieving soybean expansion will require the use of fertilizer.
• Only 30% of farmers are using fertilizer.
• Glasshouse studies used soil filled pots with blends applied before sowing with a simulated furrow application under the seed bed at 100 kg K₂O ha⁻¹.
• The field study conducted in the State of Bahia used a randomised block design with potassium fertilizer applied in advance of P blends.

NUTRIENT APPLIED IN POT STUDY (kg ha⁻¹)

<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>CaO</th>
<th>MgO</th>
<th>S</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial 2:28:0+8S and MOP</td>
<td>10</td>
<td>140</td>
<td>100</td>
<td>107</td>
<td>0</td>
<td>38</td>
<td>80</td>
</tr>
<tr>
<td>POLY4 2:28:6+8S and MOP</td>
<td>10</td>
<td>140</td>
<td>101</td>
<td>75</td>
<td>12</td>
<td>40</td>
<td>64</td>
</tr>
</tbody>
</table>

NUTRIENT APPLIED IN FIELD STUDY (kg ha⁻¹)

<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>CaO</th>
<th>MgO</th>
<th>S</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOP pre-planting + Commercial 2:28:0+7S</td>
<td>4</td>
<td>56</td>
<td>90</td>
<td>43</td>
<td>0</td>
<td>15</td>
<td>72</td>
</tr>
<tr>
<td>POLY4 pre-planting + 2:28:6+7S</td>
<td>4</td>
<td>56</td>
<td>90</td>
<td>123</td>
<td>39</td>
<td>123</td>
<td>19</td>
</tr>
</tbody>
</table>
The POLY4 blend delivers additional potassium, showing an 8% improvement in soybean dry matter.

Soil potassium levels indicate that maintenance is required in the fertilizer plan.

The magnesium and micro-nutrient content in the POLY4 option differentiates it from the commercial option, resulting in improved crop biomass.

Substituting SSP in the commercial blend for POLY4 adds magnesium, supporting balanced fertilization.

These results are indicative of POLY4’s sulphur, magnesium and potassium availability being exploited for crop growth.

Increasing sulphur supply to the plant from POLY4 supports nitrogen fixation, which is essential to soybean growth.

Soil nutrient levels post cropping are the result of inputs minus nutrient offtake and leaching losses.

Plant nutrition use and soil losses are affected by the nutrient source.

In this trial, nutrient offtake was increased and soil nutrient residues were higher following POLY4 application.
**FIELD TRIAL**

**YIELD** (t ha\(^{-1}\))\(^{7-10}\)

Soybean yield (t ha\(^{-1}\))

![Graph showing yield vs application rate](image)

- In Brazil, MOP is applied in advance of soybean emergence to lower the negative impacts of chloride.
- Potassium fertilizer replaces crop offtake at a recommended rate of 88 kg K\(_2\)O ha\(^{-1}\)\(^{11}\).
- Using POLY4 the yields were higher than the current commercial practice.
- Maximum yield of 4.4 t ha\(^{-1}\), currently supported with the commercial option at 120 kg K\(_2\)O ha\(^{-1}\) can be achieved with less K\(_2\)O if the POLY4 option is chosen.
- By substituting SSP with POLY4, as the S source, we support the same yield and improve crop fertilization balance with an additional 17 kg MgO, 21 kg CaO and 38 kg S ha\(^{-1}\).

**POST TRIAL NUTRIENT ANALYSIS** (mg kg\(^{-1}\))\(^{8-10, 12}\)

- Fertilizer plans were balanced for NPK\(^{1}\).
- POLY4 improves soil health by increasing potassium, calcium, magnesium and sulphur across multiple horizons.

**FARMER ECONOMICS** (kg ha\(^{-1}\) and cost in US$)\(^{13, 14, 15}\)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>MOP pre-planting + Commercial 2:28:0+7S</th>
<th>POLY4 pre-planting + 2:28:6+7S</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>P(_2)O(_5)</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>K(_2)O</td>
<td>96</td>
<td>104</td>
</tr>
<tr>
<td>S</td>
<td>17</td>
<td>28</td>
</tr>
</tbody>
</table>

**Blend application**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>MOP pre-planting + Commercial 2:28:0+7S</th>
<th>POLY4 pre-planting + 2:28:6+7S</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>P(_2)O(_5)</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>K(_2)O</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>S</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Total nutrient input**

- MOP: 9% N, 9% P\(_2\)O\(_5\), 32% K\(_2\)O, 50% S
- POLY4: 9% N, 20% P\(_2\)O\(_5\), 71% K\(_2\)O, 3% S

**Total input sources**

- MOP: 9% N, 9% P\(_2\)O\(_5\), 32% K\(_2\)O, 50% S
- POLY4: 9% N, 20% P\(_2\)O\(_5\), 71% K\(_2\)O, 3% S

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1) Forecast by OCED/FAO 2015; 2) Census conducted by Brazilian Institute of Geography and Statistics in 2006; 3) GENSTAT mean results; 4) All pots received 10 kg N ha\(^{-1}\); 140 kg P\(_2\)O\(_5\) ha\(^{-1}\); 100 kg K\(_2\)O ha\(^{-1}\); 5) Commercial blend made with SSP, TSP and MAP with MOP providing 100 kg K\(_2\)O ha\(^{-1}\); 6) POLY4 blend made with POLY4, TSP and MAP with 29 kg K\(_2\)O ha\(^{-1}\) from POLY4 and 71 kg K\(_2\)O ha\(^{-1}\) from additional MOP; 7) GENSTAT regression analysis; 8) All plots received N 4 kg ha\(^{-1}\); 56 kg P\(_2\)O\(_5\) ha\(^{-1}\) and K\(_2\)O ha\(^{-1}\) from MOP or POLY4 according to treatment; 9) Commercial blend made with SSP, TSP and MAP plus MOP providing 100 kg K\(_2\)O ha\(^{-1}\); 10) POLY4 blend made with POLY4, TSP and MAP plus POLY4 at 30 days pre-planting; 11) Based on Bataglia and Mascarenhas (1978) recommended at 4.4 t ha\(^{-1}\) yield x 20 kg K\(_2\)O ha\(^{-1}\); 12) GENSTAT means of 30 – 120 kg K\(_2\)O ha\(^{-1}\); 13) Weight of MOP starter + Blend 2:28:0+7S was 200kg MOP + 200kg blend 2:28:0+7S = 400kg total input; 14) Weight of POLY4 starter + POLY4 blend 2:28:6+7S was 203kg POLY4 + 200kg blend 2:28:6+7S = 403kg; 15) Fertilizer prices based on quoted CRU Brazil prices Q3-2015 TSP (US$375/t), SSP (US$298/t), MAP (US$479/t), MOP (US$317/t), POLY4 price (US$200/t). Initial soil analysis (0 – 10cm) pH 5.5; P 33 mg kg\(^{-1}\), K 98 mg kg\(^{-1}\), Mg 49 mg kg\(^{-1}\), Ca 340 mg kg\(^{-1}\).

**Sources:** FAO 2013, OCED/FAO 2015; Brazilian Institute of Geography and Statistics, 2006; University of São Paulo 2015, USDA 2015, Sirius Minerals 4000-USP-4014-14.

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