Current issues in soybean production

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Current issues in soybean production

- Desire to increase soybean yield
  - Soybean yield plateau, perceived or real?
  - Genetic traits for high yield
  - High inputs/management for high yield
- Exponential soybean seed costs increases
  - Reducing soybean seeding rates
    - How much do we really know about management in much lower soybean plant populations? (seed treatments, weed control, row spacing)
  - Increasing genetic trait availability
    - Herbicide-resistant weeds (including volunteer corn)

Soybean Yield Plateau perceived or real?

  - Corn productivity is 2.8 times faster than soybean productivity with unlimited water (irrigated production)
  - Concluded corn and soybean relative rate of yield improvement was effectively identical and presented evidence that soybean yields were increasing at an exponential rate
  - Corn and soybean productivity relatively uniform rates for last 40 years (1.8% corn versus 1.4% soybean)
    - Effectively, no difference in the last 40 years

Soybean Yield Plateau perceived or real?

A bushel of corn is not the same as bushel of soybean

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A bushel: Corn vs. Soybean

- 56 lb corn x 84.5% dry matter = 47.3 lb DM
- 60 lb soybean x 87% dry matter = 52.2 lb DM
  - A bushel of soybean has 10% more DM
- Difference in DM composition

<table>
<thead>
<tr>
<th></th>
<th>Carbohydrate</th>
<th>Protein</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>85</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Soybean</td>
<td>40</td>
<td>40</td>
<td>20</td>
</tr>
</tbody>
</table>

*Production Values* (McDermitt and Loomis 1981)

- Effectively, soybean requires ~63% more energy per bushel than corn due to a difference in grain composition
- In addition, soybean C3 versus corn C4
  - Needs to ‘work’ over twice as ‘hard’

The point,

- The train is not off the track,
  - But, there is no reason to be complacent
- We need to be realistic in our goals for increasing yield and evaluating management changes/inputs
- Be realistic about what inputs will do, there are NO “Magic Pills”

It takes a total management approach for high yields

- Appropriate fertility levels
- Variety selection
  - Including SCN and other appropriate protection traits
- Good planting and agronomic practices
  - Timely
  - Row spacing and seeding rate
- Increasing inputs for high yields??
  - Pest management protects yield potential
  - Eliminate bushels lost to weeds
  - Eliminate bushels lost to other pests by thresholds – MUST SCOUT!

Nutrient requirements soybean versus corn

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P2O5</th>
<th>K2O</th>
<th>Mg</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean</td>
<td>Lb per bushel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain</td>
<td>3.8</td>
<td>0.84</td>
<td>1.3</td>
<td>0.21</td>
<td>0.18</td>
</tr>
<tr>
<td>Stover</td>
<td>1.1</td>
<td>0.24</td>
<td>1.0</td>
<td>0.22</td>
<td>0.17</td>
</tr>
<tr>
<td>Total</td>
<td>4.9</td>
<td>1.08</td>
<td>2.3</td>
<td>0.43</td>
<td>0.35</td>
</tr>
<tr>
<td>Corn</td>
<td>Lb per bushel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain</td>
<td>0.9</td>
<td>0.38</td>
<td>0.27</td>
<td>0.09</td>
<td>0.08</td>
</tr>
<tr>
<td>Stover</td>
<td>0.45</td>
<td>0.16</td>
<td>1.1</td>
<td>0.14</td>
<td>0.07</td>
</tr>
<tr>
<td>Total</td>
<td>1.35</td>
<td>0.54</td>
<td>1.37</td>
<td>0.23</td>
<td>0.15</td>
</tr>
</tbody>
</table>

100 bu soybean vs 300 bu corn

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>Mg</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean</td>
<td>380</td>
<td>84</td>
<td>130</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>Grain</td>
<td>110</td>
<td>24</td>
<td>100</td>
<td>22</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>490</td>
<td>108</td>
<td>230</td>
<td>43</td>
<td>35</td>
</tr>
<tr>
<td>Corn</td>
<td>270</td>
<td>114</td>
<td>81</td>
<td>27</td>
<td>24</td>
</tr>
<tr>
<td>Grain</td>
<td>135</td>
<td>48</td>
<td>330</td>
<td>42</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>405</td>
<td>162</td>
<td>411</td>
<td>69</td>
<td>45</td>
</tr>
</tbody>
</table>

International Plant Nutrition Institute: http://www.ppirc.org/ps overwhelmed/soyacorn/NP2O5K2OMgnsp

Fertility challenges

- Many fertilize for corn
  - Corn yields increasing, fertilizer rates constant to decreasing
- Not easy to add nitrogen without losing the benefit of nitrogen fixation
  - The efficiency of soybean to move nutrients during seed fill is poor and not well understood

Variety selection

- Most important management decision!
- Improved breeding (molecular tools) for selecting high yielding varieties new on market: higher yield potential, higher cost
- UI Variety Testing Data http://vt.cropsci.illinois.edu/
- Variety Information Program for Soybeans (VIPS) http://www.vipsoybeans.org
- Purdue Crop Performance Program http://www.ag.purdue.edu/agry/PCPP/Pages/default.aspx

2009 UI Variety Testing Data http://vt.cropsci.illinois.edu/

- Test your fields for SCN
- Use VIPS (Variety Information Program for Soybeans) http://www.vipsoybeans.org
You must have ‘good’ planting practices

- Plant timely (not necessarily early)
- Row spacing less than 30 inch for high yields
- Seeding rate likely does NOT need to increase

Soybean yield loss due to planting date in the Midwest from historical data

Graphic data adapted from (Egli and Cornelius, 2009)

Plant timely, not necessarily early

- Historical perspective
  - They used data from 9 previous manuscripts (Midwest)
  - In the Midwest rapid decline in soybean yield began on May 30th
    - 0.7% per day
      - (40 bu/acre = 0.3 bu; 50bu=0.35bu; 60bu=0.4bu)

Graphic data adapted from (De Bruin and Pedersen, 2008)

Soybean yield response for 24 site-years from 6 locations during 2003-2006 in Iowa

- 4 planting dates (late-April, Early-May, Late-May, Early-June), 6 locations, 2003 through 2006 (24 site-years)
- Highest yields Late-April and Early-May

  - 6 planting dates (late-March to Mid-June), 3 varieties, 2006 and 2007
  - Yields were lower in Late-March and Mid-April versus late-April through Mid-May for 2 varieties, and yield were not increased for other 4
  - Last week of April through ~10th of May produced the highest yields
  - Yields decreased 0.5 bu/day after May 15th
Response to planting date in Illinois

- 8 site-years in the 1990s at Monmouth and DeKalb
  - Planting date for the highest yield was April 27, and the yield loss was 0.10, 0.23, 0.36, and 0.54 bushels per day of delay for the May 1-10, May 11-20, May 21-30, and June 1-10 periods, respectively.

- 5 site-years at Brownstown and Dixon Springs, 2006-2008
  - Planting date for the highest yield was May 9, and the yield loss was 0.10, 0.26, 0.42, and 0.59 bushels per day of delay for the May 10-20, May 20-30, June 1-10, and June 10-20 periods, respectively.

Response to planting date in Illinois

- Correlation between date of 50% completed soybean planting in Illinois and statewide yield (bu/acre), 1994-2008
- The date of 50% completed planting in 2009 was June 5th

Reducing soybean seeding rates: Is it risky?

- May 8th 2009; issue 7 of the Bulletin and can be accessed at: http://ipm.illinois.edu/bulletin/article.php?id=1115
- What are the drawbacks to reduced seeding rates?
  - Established plant stand too low
  - Slower to canopy reducing weed suppression
  - Just does not ‘look right’

Two studies in Illinois

- 1) Eric Adee data from 1998 at Monmouth + 1999 and 2000 at Monmouth, DeKalb, and Urbana (7 site years)
  - 3 row widths 7.5”, 15”, and 30”
  - 3 seeding rates 125, 175, and 225 (X 1,000)
- 2) Emerson Nafziger (UI Variety Testing) 2005-2008 (33 site years)
  - 4 seeding rates 50, 100, 150, and 200 (x 1,000)
  - 30” rows

Soybean yield (bushels per acre)

- 53.6, 53.0, 50.9*

Row spacing (Inches)

*significant at alpha 0.05
Economic Optimum Soybean Seeding Rates based on 33 site years of data generated from 2005 through 2008 at locations throughout Illinois

<table>
<thead>
<tr>
<th>Price of soybean seed ($) per 1000 seeds</th>
<th>Soybean value in dollars bushel⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>134 135 136 136 136 136 137 137 137</td>
</tr>
<tr>
<td>0.15</td>
<td>126 127 129 130 131 132 132 133 133</td>
</tr>
<tr>
<td>0.25</td>
<td>117 120 122 123 125 126 127 128 129 129</td>
</tr>
<tr>
<td>0.35</td>
<td>108 112 115 117 119 121 122 123 124 125</td>
</tr>
<tr>
<td>0.45</td>
<td>100 104 108 111 114 116 118 119 120 122</td>
</tr>
<tr>
<td>0.55</td>
<td>91  97 102 105 108 111 113 115 116 118</td>
</tr>
<tr>
<td>0.65</td>
<td>82  89  95  99 103 106 108 110 112 114</td>
</tr>
</tbody>
</table>

Economic optimum seeding rates based on price of soybean seed and product value

<table>
<thead>
<tr>
<th>Price of soybean seed ($) per 1000 seeds</th>
<th>Soybean value in dollars bushel⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>134 135 136 136 136 136 136 136 137 137</td>
</tr>
<tr>
<td>0.15</td>
<td>126 127 129 130 131 132 132 133 133 133</td>
</tr>
<tr>
<td>0.25</td>
<td>117 120 122 123 125 126 127 128 129 129</td>
</tr>
<tr>
<td>0.35</td>
<td>108 112 115 117 119 121 122 123 124 125</td>
</tr>
<tr>
<td>0.45</td>
<td>100 104 108 111 114 116 118 119 120 122</td>
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<tr>
<td>0.55</td>
<td>91  97 102 105 108 111 113 115 116 118</td>
</tr>
<tr>
<td>0.65</td>
<td>82  89  95  99 103 106 108 110 112 114</td>
</tr>
</tbody>
</table>

High input, or intensive management

- I’ve done all that, what else?

U of I “High-Yield” Soybean Management

- Funded by the IL Soybean Assoc. in 2008 at DSAC (Ebelhar) and at Urbana (Nafziger)
- Includes +/- sprinkler irrigation
- Fungicide and N (and sometimes other stuff) in combination within irrigation treatments
No Significant Effects of Any Treatments

High-Yield Soybean, DSAC 2008

<table>
<thead>
<tr>
<th>Nitrogen</th>
<th>Headline</th>
<th>Irrigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>-N</td>
<td>-F</td>
<td>Not irrigated</td>
</tr>
<tr>
<td>+N</td>
<td>+F</td>
<td>Irrigated</td>
</tr>
</tbody>
</table>

Yield

No Significant Effects of Any Treatments

2009 “High-Yield” Study at Brownstown, IL

<table>
<thead>
<tr>
<th>Nitrogen</th>
<th>Headline</th>
<th>Irrigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>-N</td>
<td>-F</td>
<td>Not irrigated</td>
</tr>
<tr>
<td>+N</td>
<td>+F</td>
<td>Irrigated</td>
</tr>
</tbody>
</table>

“High-Yield” Soybean at Urbana

- Nitrogen (urea at 100 lb/ac) at R2 and R5
- Fungicide (Headline) at R3 and R6
- Insecticide (Warrior) with fungicide at R3 and R6
- Micronutrient mix (Mn, Fe, Zn, S, B) + cytokinin at R2 and R5
- Stance (mepiquat chloride) stem shortener at R2, R3, and R5 (with N, F, and M)
Urbana “High-Yield” Soybean Study, 2008

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Irrigated</th>
<th>Not irrigated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bushels per acre</td>
<td></td>
</tr>
<tr>
<td>Untreated</td>
<td>63</td>
<td>59</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>71</td>
<td>59</td>
</tr>
<tr>
<td>Fungicide</td>
<td>68</td>
<td>59</td>
</tr>
<tr>
<td>Micronutrients</td>
<td>62</td>
<td>58</td>
</tr>
<tr>
<td>Nitrogen + fungicide</td>
<td>68</td>
<td>60</td>
</tr>
<tr>
<td>Nitrogen + fungicide + micronutrients</td>
<td>67</td>
<td>61</td>
</tr>
<tr>
<td>Average</td>
<td>66</td>
<td>59</td>
</tr>
</tbody>
</table>

“High-Yield” Experiment in Wisconsin from Shawn Conley

- RCB split-plot design with 5 reps
  - Experimental unit: 20’ by 50’

Grain Yield by Management System

- No response to management in a rain-fed environment
- Significant (p ≤ 0.10) management response in irrigated system

Comparison of System Profitability

- High input practices may not pay

Differential Input Costs per Acre

<table>
<thead>
<tr>
<th>Input</th>
<th>Product</th>
<th>Low</th>
<th>Med</th>
<th>High</th>
<th>U. High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation</td>
<td>Rain-fed</td>
<td>14.80</td>
<td>16.80</td>
<td>18.80</td>
<td>20.80</td>
</tr>
<tr>
<td>Biocide</td>
<td>Contain WG</td>
<td>42.00</td>
<td>42.00</td>
<td>42.00</td>
<td>42.00</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>Chicken Droppings</td>
<td>30.00</td>
<td>30.00</td>
<td>30.00</td>
<td>30.00</td>
</tr>
<tr>
<td>Inoculant</td>
<td>Optimize</td>
<td>2.13</td>
<td>2.13</td>
<td>2.13</td>
<td>2.13</td>
</tr>
<tr>
<td>PGR</td>
<td>Pistill</td>
<td>31.09</td>
<td>31.09</td>
<td>31.09</td>
<td>31.09</td>
</tr>
<tr>
<td>Foliar fungicide</td>
<td>Headline (1x)</td>
<td>15.00</td>
<td>30.00</td>
<td>30.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Foliar fungicide</td>
<td>Quilt (1x)</td>
<td>15.00</td>
<td>15.00</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Foliar nutrients</td>
<td>Micros (3x)</td>
<td>13.00</td>
<td>13.00</td>
<td>13.00</td>
<td>13.00</td>
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<tr>
<td>Insecticide</td>
<td>Warrior</td>
<td>6.00</td>
<td>6.00</td>
<td>6.00</td>
<td>6.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>109.85</td>
<td>142.48</td>
<td>368.97</td>
<td>406.80</td>
</tr>
</tbody>
</table>

WI data from Shawn Conley
Increasing soybean yield brings challenges

- Fundamental research questions need to be addressed
- Focus on proper agronomics: variety selection, fertility, planting date, row spacing, seeding rate, and scouting
- Technology to ‘over come’ time constraints and logistics of ‘good’ planting need to be developed/adopted
- There is no “magic pill” and increasing inputs may not pay, many products entering the market needs to be evaluated

Why talk about drift?

- Complaints from specialty crop growers are on the rise.
- 79% were from applications made to agronomic crops.
- Of agronomic crop drift complaints, 67% were from commercial applications and 25% from private applications.

Why talk about drift?

- Spotty pest control
- Wasted chemicals
- Off-target damage
- Litigious Society
- Result-higher costs-$$$
- Environmental impact
- More populated areas?
- Public more aware of pesticide concerns! (Negative)

Why talk about drift?

- Issues with giant ragweed, horseweed (marestail), waterhemp, lambsquarters
- Dicamba soybean
- DHT soybean

Will Drift Affect You?

“One out of 10 will have to deal with a drift complaint.”  (Fred Whitford, Purdue Pesticide Program)

www.driftwatch.org