How Safe is Your Seed Placed Fertilizer?
A current research update

Warren Ward
Agronomy Specialist SE SK
Canola Council of Canada
Why Talk About Seed Placed Fertilizer?

• 2015 was a year of extremes
  – Early start to planting
  – Conditions variable

• Many challenges in the spring:
Prairie Region
Rainfall: Percent of Normal: Jul 23-29, 2015

Percent of Normal
- 0
- 20
- 40
- 60
- 80
- 100
- 120
- 140
- 160
- 180
- 200
- 220
- 240
- 260
- 280
- 300 +

Locations:
- Fort St John
- Peace River
- Grande Prairie
- Slave Lake
- Cold Lake
- Red Deer
- Medicine Hat
- Swift Current
- Moose Jaw
- Regina
- Calgary
- Brooks
- Lethbridge
- Estevan
- Weyburn
- Meifort
- North Battleford
- Prince Albert
- Saskatoon
- Dauphin
- Brandon
- Winnipeg
- The Pas
- Thompson

Created by: WIN Weather Innovations Consulting LP
Created for: weatherfarm
Recap:

• Dry spring
• Early seeding
  – Poor emergence
  – Many reports of high insect pressure
• Late spring frost
  – Many acres reseeded
• Reseeded crops emerged well
  – Went on to produce much better than expected yields
Can We Compare the Early Seeded to Reseeded?

• The major differences were:
  – Soil temp
  – Seeding depth/moisture
  – Seed placed fertilizer

• Can we quantify which factor(s) were the most problematic???
  – Maybe
Soil Temperature

![Chart showing germination percentage over days at different soil temperatures (2C, 3C, 4C, 6C, 8C).]
Seeding Depth and Moisture

• When reseeded (early June):
  – Moisture conditions were not much better
    • Maybe worse, maybe the same
  – Some fields were seeded deeper
    • To try and get into moisture
  – Let’s call this “similar” to early seeding conditions
    • We are making a few assumptions
Seed Placed Sulphur

- Ammonium sulphate (20-0-0-24)
- Ammonium thiosulphate (15-0-0-30)
  - High salt index
  - Can lead to ammonia toxicity
    - Affected by fertilizer source, soil pH, CEC, texture, temperature and water and lime (CaCO$_3$) content

- BMP: do not seed place sulphur
Seed Placed Phosphorus – Safe Rate

- 11-52-0 monoammonium phosphate
- 10-34-0 ammonium polyphosphate

<table>
<thead>
<tr>
<th>Crop</th>
<th>Actual $P_2O_5$ (lb/ac.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>50</td>
</tr>
<tr>
<td>Canola</td>
<td>25</td>
</tr>
<tr>
<td>Canaryseed, Pinto bean</td>
<td>30</td>
</tr>
<tr>
<td>Flax, pea, forages (alfalfa, bromegrass)</td>
<td>15</td>
</tr>
<tr>
<td>Faba bean</td>
<td>40</td>
</tr>
<tr>
<td>Lentil, mustard, chickpea</td>
<td>20</td>
</tr>
</tbody>
</table>

11% SBU, good soil moisture

http://www.agriculture.gov.sk.ca
Fertilizer Use

Fertilizer Placement in Canola - % Nutrient Volume

Note: Nutrient volume was calculated from all sources of the nutrient contained in all fertilizer types.
Phosphorus (P$_2$O$_5$) Placement in Canola (% of Volume) – by Province

**Note:** Nutrient volume was calculated from all sources of the nutrient contained in all fertilizer types.

### Fertilizer Types

<table>
<thead>
<tr>
<th>Primary Component</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anhydrous ammonia</td>
<td>82</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Urea</td>
<td>46</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Urea-ammonium-nitrate (UAN) 28%</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Urea-ammonium-nitrate (UAN) 32%</td>
<td>32</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ammonium Nitrate</td>
<td>34</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ammonium Phosphate</td>
<td>10</td>
<td>34</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Monoammonium Phosphate (MAP)</td>
<td>11</td>
<td>52</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Diammonium Phosphate (DAP)</td>
<td>18</td>
<td>46</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Alpine</td>
<td>6</td>
<td>22</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Potash</td>
<td>0</td>
<td>0</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>Liquid Potash</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Ammonium Sulphate</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Ammonium Thiosulphate</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>K Mag</td>
<td>0</td>
<td>0</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Tiger 90</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>90</td>
</tr>
</tbody>
</table>

For each fertilizer type used in either a custom blend or applied as an unblended product, respondents were asked: a) how many acres they applied at each placement, and b) the application rate – either as pounds (gallons) of product/ac or pounds of actual nutrient/ac. Application rates were standardized in pounds of actual nutrient using the concentrations as listed in the adjacent table – click on the A symbol.

The graph illustrates the % of total Phosphorus (P$_2$O$_5$) volume applied in canola that was applied using each placement. Total pounds of actual Phosphorus (P$_2$O$_5$) applied was calculated based on all sources of Phosphorus (P$_2$O$_5$) from all fertilizer types.
### Sulphur Placement in Canola (% of Volume) — by Province

#### Total Market

<table>
<thead>
<tr>
<th>Placement Method</th>
<th>Sulphur Volume (n = 360)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcast; no incorporation</td>
<td>10.2</td>
</tr>
<tr>
<td>Broadcast; followed by incorporation</td>
<td>11.4</td>
</tr>
<tr>
<td>Pre-plant banded</td>
<td>1.4</td>
</tr>
<tr>
<td>Side banded at planting</td>
<td>30.8</td>
</tr>
<tr>
<td>Mid row banded at planting</td>
<td>16.0</td>
</tr>
<tr>
<td>Seed placed</td>
<td>26.6</td>
</tr>
<tr>
<td>In-crop top dressed</td>
<td>3.7</td>
</tr>
</tbody>
</table>

#### Alberta

<table>
<thead>
<tr>
<th>Placement Method</th>
<th>Sulphur Volume (n = 101)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcast; no incorporation</td>
<td>4.9</td>
</tr>
<tr>
<td>Broadcast; followed by incorporation</td>
<td>1.7</td>
</tr>
<tr>
<td>Pre-plant banded</td>
<td>1.9</td>
</tr>
<tr>
<td>Side banded at planting</td>
<td>41.1</td>
</tr>
<tr>
<td>Mid row banded at planting</td>
<td>24.6</td>
</tr>
<tr>
<td>Seed placed</td>
<td>22.9</td>
</tr>
<tr>
<td>In-crop top dressed</td>
<td>3.0</td>
</tr>
</tbody>
</table>

#### Saskatchewan

<table>
<thead>
<tr>
<th>Placement Method</th>
<th>Sulphur Volume (n = 199)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcast; no incorporation</td>
<td>15.0</td>
</tr>
<tr>
<td>Broadcast; followed by incorporation</td>
<td>16.1</td>
</tr>
<tr>
<td>Pre-plant banded</td>
<td>0.8</td>
</tr>
<tr>
<td>Side banded at planting</td>
<td>29.9</td>
</tr>
<tr>
<td>Mid row banded at planting</td>
<td>11.3</td>
</tr>
<tr>
<td>Seed placed</td>
<td>23.3</td>
</tr>
<tr>
<td>In-crop top dressed</td>
<td>3.6</td>
</tr>
</tbody>
</table>

#### Manitoba

<table>
<thead>
<tr>
<th>Placement Method</th>
<th>Sulphur Volume (n = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcast; no incorporation</td>
<td>3.3</td>
</tr>
<tr>
<td>Broadcast; followed by incorporation</td>
<td>14.0</td>
</tr>
<tr>
<td>Pre-plant banded</td>
<td>2.4</td>
</tr>
<tr>
<td>Side banded at planting</td>
<td>12.4</td>
</tr>
<tr>
<td>Mid row banded at planting</td>
<td>15.4</td>
</tr>
<tr>
<td>Seed placed</td>
<td>46.6</td>
</tr>
<tr>
<td>In-crop top dressed</td>
<td>5.8</td>
</tr>
</tbody>
</table>

#### Note

- Nutrient volume was calculated from all sources of the nutrient contained in all fertilizer types.
- Significantly higher than Total Market (90% confidence).
- Significantly lower than Total Market (90% confidence).
So, What Are the Implications?
Maximum Fertilizer Material to Apply with Seed

Select Crop
- Corn
- Soybeans
- Wheat-hard red spring
- Wheat-durum
- Alfalfa
- Barley
- Canola
- Cotton
- Flax
- Leek
- Mustard
- Oats
- Pea
- Safflower
- Sorghum
- Sunflower

Select Fertilizer
- Urea (46-0-0)
- Urea NBP (28-0-0)
- Ammonium nitrate (34-0-0)
- DAP (18-46-0)
- TSP (0-46-0)
- 10-54-0
- 10-21-1
- 3-18-9
- 4-10-9
- KCL (0-0-60)
- K2SO4 (0-0-46)
- K2S (0-0-50-173)
- Sulfate of Ammonium (12-0-0-265)

Fertilizer Rate (F)
- 25.7 lbs/a with the seed
- 2.8 lbs/a of Nitrogen (N)
- 14.2 lbs/a of Phosphorus (P2O5)
- lbs/a of Potassium (K2O)
- lbs/a of Sulfur (S)
- lbs/a of Mg

Parameters
- 1.0 Soil Moisture & Texture (MX)
- -0.97 Coefficient (C)

Enter Values in Boxes
- Seed Furrow Opening Width (C) 1 inches
- Row Spacing (R) 12 inches
- Tolerated Stand Loss (T) 10%

Equation: F = 30S(-T)/CRMX
Where:
F = fertilizer material in lb/a
S = seed furrow opening width in inches
T = is the tolerated stand loss, as a percent, due to fertilizer applied with the seed over typical stands - no fertilizer is applied.
C = negative regression coefficient for the selected crop x fertilizer (1/ lbs a^-1)
R = row spacing in inches
MX = planting soil moisture and soil texture coefficient.

Yellow Boxes are Calculated

Values should match "Enter Values in Boxes" entries

Press: Seed Furrow Width & Stand Definitions

Press: Fit Program to Screen
Maximum Fertilizer Material to Apply with Seed

Select Crop
- Corn
- Soybean
- Wheat-hard red spring
- Wheat-durum
- Alfalfa
- Barley
- Canola
- Cotton
- Flex
- Lentil
- Mustard
- Onions
- Peas
- Safflower
- Sorghum
- Sunflower

Select Fertilizer
- Urea [46 - 0 - 0]
- urea NEPT
- 28-0-0
- Ammonium nitrate (34 - 0 - 0)
- DAP (18 - 46 - 0)
- MAP (11-55-0)
- TSP (0 - 46 - 0)
- 10-34-0
- T-21-7
- 9-18-9
- 3-18-18
- 4-10-10
- KCL (0 - 0 - 60)
- KSMg (0-0-22-228-11Mg)
- K Sulfate (0-0-50-17S)
- ATS [12-0-0-26S]

Fertilizer Rate (F)
- 12.9 lbs/a with the seed
- Yellow Boxes are Calculated
- 1.4 lbs/a of Nitrogen (N)
- 7.1 lbs/a of Phosphorus (P₂O₅)
- 2.0 lbs/a of Potassium (K₂O)
- 0.97 lbs/a of Sulfur (S)
- 0.97 lbs/a of (Mg)

Parameters
- Soil Moisture & Texture (MX)
- Coefficient (C)
- 2.0
- 0.97

Enter Values in Boxes
- Seed Furrow Opening Width (S) 1 inches
- Row Spacing (R) 12 inches
- Tolerated Stand Loss (T) 10 %

Equation: F = 30S(-T)/CRAIN

Where:
- F = fertilizer material in lb/a
- S = seed furrow opening width in inches
- T = is the tolerated stand loss, as a percent, due to fertilizer applied with the seed over typical stands - where no fertilizer is applied.
- C = negative regression coefficient for the selected crop x fertilizer. (lb/a-1)
- R = row spacing in inches
- MX = planting soil moisture and soil texture coefficient.

Select: Soil Texture
- Moist
- Borderline
- Dry

Values should match “Enter Values in Boxes” entries

Press: Seed Furrow Width & Stand Definitions
Press: Fit Program to Screen
What Does Recent Research Show???

• 0, 20, 40 kg P$_2$O$_5$/ha
  – 11-52-0, coated 11-51-0, 10-34-0

• 0, 9, 18 kg S/ha
  – 20-0-0-24, 15-0-0-20, 0-0-0-90 (Vitasul)

• Microessentials S15
  – 20 kg P$_2$O$_5$/ha + 9 kg S/ha
  – 40 kg P$_2$O$_5$/ha + 18 kg S/ha

Treatments used by Grenkow et al.
Results

- AS or MAP alone didn’t reduce plant stand most years

- P + S increased the frequency of stand reduction
  - High rates of AS most damaging

- MES15, Vitasul, coated MAP less toxic than conventional equivalents
  - Not as consistent as MAP for increasing yield
Results Cont’d

• High MAP + low AS = greatest yield increase

• High Map + high AS = greatest stand reduction (not the highest yield)

• Coated MAP, MES15 and Vitasul yield response may be more variable
  • Availability
    – Somewhat safer

• Liquid forms had a greater chance of reducing stand
Why is Stand Reduction Important?
General Response of Canola Yield to Plant Population

Need about 5 plants/ft² have a chance at achieving full yield potential

% Yield

plants per square foot

≈25%

10%
Landscape Position Effects – Grenkow et al

- AS has a high salt index and risk of ammonia toxicity, especially on calcareous soils (i.e. eroded knolls)
  - AS has a greater potential to reduced plant stands than MAP
- Risk of seedling damage greater on hilltop soils because:
  - Increased NH3 formation from AS on exposed, high lime (CaCO3) sub-soils
  - Greater salt toxicity because of lower water content
- Seedling emergence with seed-placed AS can be improved by applying a low rate of MAP with AS on calcareous soils (20 kg P₂O₅/ha)
Conclusion

• Adequate fertilizer rates increase yield
  – High seed placed rates can reduce stand and yield

• AS in the seed row can be more harmful than MAP
  – Ideally place it away from the seed
  – Use the safest product that will achieve yield targets

• Follow recommended safe rates!
  – Remember to reduce rates based on conditions
What Did 2015 Teach Us?

- Need to reduce seed placed fertilizer rates when:
  - Cold
  - Dry

- Ideally wait for soil conditions to improve

- Don’t change entire seeding practice
  - Follow recommendations
  - Manage the variables
  - Every year can/will be different
Where to get your information?

• Sign up for Canola Watch