Corn Agronomy Research Update and Considerations for 2012

Southern MN Corn Economics Group Meeting
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www.extension.umn.edu/corn
Corn Yield is Limited by Weather, Site, & Management

Record yields obtained with *common hybrids*, often at *normal plant populations*.

<table>
<thead>
<tr>
<th>Year</th>
<th>Location in Minnesota</th>
<th>Non-irrigated yield contest category</th>
<th>Contest yield</th>
<th>County average yield</th>
<th>Yield gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>Brown</td>
<td>Normal</td>
<td>268</td>
<td>184</td>
<td>84</td>
</tr>
<tr>
<td>2010</td>
<td>Faribault</td>
<td>Normal</td>
<td>264</td>
<td>179</td>
<td>85</td>
</tr>
<tr>
<td>2011</td>
<td>Winona</td>
<td>Normal</td>
<td>246</td>
<td>160*</td>
<td>86</td>
</tr>
<tr>
<td>2009</td>
<td>Houston</td>
<td>Strip-/no-till</td>
<td>269</td>
<td>172</td>
<td>97</td>
</tr>
<tr>
<td>2010</td>
<td>Wabasha</td>
<td>Strip-/no-till</td>
<td>253</td>
<td>186</td>
<td>67</td>
</tr>
<tr>
<td>2011</td>
<td>Freeborn</td>
<td>Strip-/no-till</td>
<td>230</td>
<td>160*</td>
<td>70</td>
</tr>
</tbody>
</table>

*State average yield.
Foundation Needed for High-Yield Corn

• Tillage system
• Soil fertility
• Soil moisture
• Pest management
Agronomic Management Factors to Consider for High-Yield Corn

- Hybrid selection
- Crop rotation
- Planting date
- Stand establishment
- Plant population
- Row spacing
Hybrid Selection is Critical
## Yield Differences among Hybrid Entries are Huge


<table>
<thead>
<tr>
<th>Year</th>
<th>Highest-yielding entry</th>
<th>Lowest-yielding entry</th>
<th>Difference</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bu/acre</td>
<td>bu/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>212</td>
<td>141</td>
<td>71</td>
<td>50</td>
</tr>
<tr>
<td>2008</td>
<td>239</td>
<td>146</td>
<td>93</td>
<td>64</td>
</tr>
<tr>
<td>2009</td>
<td>218</td>
<td>150</td>
<td>68</td>
<td>45</td>
</tr>
<tr>
<td>2010</td>
<td>215</td>
<td>157</td>
<td>58</td>
<td>37</td>
</tr>
<tr>
<td>2011</td>
<td>230</td>
<td>155</td>
<td>75</td>
<td>48</td>
</tr>
<tr>
<td><strong>Avg.</strong></td>
<td><strong>223</strong></td>
<td><strong>150</strong></td>
<td><strong>73</strong></td>
<td><strong>49</strong></td>
</tr>
</tbody>
</table>

88-153 hybrid entries/year
Relative Maturity has Limited Effect on Yield

Lamberton, Rochester, & Waseca (2007-2011)

9 to 64 hybrid entries/group in each year

<table>
<thead>
<tr>
<th>Relative maturity group (days)</th>
<th>Yield (bu/acre)</th>
<th>Harvest moisture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>93 to 97</td>
<td>187</td>
<td>16.6</td>
</tr>
<tr>
<td>98 to 102</td>
<td>191 (+2%)</td>
<td>17.8</td>
</tr>
<tr>
<td>103 to 107</td>
<td>195 (+4%)</td>
<td>19.9</td>
</tr>
</tbody>
</table>

April 21 to May 6
(within 1% of maximum yield)

Data from Bruce Potter & Steve Quiring
2010 Planting Date Trial - Morris, MN

Photo on June 14

April 20

May 19
How early is too early for planting?

• Remember the 2010 growing season...
  – Earliest planting on record
  – Freeze on May 9

• New growth can have trouble emerging through freeze-damaged tissue, causing buggy-whipping (worse on larger plants).

Renville County, 2010
Expected Losses due to a Spring Freeze

• Corn at VE (spiking) is affected less by a freeze than corn at later growth stages.

• 85 to 90% of buggy-whipped plants break through.

• 9 to 15% yield loss if the entire top is lost on corn that is 6 inches or shorter.

Renville County, 2010
How early is too early for planting?

• Frost-free dates...
  – Only a 10% chance of freezing temperatures on or after May 8 to May 14.

• Corn requires 155 GDD from planting to V1.

<table>
<thead>
<tr>
<th>Desired date of V1</th>
<th>Corresponding planting date based on long-term average temperatures</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 8</td>
<td>April 15</td>
</tr>
<tr>
<td>May 11</td>
<td>April 21</td>
</tr>
<tr>
<td>May 14</td>
<td>April 26</td>
</tr>
</tbody>
</table>
Crop Rotation Increases Yield Potential
1) Crop rotation increased yield (10-19% at the high N rate).
2) Crop rotation reduced the N fertilizer requirement for corn.

From Stanger et al. (Agronomy Journal, 2008)
Yield penalty for corn-on-corn is less in high-yield environments (data from 2011)

20 hybrid entries in each rotation.

From Crop Production Services
Reduce the Risks of Corn-on-Corn

- Take care of soil fertility & pest management.
- Pick fields with high yield potential.
- Use a corn-intensive crop rotation rather than continuous corn.
- If possible, pick fields with lower residue levels.
- Select hybrids carefully.
- Manage for uniform emergence.
12 site-years in northern & central Illinois (2004-2007)

<table>
<thead>
<tr>
<th>Crop and rotation</th>
<th>Yield (bu/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td></td>
</tr>
<tr>
<td>Corn-soy</td>
<td>197</td>
</tr>
<tr>
<td>1st-year corn in corn-corn-soy</td>
<td>196</td>
</tr>
<tr>
<td>2nd-year corn in corn-corn-soy</td>
<td>184 (-7%)</td>
</tr>
<tr>
<td>Continuous corn</td>
<td>178 (-10%)</td>
</tr>
<tr>
<td>Soybean</td>
<td></td>
</tr>
<tr>
<td>Corn-soy</td>
<td>54.9</td>
</tr>
<tr>
<td>Corn-corn-soy</td>
<td>58.3 (+6%)</td>
</tr>
</tbody>
</table>

From Nafziger, 2009 (Illinois Agronomy Handbook)
1) Yield increased by 7-11% when stover was removed.

2) Strip-till & no-till yields were similar to disk-rip when stover was removed.

Lamberton & Waseca, MN (2009-2011); 200 lb N/acre

Continuous corn yield (bu/ac)

<table>
<thead>
<tr>
<th>Method</th>
<th>No stover removal</th>
<th>Stover removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk-rip</td>
<td>190 (204)</td>
<td>+7%</td>
</tr>
<tr>
<td>Strip-till</td>
<td>183 (203)</td>
<td>+11%</td>
</tr>
<tr>
<td>No-till</td>
<td>182 (199)</td>
<td>+9%</td>
</tr>
</tbody>
</table>
Hybrid Considerations for Corn-on-Corn

- Disease tolerance
- Stress emergence rating
- High residue suitability rating
- Root strength
- Drought tolerance
- Stalk strength
2 ½ Leaf Stages Behind
Plant that was 2 ½ leaf stages behind is late to silk.
Lamberton, MN (32,000 plants/acre)

<table>
<thead>
<tr>
<th>Emergence pattern</th>
<th>Avg. of all plants</th>
<th>Early plants</th>
<th>Late plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniform</td>
<td>100%</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1 leaf-stage delay on every other plant</td>
<td>94%</td>
<td>107%</td>
<td>80%</td>
</tr>
<tr>
<td>2 leaf-stage delay on every other plant</td>
<td>83%</td>
<td>118%</td>
<td>49%</td>
</tr>
<tr>
<td>Every other plant missing</td>
<td>73%</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

Yield (% of control)

From Ford & Hicks, 1992 (Journal of Production Agriculture)
Uneven Moisture in the Seed Zone

• #1 cause of uneven emergence

• The result of...
  – Variable soil conditions
  – Tillage & residue patterns
  – Uneven seeding depth
Conserve Moisture in the Seed Zone

• Prepare seedbeds close to planting.

• Avoid unnecessary tillage passes in spring.

• Avoid tilling deeper than needed in spring.

• Consider rolling baskets to seal in moisture.
Depth of seed placement should ensure uniformly adequate moisture for germination

- 2” is optimal in most situations.
- Less than 1.5” increases risk of uneven germination due to drying of surface soil.
- Planting deep (2.5”) to reach moisture is ok if planting is not early & soils are warm.
Avoid Seed-to-Air Contact

– Soil must be firmed completely around seed for the seed to quickly & uniformly absorb moisture.

– Have enough down pressure, but not too much.

– Seed furrows can open up when planting into wet clay soils that later dry out.
Avoid Seed-to-Residue Contact

– Especially important in corn-on-corn.

– Distribute residue evenly behind the entire width of the combine.

– Shred stalks & till *early* in the fall.

– Set row cleaners properly.
1) Each 10% increase in residue coverage reduced emergence by 1%.

2) Over-seeding rate should be a little higher for corn-on-corn.
Avoid Seed-to-Clod Contact

– Small clods can create air pockets around seed.

– Don’t work wet soils = soil in the depth of tillage should crumble.

– Move big clods out of the way with row cleaners.
Plant Population

Final plant population (thousands/ac)

16  21.5  27  32.5  38  43.5
1) Response to plant population similar for all planting dates.  
2) On average, yield maximized at 32,800 plants/ac or higher.
Lamberton & Waseca, MN (2008-2010)
(1 hybrid; averaged over 3 planting dates)

<table>
<thead>
<tr>
<th>Seed cost ($/unit)</th>
<th>Corn price ($/bu)</th>
<th>Optimum seeding rates* (within $1/acre maximum net return)</th>
</tr>
</thead>
<tbody>
<tr>
<td>225</td>
<td>5.00</td>
<td>30,900 to 33,300</td>
</tr>
<tr>
<td>225</td>
<td>6.00</td>
<td>31,400 to 33,700</td>
</tr>
<tr>
<td>275</td>
<td>5.00</td>
<td>30,400 to 32,900</td>
</tr>
<tr>
<td>275</td>
<td>6.00</td>
<td>30,900 to 33,200</td>
</tr>
</tbody>
</table>

Optimum rates in all scenarios above = 31,400 to 32,900

*Assume 5% over-seeding.
Narrow rows may reduce plant-to-plant competition and increase yield, especially with higher populations in some environments.

44,000 plants/acre 30-inch rows

44,000 plants/acre 20-inch rows
1) No yield difference between row widths.

2) Response to plant population similar for both row widths.

3) On average, yield maximized at 34,300 plants/ac or higher.

Avg. of 3 hybrids; corn on corn
1) Yield was 7 and 14% higher with the 101- and 105-day hybrids compared to the 95-day hybrid.

2) Response to plant population was similar for all hybrids.

3) On average, yield maximized at 34,300 plants/acre or higher.
Lamberton & Waseca, MN (2009-2010)  
(averaged over 3 hybrids & 2 row widths)

<table>
<thead>
<tr>
<th>Seed cost ($/unit)</th>
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<tr>
<td>225</td>
<td>5.00</td>
<td>31,700 to 34,400</td>
</tr>
<tr>
<td>225</td>
<td>6.00</td>
<td>32,200 to 34,900</td>
</tr>
<tr>
<td>275</td>
<td>5.00</td>
<td>31,200 to 33,800</td>
</tr>
<tr>
<td>275</td>
<td>6.00</td>
<td>31,700 to 34,300</td>
</tr>
</tbody>
</table>

Optimum rates in all scenarios above = 32,200 to 33,800  

*Assume 5% over-seeding.
Photos from Liz Stahl (Univ. of Minnesota)
43,000 seeds/acre yielded more than the lower seeding rates in twin rows, but not in 30-inch rows.

Data from Liz Stahl (Univ. of Minnesota)
Optimum Population Varies With Yield Level

120 bu/acre

240 bu/acre
2009 Hybrid x Population Study

- Silt loam soil
- Corn following corn

<table>
<thead>
<tr>
<th>Month</th>
<th>Rainfall (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>0.5</td>
</tr>
<tr>
<td>June</td>
<td>2.1</td>
</tr>
<tr>
<td>July</td>
<td>1.0</td>
</tr>
<tr>
<td>Aug.</td>
<td>3.8</td>
</tr>
<tr>
<td>Sept.</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Morris, MN - 2009 (averaged over 3 hybrids)

![Graph showing the relationship between final plant population and corn grain yield.](image-url)
Relationship Between Yield Level & Optimum Final Plant Population


Yield Increase for Practices in Southern MN

- 37-64% = hybrid selection (best vs. worst)
- 4-19% = crop rotation vs. continuous corn
- 6% = uniform emergence vs. 1-leaf stage delay
- 4% = 103- to 107-day vs. 93- to 97-day hybrids
- 2-5% = planting in late April vs. mid-May
- 1-2% = final stand of 34,000 vs. 30,000 plants/ac
- 0-4% = narrow or twin rows vs. 30-inch rows
Thanks!

www.extension.umn.edu/corn