Competitive Effects of Volunteer Corn
\((Zea \, mays \, L.)\) in Corn

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Herbicide Resistant Corn Adoption – 2009
includes stacked with insect resistance

Source: NASS, USDA
Why do we have volunteer corn?

Lodging
• Weather
• Insects
• Poor stalk quality

Harvest Inefficiencies
• Improper combine settings
• Human error

http://pownal.pbwiki.com/Pownal-Pictures
http://www.leerealty.com/CombiningCornGreen1.jpg
Field Surveys (2008 & 2009)

- Central MO;
  - 2008 – 10 fields
  - 2009 – 10 fields
- harvested by different combines
  - ≥ 20 acres
    - 1 square meter area sampled
    - 60 areas/field

<table>
<thead>
<tr>
<th>Corn Field</th>
<th>2008 Mean Harvest Loss (Bushels/A)</th>
<th>2009 Mean Harvest Loss (Bushels/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>0.5</td>
<td>4.5</td>
</tr>
<tr>
<td>4</td>
<td>0.75</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>7</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>10</td>
<td>0.25</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>0.85</td>
<td>1.9</td>
</tr>
</tbody>
</table>
Research Objective

• Assess the season-long effects of volunteer corn on leaf chlorophyll content, stalk diameter, and grain yield of row corn.
Methodology

- Burndown + PRE (glyphosate, 0.87 kg ae/ha; atrazine, 0.6 kg ai/ha; S-metolachlor, 0.37 kg ai/ha)

- Glyphosate-resistant corn (DKC 6342) planted (28,000 seeds/A) on May 21 (Columbia) & 22 (Novelty), 2009.
  - Ammonium nitrate: broadcasted at 125 lbs/A

- Glyphosate-resistant volunteer corn was established at densities ranging from 0 to 8 plants/m².
  - 8 plants/m² = 32,000 plants/A
    - Columbia
      - 0 – 3.4 plants/m²
    - Novelty
      - 0 – 8 plants/m²
Methodology

- Glyphosate (0.87 kg ae/ha) and mesotrione (0.17 kg ai/ha) were applied POST to reduce weeds.
- Data collected from 15 random plants of row corn:
  - Corn leaf chlorophyll (SPAD® meter) at V6, V8, & VT
  - Stalk diameter
  - Grain yield
    - 15.5% moisture

http://www.specmeters.com/pictures/dl-m.jpg
http://www.drillspot.com/pimages/2468/246853_300.jpg
# Leaf Chlorophyll Content (SPAD® Meter)

## Columbia

<table>
<thead>
<tr>
<th>Row Corn Growth Stage</th>
<th>Volunteer Corn Density (plants/m²)</th>
<th>LSD (α=0.05)</th>
<th>0</th>
<th>0.14</th>
<th>0.23</th>
<th>0.45</th>
<th>0.5</th>
<th>0.68</th>
<th>1</th>
<th>1.58</th>
<th>3.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>V6</td>
<td>43.6 ab</td>
<td>2.82</td>
<td>44.2 ab</td>
<td>45.1 a</td>
<td>43 abc</td>
<td>43.7 ab</td>
<td>42.8 ab</td>
<td>42.2 bc</td>
<td>42 bc</td>
<td>40.5 c</td>
<td></td>
</tr>
<tr>
<td>V8</td>
<td>46.9 ab</td>
<td>4.28</td>
<td>47.7 a</td>
<td>47.8 a</td>
<td>44.7 abc</td>
<td>46 abc</td>
<td>43.2 bc</td>
<td>43.2 bc</td>
<td>42.4 cd</td>
<td>38.6 d</td>
<td></td>
</tr>
<tr>
<td>VT</td>
<td>39.5 abc</td>
<td>5.57</td>
<td>41 ab</td>
<td>42 a</td>
<td>36.3 bcd</td>
<td>39 abc</td>
<td>35.1 cd</td>
<td>35.5 cd</td>
<td>35.8 bcd</td>
<td>31.5 d</td>
<td></td>
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</table>

## Novelty

<table>
<thead>
<tr>
<th>Row Corn Growth Stage</th>
<th>Volunteer Corn Density (plants/m²)</th>
<th>LSD (α=0.05)</th>
<th>0</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>V6</td>
<td>37.8 a</td>
<td>3.45</td>
<td>34.2 bc</td>
<td>32.8 bc</td>
<td>34.5 ab</td>
<td>32.3 bc</td>
<td>32.1 bc</td>
<td>31.6 bc</td>
<td>31 c</td>
<td>31.5 bc</td>
<td></td>
</tr>
<tr>
<td>V8</td>
<td>38.3 a</td>
<td>2.26</td>
<td>34.7 b</td>
<td>34.4 b</td>
<td>33.8 b</td>
<td>31.4 c</td>
<td>31 c</td>
<td>30 c</td>
<td>30.7 c</td>
<td>30.4 c</td>
<td></td>
</tr>
<tr>
<td>VT</td>
<td>28.3 a</td>
<td>2.87</td>
<td>25.4 b</td>
<td>25.1 b</td>
<td>24.6 bc</td>
<td>22.2 cd</td>
<td>22 cde</td>
<td>19.3 e</td>
<td>21.1 de</td>
<td>21 de</td>
<td></td>
</tr>
</tbody>
</table>
Leaf Chlorophyll Content

Columbia

Novelty

Predicted Value
Leaf Chlorophyll Content

**Columbia**
- Volunteer Density
  - 3.4 plants/m²
- V6 ↓ 7%
- V8 ↓ 18%
- VT ↓ 20%

**Novelty**
- Volunteer Density
  - 3.4 plants/m²
- V6 ↓ 12%
- V8 ↓ 14%
- VT ↓ 18%

(Compared to control)
Leaf Chlorophyll Results

• Corn leaf nitrogen decreased as corn matured from the V6 to VT growth stage

• Leaf nitrogen decreased from 18 to 20% at 3.4 plants/m² at the VT growth stage
Stalk Diameters

Columbia

\[ y = -2.4019x + 0.3937x^2 + 16.3991 \]
\[ R^2 = 0.42 \]

Novelty

\[ y = -1.3045x + 0.0965x^2 + 18.5909 \]
\[ R^2 = 0.68 \]
Stalk Diameters

**Columbia**
- Volunteer Density
  - 3.4 plants/m²
    - ↓ 24%

**Novelty**
- Volunteer Density
  - 3.4 plants/m²
    - ↓ 17%
Stalk Diameter Results

- With increasing volunteer corn densities, stalk diameters decreased rapidly up to 4 plants/m²

- Stalk diameters were reduced from 17 to 24% at 3.4 plants/m² at both locations
Grain Yield

Columbia Volunteer Corn (plants/m²)

\[ y = -25.1576x + 2.632x^2 + 90.9025 \]
\[ R^2 = 0.47 \]

Novelty Volunteer Corn (plants/m²)

\[ y = -10.7218x + 0.7384x^2 + 60.8562 \]
\[ R^2 = 0.83 \]
Grain Yield

**Columbia**

- Volunteer Density
  - 3.4 plants/m²
  - ↓62%

**Novelty**

- Volunteer Density
  - 3.4 plants/m²
  - ↓40%
Grain Yield Results

• Grain yield decreased with increasing densities of volunteer corn

• Grain yield was reduced by 16.8% at 0.5 plants/m²

• Volunteer corn densities reduced grain yield of row corn from 40 to 62% at 3.4 plants/m²
Summary

- Volunteer corn reduced nitrogen availability by 20% at 3.4 plants/m²

- Stalk diameter reduced by 24% at 3.4 plants/m² which can contribute to plant lodging

- Volunteer corn is a competitive weed which can significantly reduce grain yields
  - Grain yields were reduced up to 62% at 3.4 plants/m²
Control of Glyphosate-resistant volunteer corn

1. Clearfield® corn and Lightning®

2. Liberty Link® corn and Ignite®
### Clearfield®

<table>
<thead>
<tr>
<th>Control with Lightning® (Columbia)</th>
<th>Application Timing</th>
<th>Visual Rating %</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 WAT</td>
<td>Volunteer Corn Density</td>
<td></td>
</tr>
<tr>
<td>0.5 plant/m²</td>
<td>1.3 plants/m²</td>
<td></td>
</tr>
<tr>
<td>4”</td>
<td>86.25</td>
<td>58.75</td>
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<tr>
<td>8”</td>
<td>67.5</td>
<td>62.5</td>
</tr>
<tr>
<td>16”</td>
<td>83.75</td>
<td>85</td>
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</table>

### Control with Lightning® (Novelty)

<table>
<thead>
<tr>
<th>Application Timing</th>
<th>Visual Rating %</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 WAT</td>
<td>Volunteer Corn Density</td>
</tr>
<tr>
<td>1 plant/m²</td>
<td>4 plants/m²</td>
</tr>
<tr>
<td>4”</td>
<td>16.25</td>
</tr>
<tr>
<td>8”</td>
<td>80</td>
</tr>
<tr>
<td>16”</td>
<td>55</td>
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</table>

### Liberty Link®

<table>
<thead>
<tr>
<th>Control with Ignite® (Columbia)</th>
<th>Application Timing</th>
<th>Visual Rating %</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 WAT</td>
<td>Volunteer Corn Density</td>
<td></td>
</tr>
<tr>
<td>0.5 plants/m²</td>
<td>1.1 plants/m²</td>
<td></td>
</tr>
<tr>
<td>4”</td>
<td>11.25</td>
<td>13.75</td>
</tr>
<tr>
<td>8”</td>
<td>88.75</td>
<td>90</td>
</tr>
<tr>
<td>16”</td>
<td>93.75</td>
<td>22.5</td>
</tr>
</tbody>
</table>

### Control with Ignite® (Novelty)

<table>
<thead>
<tr>
<th>Application Timing</th>
<th>Visual Rating %</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 WAT</td>
<td>Volunteer Corn Density</td>
</tr>
<tr>
<td>1 plant/m²</td>
<td>4 plants/m²</td>
</tr>
<tr>
<td>4”</td>
<td>7.5</td>
</tr>
<tr>
<td>8”</td>
<td>82.5</td>
</tr>
<tr>
<td>16”</td>
<td>66.25</td>
</tr>
</tbody>
</table>
Volunteer Corn Dry Weight

2009 Volunteer Corn Dry Weights
Columbia

2009 Volunteer Corn Dry Weights
Novelty

Dry Weight (g)

Glufosinate

Imazethapyr + Imazapyr

Dry Weight (g)

1 plant /m² Treated
1 plant /m² Untreated
4 plants /m² Treated
4 plants /m² Untreated

0 20 40 60 80 100 120 140

0 20 40 60 80 100 120 140

4 " 8 " 16 "

4 " 8 " 16 "

4 " 8 " 16 "

4 " 8 " 16 "
At average volunteer corn densities, how many times would you predict volunteer corn could reduce yield of planted hybrid?

- **0 - 25%**: 60%
- **26 - 50%**: 28%
- **51 - 75%**: 7%
- **76 - 100%**: 5%
What management practice is most commonly used to control Glyphosate-R volunteer corn in corn?

- Fall Tillage: 26%
- Spring Tillage: 27%
- Rotation with Clearfield® corn: 3%
- Rotation with Liberty Link® corn: 40%
- Other: 3%
Is it cost-effective to control Glyphosate-R volunteer corn by rotating with Clearfield® or Liberty Link® corn?

### Clearfield
- Yes: 35%
- No: 65%

### Liberty Link
- Yes: 82%
- No: 18%
Questions?