Effects of Population and Variable Rate Seeding on Corn Yield

- Corn populations have increased by 300 to 425 plants/acre per year in the Corn-Growing Area over the past 25 years.\(^1\)\(^,\)\(^2\)
- Plant population increases have been directly correlated to corn yield increases.
- Optimum seeding rate is complex and affected by economics and may vary across sub-field areas.
- Variable Rate Seeding (VRS) can lead to optimum seeding rates for each part of a field.

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 affected by plant population.

Population Research
Great efforts are spent researching plant populations for specific corn products. After identifying products that are adapted to your area, population recommendations for each product should be carefully examined. Understanding how the individual products respond to different populations can help maximize corn yield potential.

Corn product response to population can be divided into two general categories. “Flex ear” products have the capacity to sustain yield potential at lower plant populations when the growing conditions are good. Many “Flex” products also have the ability to perform at higher plant populations. “Fixed ear” products tend to perform best at higher-than-average plant populations. It is rare to find products that are on the extremes of “Flex” or “Fixed” characterization; however, there is a range of “ear flex” in the marketplace.

Researchers can refer to several statistical models to determine optimum seeding rates. For example, a quadratic plateau model demonstrates yield increases with increasing seeding rates to a point where yield then levels off. Yields that level off, rather than drop off (Figure 1), as populations become greater is an important factor for VRS. Modern corn products with tolerance to the stress of high populations demonstrate yield leveling as the population needed to maximize yield potential in a certain area of a field in a given year is exceeded.

Variable Rate Seeding
Variable rate seeding (VRS) may be another management strategy to mitigate some of the risk related to areas affected by drought. Identification of yield potential in sub-field areas, and ultimately the attributes of those specific environments within a field that influence yield, will aid in understanding the potential benefits of VRS. Seed product selection as well as 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 potential in a particular field help form seeding rate recommendations. Defining these areas most often occurs by utilizing past yield data and/or imagery of a field, but some caution should be taken. Yield data as well as imagery is merely an assessment of how the crop has performed up to that point in time, and is highly influenced by the environment (soil mineralogy, landscape position, weather conditions of the growing season, etc).

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These factors need to be known to understand the primary attributes that contribute to yield potential in each of the sub-field environments.

Along with environment, characteristics of a corn product and the associated response to population should be considered. Corn products respond differently in various environments and that response is also confounded by population management. Corn product characterization by yield environment, as well as understanding the product response to population in that specific yield environment, helps bring clarity to optimizing seeding rate on each acre or sub-acre area of a field. Without understanding both the corn product response to environment and population and environmental attributes that contribute to yield in sub-field areas, the true potential of VRS will be difficult to achieve.

**Evaluation.** When making a seeding rate prescription, check strips or blocks can be included to evaluate the prescribed seeding rates within that year. Evaluation should also include stand counts early in the year to determine if the seeding rate accomplished the targeted plant population. Compare the costs and return of the prescribed variable seeding rates to a uniform seeding rate. Some additional questions when evaluating VRS include:

- What is the optimum seeding rate recommended for the corn product?
- If the optimum seeding rate was used as a uniform seeding rate, what would be the maximum yield potential? How much of the field reached maximum yield potential in a given year?
- Were conditions good enough that poor-yielding areas could provide average yield?
- Did bad conditions dominate and good-yielding areas struggle to yield?
- What was the cost to implement VRS?

**Summary**

Corn yield increases associated with population increases are related to stress tolerance of modern corn products. Successful pollination and ear production can be affected by field variability and growers and researchers are evaluating ways to prescribe target populations for each area of the field. Target populations are complex to determine, as they are affected by economics and yield components. VRS combines prescribed seeding rates with variable rate controller technology on planters. Execution and evaluation of VRS can lead to economically optimized seeding rates for each part of a field.

Table 1. Estimated return of investment to uniform seeding rates is a place to begin evaluating variable rate seeding.

<table>
<thead>
<tr>
<th>Seeding rate/acre</th>
<th>Seed cost $/acre*</th>
<th>Breakeven bu/acre**</th>
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* Estimated cost of $350 per 80,000 seed unit
** Assumed corn grain price of $3.50/bu

Sources:
Other publications:
Web sources verified 12/15/14.

For additional agronomic information, please contact your local seed representative.