Effects of Corn Population

Dave Heimkes

- 30-inch row spacing
- Twin-row spacing
- Skip-row 2-1-2 or 2-2-2 arrangement
Plant Population Through the Years

- Corn populations have been steadily increasing over the last 25 years by increasing approximately 300 to 425 plants/acre/year based on a Purdue University study.\(^1\),\(^2\)

Figure 1. Trend of plant density and grain yield in U.S. maize production over past 80 years.

General Information About Populations

• Corn populations have been steadily increasing over past 25 years from approximately 300 to 425 plants/acre/year based on a Purdue University study.¹²

• Yields have been increasing due to better genetics, stronger agronomics, and grower management, which includes increasing populations.

• Environmental conditions, soil types, and moisture all influence crop production and factors relating to population decisions.

• Selecting the “right product” for the right field along with the “right population” is important for a successful result.

• Research shows that newer genetics perform better at higher populations.
General Information About Populations

• Understanding population versus seeding rate
  – **Population** is the measurement of the final plant stand/acre.
  – **Seeding rate** is the calculation based on the desired final stand and the seed germination (typically around 95% for most products) and expected plant survival.

• Other factors that contribute to population decisions include:
  – Row spacing
  – Planting speed
  – Germination
  – Fertility
  – Weed management
  – Equipment
Population and Yield Components

• Yield increases with modern corn products are related to the ability of plants to withstand stress and produce an ear on every plant.

• More plants per acre are expected to lead to more ears per acre.

• In addition to ears per plant, kernels per ear and weight per kernel are also affected by plant population.
Effects of Plant Population

• **Important agronomic considerations include** standability, disease and drought tolerance, insect and herbicide resistance, and good emergence in cool conditions.

• **Emergence and Vigor:** A strong emergence and vigor rating for a product is especially beneficial if that product will be planted in a no-till or reduced tillage field, or planted early.

• **Disease Tolerance:** It is important to evaluate products for tolerance to diseases that are common in your geography.

• **End of Season Characteristics:** Drydown, stalk quality, and root strength can help plan out harvest.

• **Trait Consideration:** Planting products with multiple mode protection, such as products with the Genuity® SmartStax® technology can help minimize risks from insect damage.
Response of Yield to Plant Populations

- Yield increases with increasing seeding rates to a point and then levels off.
- Yields that level off, rather than drop off as populations become greater, is an important factor for Variable Rate Seeding.

Ear Type and the Effect on Population

- **Fixed**: *Consistent size across plant populations.*
  - “Fixed ear” corn products tend to perform best at higher-than-average plant populations.

- **Limited Flex**: *Slight increase in ear size at lower plant populations.*

- **Flex**: *Significant increase in ear size at lower plant populations.*
  - “Flex ear” corn products have the capacity to sustain yield potential at lower plant populations under good growing conditions.
  - Many “Flex ear” corn products also have the ability to perform at higher plant populations.

- **Prolific**: *Produces more than one harvestable ear per plant at lower plant populations.*
Ear Effect on Populations:
Monsanto Research Farm Trial at West Lafayette, IN

Each row of each product gets progressively “thinner” as you move down the row, from 30K, to 22K, to 12K.
30,000 PPA at pollination

22,000 PPA at pollination

12,000 PPA at pollination
Ear Effect on Populations

Hand harvested 3 consecutive plants from each population at harvest time.
Remember....

This may look good, but....

There are 2 ½ times as many plants per acre here.
Example of a Fixed Ear Corn Product
Example of a Limited Flex Ear Corn Product

12,000

24,000

30,000
Example of a Flex Ear Corn Product

12,000  24,000  30,000
Each year farmers select specific corn products to be planted in particular fields at certain planting populations, while carefully weighing the potential for increased yield with the potential for stalk and root lodging or lack of return on the investment for increased seeding rates.

- **Advancements in biotech traits** have helped reduce the risk of stalk and root lodging due to damage from target insects like ECB and CRW.

- **Advancements in germplasm** have helped reduce plant and ear heights, which may help reduce the risk of stalk lodging due to conditions which cause stalks to weaken and lodge (windstorms).
Soil can influence population decisions. Understanding your soils and fertility levels is crucially important when increasing populations.

When increasing populations, applied nutrients must also increase.

Figure 3. Soil textural triangle.

Figure 4. Aerial map of field identifying different soil types with FieldScripts®.

Effects of Plant Population: Corn Product Response to Population, Row Configuration, and Soil Type

Figure 5. Effect of population on corn yield across seven corn products in 30-inch single rows in sandy loam vs. silty clay locations.

Source: Corn response to population, row configuration, and soil type. 2011. The Learning Center at Scott, MS.
# Effects of Plant Population: Nutrient Consideration

<table>
<thead>
<tr>
<th>Corn Nutrient Removal - Grain Only (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual nutrient removal may vary based on many factors.*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bu/Acre</th>
<th>Nitrogen (N)</th>
<th>Phosphorus (P)</th>
<th>Potassium (K)</th>
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</thead>
<tbody>
<tr>
<td>300</td>
<td>201</td>
<td>105</td>
<td>75</td>
</tr>
<tr>
<td>240</td>
<td>161</td>
<td>84</td>
<td>60</td>
</tr>
<tr>
<td>200</td>
<td>134</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>180</td>
<td>120</td>
<td>63</td>
<td>45</td>
</tr>
<tr>
<td>160</td>
<td>107</td>
<td>56</td>
<td>40</td>
</tr>
<tr>
<td>100</td>
<td>67</td>
<td>35</td>
<td>25</td>
</tr>
</tbody>
</table>

*N, P, and K numbers courtesy of the International Plant Nutrition Institute (IPNI). These numbers are estimations.

Figure 6. Corn nutrient removal based on yield.

Higher populations means that the placement of every plant - every seed is critical.

Corn plants closer than 4 inches sense stress and respond.

Today's planters can achieve spacing accuracy of 97% or more.

Figure 7. Corn yields for seed products with and without corn rootworm protection as plant population increases.

Effects of Plant Population: Impact of Planting Speed on Corn Population

- Data shows that as planting speed increased, the average plant population decreased.

- For each 1 MPH increase in planting speed, the corn population decreased by 1,738 plants/acre when averaged across planter meter types under the conditions of this trial.

Figure 8. Bivariate fit of average plant population by planting speed when analyzed across planter meter types (Linear Fit: Ave Population = 39,177.53 – (1738.11 x speed); Summary of fit: R² = 0.483492, adjusted = 0.468734).

Effects of Plant Population

- Twin rows are a popular planting method in some areas of the country

Benefits –
- Better weed control
- Less water loss to evaporation
- Use of less equipment
- More equal planting distance in the row
- Potentially higher yields

Cons –
- Potential compaction issues
- Options for herbicides and cultivation may be more difficult
- Equipment updates to move to twin row equipment

Figure 13. Yield response of corn to 15-, 30-, and 36-inch single row and 30-inch twin row spacings at the Monsanto Learning Center at Gothenburg, NE. 2010.

Figure 14. Yield response of 114 RM product and 116 RM product to single and twin row spacing at the Monsanto Learning Center at Scott, MS 2012.

Effects of Plant Population

- When selecting a product for narrow rows, consider:
  - Stalk strength
  - Root strength
  - High yield potential products
  - Upright leaf type products
  - Stress and disease tolerant products

<table>
<thead>
<tr>
<th>Seeds planted (per acre)</th>
<th>Row Spacing (in)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>24,000</td>
<td>13.1</td>
</tr>
<tr>
<td>26,000</td>
<td>12.1</td>
</tr>
<tr>
<td>28,000</td>
<td>11.2</td>
</tr>
<tr>
<td>30,000</td>
<td>10.5</td>
</tr>
<tr>
<td>32,000</td>
<td>9.8</td>
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<tr>
<td>34,000</td>
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<td>36,000</td>
<td>8.7</td>
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<tr>
<td>52,000</td>
<td>6.0</td>
</tr>
<tr>
<td>54,000</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Figure 15. Row spacing for 20- and 30-inch rows by planting population.

Source: Table modified from Waitrak, P. Planting populations. Clemson University. http://www.clemson.edu/
Row Spacing Study at Champaign, IL in 2013

- The biological maximum yield for 30-inch rows occurs at 36,000-38,000 plants/acre.

- Overall, response to 20-inch rows showed the most value at higher plant densities.

- Specific corn products had greater yields with narrower row spacing.

Figure 16. Yield response of 20- and 30-inch rows to planting population.

Effects of Plant Population

- **Irrigation and water needs** play an important role when increasing population.

- Along with water, one should **increase nutrients** when irrigating a crop at higher populations.

### Table 2. Average crop water use (ET) by growth stage for 113-day maturity corn grown in South Central Nebraska

<table>
<thead>
<tr>
<th>Growth stage</th>
<th>Average water use rate (inches/day)</th>
<th>Duration* (days)</th>
<th>Water needed to reach stage (inches)</th>
<th>Water needed cumulative (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-leaf (V4)</td>
<td>0.08</td>
<td>0-10</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>8-leaf (V8)</td>
<td>0.10</td>
<td>11-29</td>
<td>1.8</td>
<td>2.6</td>
</tr>
<tr>
<td>12-leaf (V12)</td>
<td>0.18</td>
<td>30-46</td>
<td>2.9</td>
<td>5.5</td>
</tr>
<tr>
<td>Early tassel (R1)</td>
<td>0.26</td>
<td>47-55</td>
<td>1.8</td>
<td>7.3</td>
</tr>
<tr>
<td>Silking (R2)</td>
<td>0.32</td>
<td>56-68</td>
<td>3.8</td>
<td>11.1</td>
</tr>
<tr>
<td>Blister kernel</td>
<td>0.32</td>
<td>69-81</td>
<td>3.8</td>
<td>14.9</td>
</tr>
<tr>
<td>R3</td>
<td>0.32</td>
<td>82-88</td>
<td>1.9</td>
<td>16.8</td>
</tr>
<tr>
<td>Beginning dent</td>
<td>0.24</td>
<td>89-104</td>
<td>3.8</td>
<td>20.7</td>
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<tr>
<td>R4.7</td>
<td>0.20</td>
<td>105-125</td>
<td>3.8</td>
<td>24.5</td>
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<tr>
<td>Full dent (R5.5)</td>
<td>0.10</td>
<td>126-140</td>
<td>1.4</td>
<td>25</td>
</tr>
</tbody>
</table>

*Long-term average number of days since planting required to progress from the previous growth stage to the next. For example, to go from the blister kernel stage to the beginning dent stage requires approximately 15 days (day 89 to day 104). Days to each growth stage were determined using the Hybrid-Maize Corn Growth Model for the period 1982-2005 at Clay Center, NE.

Source: Hybrid-Maize Corn Growth Model for the period 1982-2005 at Clay Center, NE. University of Nebraska.
PNW Differences

Positives
• Sunlight
• Day to Night Temp Differences
• Water / Water Timing

Negative Considerations
• Soil Attributes - Organic Matter, PH, Water Holding Ability
Effects of Plant Population: Product Positioning

• What is Product Positioning?
  – The process of positioning your product under the right conditions/fields to meet your needs, field conditions, management practices and create a success for your operation.
  – In simple terms: “Placing the right product on the right ground.”
Effects of Plant Population: Increasing Yield Potential with VRS

- Variable rate seeding (VRS) has helped increase yield potential in fields:
  - Plant populations can vary 5-12,000 plants/acre depending on the field conditions.
  - VRS allows the grower to adjust populations based on the conditions and soil variability of the field.
  - VRS also allows the grower to match products with the field conditions and populations.

- FieldScripts® is a technology developed by Monsanto to help growers maximize their yield potential and use VRS.
Effects of Plant Population: Variable Rate Seeding (VRS)

Seed product selection and seeding rate recommendations can be improved with knowledge of field areas.

- Knowledge of areas where moisture limitations are most common, and spatial characterization of the factors (higher elevation, increased slope percentage, lower organic matter, etc.) that most influence yield in a particular field help form seeding rate recommendations.
Summary

• Increasing populations can result in increased yield potential.

• New genetics may perform better with increased populations.

• Management decisions including nutrient application, irrigation, soil management, and product selection can all enhance yield potential based on increased populations.

• Asking your agronomist and/or seed representative to help with your product decision making.
Questions?

Thank you!
Sources/Legal


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B.t. products may not yet be registered in all states. Check with your Monsanto representative for the registration status in your state. IMPORTANT IRM INFORMATION: Genuity® RIBComplete® corn blend products do not require the planting of a structured refuge except in the Cotton-Growing Area where corn earworm is a significant pest. See the IRM/Grower Guide for additional information. Always read and follow IRM requirements.

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible.

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