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Soybean Issues: Manganese and IDC

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Manganese

- Reports from Purdue and Kansas
- Work in Southern Illinois
- Questions about Mn in glyphosate tolerant soybean varieties.
  - Glyphosate flash.
  - Mn uptake but the plant does not utilize it.
Soybean root exudates have changed with glyphosate tolerance gene.

- Reduced solubilize soil Mn

Retards Mn metabolism in the plant.
Mn in plant

- Involved in photosynthesis
- A cofactor in many plant reactions
  - Activates about 35 different enzymes in plant.
  - Nitrogen metabolism in plant
Mn and Fe Deficiencies

Mn

Fe (IDC)
http://extension.missouri.edu/explore/agguides/pests/ipm1007modeamino.htm
Purdue work (Huber)
Root uptake (%)

Glyphosate at 2.5% of recommended rate.

Fe Mn Zn

Control
+Glyphosate
Purdue work (Huber)
Translocation to shoot (%)

Glyphosate at 2.5% of recommended rate.
Huber conclusions

- Do not use glyphosate as a carrier for micronutrients.
  - Reduction of nutrient uptake
  - Reduction of nutrient utilization
  - Must wait 6 to 8 days after glyphosate application for plant uptake to occur.

- Reduced herbicide efficacy particularly with Zn products.
Kansas work (Gordon)

- Soybean
- High yielding situation
  - Irrigated
  - Neutral soil pH (6.9)
  - Crete silt loam soil
  - Soil applied Mn 0, 2.5, 5, and 7.5 lb Mn/A
Kansas work

![Graphs showing the relationship between Mn rate (lb/A) and Soybean grain yield (bu/A) for different varieties and strains.](image-url)
Kansas conclusions

In high yielding conditions (irrigated), the use of Mn reduces the yield decreases of glyphosate tolerant soybean varieties.

Data recently presented at ASA, indicates that Mn has no effect in lower yielding conditions (non-irrigated) in North Central Kansas.
Illinois work

- Three glyphosate tolerant varieties
- Check
- 5 lb/A Mn soil surface applied immediately after planting
- 0.5 lb/A Mn foliar
  - Pre = 3-5 day prior to glyphosate application
  - Post = 10 days after glyphosate application
### Illinois (Ebelhar, Adee, and Hart)

<table>
<thead>
<tr>
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<td>70.8</td>
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Soybean grain yields

---------- bushels per acre ----------
Illinois conclusions

No effect on yield from Mn application.
Minnesota work

**Morris and Lamberton**
- Conventional variety
- Glyphosate tol. Var. – con. Herb. Prog.
- Glyphosate tol. Var. – glyphosate herb. Prog.
- Broadcast rates of Mn 0, 2.5, 5, 7.5, and 10 lb/acre, and 0.5 lb/acre foliar treatment.
Minnesota work

Rochester
- Glyphosate tol. Var. – glyphosate herb. Prog.
- Broadcast rates of Mn 0, 5, and 10 lb/acre, and 0.5 lb/acre foliar treatment.
## Mn, Morris 2007

<table>
<thead>
<tr>
<th>Mn lb/acre</th>
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<th>RU NO</th>
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<th>Mean</th>
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<td>45</td>
<td>40</td>
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<td>5</td>
<td>39</td>
<td>39</td>
<td>51</td>
<td>42</td>
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<td>7.5</td>
<td>39</td>
<td>34</td>
<td>36</td>
<td>36</td>
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<tr>
<td>Mean</td>
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## Mn, Lamberton 2007

<table>
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</tr>
<tr>
<td>7.5</td>
<td>51</td>
<td>46</td>
<td>51</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
<td>47</td>
<td>47</td>
<td>48</td>
</tr>
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<td>Mean</td>
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<td>48</td>
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<td></td>
<td></td>
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<tr>
<td>0</td>
<td>43.4</td>
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<td></td>
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<td>5</td>
<td>46.2</td>
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<tr>
<td>10</td>
<td>44.3</td>
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<td>Foliar</td>
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Mn uptake and metabolism in soybean has been reported to be affected by glyphosate. Under high yielding conditions in Kansas, Mn application brought grain yields for glyphosate tolerant varieties up to conventional varieties. No response to Mn application in Illinois.
Take Home Message- Mn

- No response to Mn application at SW and WC Minnesota.
- A small response to Mn application near Rochester.
This work is a continuation of work started by George Rehm in 2006.

Cover crop and the nitrogen effect on IDC.

- Treatments
  - 0, 100, and 200 lb N/A spring applied as Urea.
- No cover crop vs cover crop
  - Oats planted at 1 bu/A the day before planting
IDC work

Four sites – 2 in 2006 and 2 in 2007.
- 2006 – Chippewa Co. and Yellow Medicine Co.
- 2007 – Kandiyohi Co. and Yellow Medicine Co.
- Glyphosate tolerant soybean in 30 in. rows.
### IDC Soil Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Depth</th>
<th>C06</th>
<th>YM06</th>
<th>K07</th>
<th>YM07</th>
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<tbody>
<tr>
<td>pH</td>
<td>0-6</td>
<td>7.7</td>
<td>8.0</td>
<td>8.0</td>
<td>7.7</td>
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<tr>
<td>Soluble salts – ds/m</td>
<td>0-6</td>
<td>1.77</td>
<td>0.96</td>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Carbonates - %</td>
<td>0-6</td>
<td>9.7</td>
<td>10.1</td>
<td>29.6</td>
<td>6.2</td>
</tr>
</tbody>
</table>

The pH at all sites were 7.7 or greater. 
The soluble salts ranged from 0.6 to 1.77 ds/m. 
The % carbonates in the soil ranged from 6.2 to 29.6 %.
Kandiyohi 07 7/05/07

No oats

0 N

100 N

200 N

Oats
<table>
<thead>
<tr>
<th></th>
<th>Yellow Medicine 07 6/20/07</th>
<th>No oats</th>
<th>Oats</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>100 N</td>
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<tr>
<td>200 N</td>
<td><img src="image" alt="200 N No oats" /></td>
<td><img src="image" alt="200 N Oats" /></td>
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</tbody>
</table>
At all sites, increased N application rate increased oat N uptake.
Soybean grain yields

<table>
<thead>
<tr>
<th>N Applied</th>
<th>Oats planted</th>
<th>C06</th>
<th>YM06</th>
<th>K07</th>
<th>YM07</th>
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<tbody>
<tr>
<td>lb/A</td>
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<td>-------</td>
<td>-------</td>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td>0</td>
<td>No</td>
<td>42.1</td>
<td>52.0</td>
<td>3.6</td>
<td>51.7</td>
</tr>
<tr>
<td>100</td>
<td>No</td>
<td>28.6</td>
<td>32.2</td>
<td>0.3</td>
<td>46.5</td>
</tr>
<tr>
<td>200</td>
<td>No</td>
<td>25.3</td>
<td>19.1</td>
<td>0.1</td>
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<tr>
<td>0</td>
<td>Yes</td>
<td>42.5</td>
<td>52.4</td>
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<td>50.7</td>
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<tr>
<td>100</td>
<td>Yes</td>
<td>20.5</td>
<td>42.6</td>
<td>24.5</td>
<td>43.4</td>
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<tr>
<td>200</td>
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<td>18.9</td>
<td>25.9</td>
<td>7.2</td>
<td>33.7</td>
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</table>

At all sites, the addition of nitrogen fertilizer reduced soybean grain yields because of increased severity of IDC. At two of the sites, YM06 and K07, the presence of a oat cover crop reduced the effects on soybean grain yield of elevated soil nitrogen.
Time of oat kill

2007 – one site Kandiyohi Co.

Treatments

- Check – no oats
- Kill oats at 6 inches
- Kill oats at 12 inches
- Kill oats at heading

Oats planted day before soybean planting.

Killed oats with glyphosate
Time of oat kill 7/05/07

- No oat cover
- Oat cover killed at 6 inches
- Oat cover killed at 12 inches
- Oat cover killed at heading
## Time of oat kill

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Oat plant growth</th>
<th>Oat N uptake</th>
<th>Soybean grain yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>No oat</td>
<td>0</td>
<td>0</td>
<td>17</td>
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<tr>
<td>Kill at 6 inches</td>
<td>114</td>
<td>6</td>
<td>14</td>
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<tr>
<td>Kill at 12 inches</td>
<td>1633</td>
<td>56</td>
<td>35</td>
</tr>
<tr>
<td>Kill at heading</td>
<td>2982</td>
<td>79</td>
<td>24</td>
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</table>
Take Home Message IDC

- Progress towards developing management strategies to reduce the severity of IDC is occurring.
- The addition of additional nitrogen will increase the severity of IDC. This can be a problem in soils with high residual nitrate or growers that put addition N on soybean.
- Soybean grown on soil’s with large amounts of carbonates (K07) can benefit from the use of a cover crop.
- In 2007, the cover crop should be killed at 10 to 12 inches.