Effect of Corn Spacing and Emergence Variation on Grain Yield

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http://corn.agronomy.wisc.edu/Extension/CC04
Uniform Stand:

- Plants emerged in adequate numbers, with uniform spacing and emergence time
  
  (Hoeft, R.G., E.D. Nafziger, R.R. Johnson, and S.R. Aldrich)
Previous Research on Corn Grain Yield Response to Plant Spacing and Emergence Variation

- **Iowa**: Non significant up to 6 inches standard deviation
  - Erbach et al. (1972)
- **Illinois**: Non significant
  - Johnson and Mulvaney (1980)
  - Dungan et al., (1958): hills
- **Indiana**: Non significant and Significant (web)
  - Nielsen (1997)
  - Nielsen (web): Grain yield decreases 2.5 bu/A for each inch standard deviation > 2 inches
- **Ontario**: Non significant
- **Kansas**: Significant
  - Krall et al. (1977): 3.4 bu/A decrease for each inch increase standard deviation
  - Vanderlip et al (1988): grain yield decreased when standard deviation values were greater than 2.4 inches
- **Nebraska**: Non significant in hills
  - Kiesselbach and Weihsing (1933)

Uneven emergence can reduce yield by 10-20% when 1/3 plants emerged 2 weeks late or later (Carter, 1989; Nafziger, 1991)
Objectives

• To measure the effects and interactions of plant spacing variation and plant emergence variation on plant growth and grain yield.

• To quantify the grain yield compensation of individual plants in variable corn stands

• To quantify the grain yield of corn in communities with variable corn stands
Plant Spacing Variability Treatments 2000-2002; Plant Population = 30,000 Plants/A
Deen et al. University of Guelph
Field Descriptions

Locations:
• Elora (E)
• Woodstock (W)

CHU:
• 2700 (E)
• 2900 (W)

Soil Types:
• London Loam (E)
• Guelph Loam (W)

Previous Crops:
• Alfalfa (E)
• Soybeans (W)
## Treatments using Roundup Ready seed to establish Plant Spacing Variability

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Roundup Ready</th>
<th>Normal Corn</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR</td>
<td>28250</td>
<td>0%</td>
</tr>
<tr>
<td>RR + 10% Normal</td>
<td>28250</td>
<td>10%</td>
</tr>
<tr>
<td>RR + 20% Normal</td>
<td>28250</td>
<td>20%</td>
</tr>
<tr>
<td>RR + 35% Normal</td>
<td>28250</td>
<td>35%</td>
</tr>
<tr>
<td>RR + 50% Normal</td>
<td>28250</td>
<td>50%</td>
</tr>
<tr>
<td>RR + 70% Normal</td>
<td>28250</td>
<td>70%</td>
</tr>
</tbody>
</table>
Establishment of Plant Standard Deviation and Plant Density

- **Treatments**
  - RR
  - RR+10c
  - RR+20c
  - RR+35c
  - RR+50c
  - RR+70c

- **Plant Standard Deviation (inches)**

- **Plant Density (plants m^{-2})**

- **LSD (0.05)**
Grain yield response to Plant Standard Deviation using Roundup Ready Treatments

[Graph showing grain yield (bu/A) plotted against plant spacing deviation (inches) for Elora 2000, Elora 2001, Woodstock 2000, and Woodstock 2001.]
Impact of Plant Spacing and Emergence Variation on Yield
## Summary of variance analysis

<table>
<thead>
<tr>
<th>Factor</th>
<th>Plant height</th>
<th>LAI</th>
<th>Forage yield</th>
<th>Grain yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergence</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Spacing</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>E X S</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

** Significant at P < 0.05, NS = Non significant
Grain Yield Response to Emergence

![Bar chart showing grain yield response to different emergence treatments. The chart compares three treatments labeled E, EM, and EL. Treatment E has the highest grain yield, followed by EM and then EL.](chart.png)
Dry Grain Yield per Plant

Grain Yield (g plant\(^{-1}\))

No. 1  No. 2  No. 3  No. 4  No. 5  No. 6

E-20 (Control)
E-40 Relative Yield

Relative Yield (%)

No.1  No.2  No.3  No.4  No.5  No.6

101  110  93  90  99  100

Plant Positions
E-60 Relative Yield

No. 1  No. 2  No. 3  No. 4  No. 5  No. 6

Plant Positions

Relative Yield (%)
EM-20 Relative Yield

![Bar chart showing relative yield (%) for Plant Positions No.1 to No.6.](chart.png)
EL-20 Relative Yield

Plant Positions

<table>
<thead>
<tr>
<th>Plant Position</th>
<th>Relative Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>101</td>
</tr>
<tr>
<td>No. 2</td>
<td>107</td>
</tr>
<tr>
<td>No. 3</td>
<td>28</td>
</tr>
<tr>
<td>No. 4</td>
<td>106</td>
</tr>
<tr>
<td>No. 5</td>
<td>102</td>
</tr>
<tr>
<td>No. 6</td>
<td>102</td>
</tr>
</tbody>
</table>
EL-60 Relative Yield

No.1: 107  No.2: 119  No.3: 95  No.4: 103  No.5: 103  No.6: 103

Plant Positions

Relative Yield (%)
Clipping Studies at Arlington

• Growth stages:
  ✓ All leaves clipped at V2, V4 and V6

• Plot plant patterns for clipping treatments:
  ✓ Untreated check, 2-, 4-, and 8-plant patterns, All

![Graph showing corn grain yield response to clipping treatments.](image)

**Grain yield (bu/A)**

Control: 206
V2-2: 194
V2-4: 189
V2-8: 197
V4-2: 174
V4-4: 182
V4-8: 186
V6-2: 178
V6-4: 181
V6-8: 179

**LSD(0.10) = 12**
Conclusions

• Corn was more responsive to plant emergence variability than plant spacing variability.
• Plant growth and grain yield were unaffected by within-row plant spacing variability (SD = 1-7 inches)
• Yield decreased 4-8% as 1/6 plants emerged 2 to 4 leaves late.
• Yield reduction due to emergence delay was not intensified by increased spacing variability.
• Planter performance evaluation and subsequent maintenance must consider crop emergence uniformity.
• Management and planting decisions that influence emergence pattern can have a significant impact on yield.