Soybean Response to Potassium Fertility and Fertilization in MB

Megan Bourns¹,
Don Flaten¹, John Heard²
and Greg Bartley³

¹Department of Soil Science, University of Manitoba
²Manitoba Agriculture
³Manitoba Pulse and Soybean Growers
Harvested Acres of Major MB Crops

http://www5.statcan.gc.ca/cansim/a47
Annual $K_2O$ Removal in MB

K$_2O$ Removed ('000 tonnes)

Soybeans
Spring Wheat
Canola

http://www5.statcan.gc.ca/cansim/a47
Current Recommendations

• According to the Manitoba Soil Fertility Guide:

<table>
<thead>
<tr>
<th>Ammonium Acetate STK level</th>
<th>Recommendation</th>
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<tbody>
<tr>
<td>&gt;100 ppm</td>
<td>No additional K</td>
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<tr>
<td>50 – 75 ppm</td>
<td>30 lb K$_2$O/ac broadcast &amp; incorporated</td>
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<tr>
<td>&lt;25 ppm</td>
<td>60 lb K$_2$O/ac broadcast &amp; incorporated</td>
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• Thresholds and rates for soybean...
  • Same as those for spring wheat and canola
  • **Lower** than what is recommended in ND, MN and Ontario
Objectives of MB K Fertility Research

1. Determine the frequency of yield response to K fertilizer across a range of soil test K levels and soil types
   • On-farm field scale trials in cooperation with Manitoba Pulse and Soybean Growers

2. Assess the effectiveness of different combinations of K fertilizer rates and placements for increasing soybean seed yields
   • Small plot field trials

3. Investigate the capacity for MB soils to retain applied K in non-exchangeable forms
Objective 1: STK & Frequency of Yield Response

- **19 on-farm trials** (2017 & 2018) in commercial fields with NH$_4$OAc STK values from 52-451 ppm
- 1 combination of spring applied potash rates & placements in replicated strips at each site
  - Either 60 lb K$_2$O/ac banded away from seed or 120 lb K$_2$O/ac broadcast and incorporated
  - Untreated Control
- Yields 17 bu/ac – 49 bu/ac, with lack of moisture being a limiting factor at most sites
Relative Yield (control as % of fertilized)
On-farm Trial 2017/18 Relative Yield

P-value = 0.0004
P-value = <0.0001
P-value = 0.0331

Not statistically significant
Statistically significant

- Broadcast & Incorporated
- Banded

Relative Yield (%)
Ammonium Acetate STK
Dry Basis
Objective 2: Effectiveness of K rate & placement

- 7 small plot trials (2017 & 2018) in commercial fields with NH₄OAc STK values from 49 – 117 ppm
- 6 combinations of spring applied potash rates & placements
  - 30 or 60 lb K₂O/ac sidebanded
  - 30, 60 or 120 lb K₂O/ac broadcast and incorporated
  - Control (0 added K)
- Collected a variety of soil & plant data
- Yields averaged 18 bu/ac in 2018, and 29 bu/ac in 2017, with lack of moisture as a yield limiting factor at most sites
Ammonium Acetate STK at Planting

0-6” depth

6-12” depth
Small Plot Trial 2017/18 Relative Yield

Broadcast & Incorporated

Sidebanded

R^2=0.077, P = 0.19

R^2=0.027, P = 0.44

Dry Basis

Dry Basis
Small Plot Trial 2017/18 Relative Yield

- **Broadcast & Incorporated**
  - Relative Yield (%)
  - Ammonium Acetate STK (ppm) Moist Basis
  - $R^2=0.13$, $P = 0.1344$

- **Sidebanded**
  - Relative Yield (%)
  - Ammonium Acetate STK (ppm) Moist Basis
  - $R^2=0.013$, $P = 0.6418$
Conclusions

1. **Frequency of yield response to fertilizer K**
   - **On-farm trials**: 2 of 19 sites had statistically significant positive responses to added K, and one had a significant negative response.
   - No agronomically significant relationship between ammonium acetate STK level and relative yield in the on-farm (or small plot) trials.
   - Frequency of response, and responsiveness at individual sites, not as predicted by NH$_4$OAc STK.

2. **Effectiveness of K fertilizer rate & placement**
   - **Small plot trials**: no statistically significant yield response to any treatment in any site year.
   - Optimum rate & placement of K fertilizer not determined, due to lack of yield response to K fertilizer.
Challenges for measuring response to K fertilizer rate & placement:

1. Moisture was a yield limiting factor (lower than average rainfall in 2017 and 2018 field seasons)
2. Variability within the sites
3. NH$_4$OAc STK was not a reliable indicator for K response
Barley Soybean K Responsiveness Study

Comparison of responsiveness:
Does barley respond to K addition where soybean does not?

- Split plot design:
  - Crop (barley, soybean)
  - Fertilizer (+ 132 kg K$_2$O/ha broadcast & incorporated, 0 K)
- 3 site years (2018)

Barley with no added K (left), barley with 132 kg K$_2$O/ha spring broadcast and incorporated (right)
Barley Soybean K Responsiveness Study

- Barley had a significant yield increase with K addition (~ 20%)
- Soybean did not respond to K addition

Can soybean access more soil K than barley?
More Questions than answers...

1. Are soybeans able to access more soil K than other crops?
   - Barley soybean K responsiveness study
2. Are our soils releasing significantly more K over the growing season than we anticipate with our NH₄OAc spring soil test?
3. Is there yield loss in K deficient patches, and if so, what is the extent of that loss?
4. How do we make K recommendations if the response is unpredictable?
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Contact:
Megan Bourns (@meg_bourns)
bournsm@myumanitoba.ca