Estimating Corn Yields Using Yield Components

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Estimating Corn Yields Using Yield Components

Abstract
It’s that time of year when corn yield estimations increase. The USDA NASS objective yield survey came out on August 17. This report indicates the third highest yield on record (behind 2016 and 2015) at 188 bushels per acre. Moderate to severe drought conditions are undoubtedly the cause for the reduced yields in Iowa this year. It should be expected that there will be large variation in yield within fields but also from one field to the next depending on hybrid selection, date of planting, and field uniformity. Following are some insights into corn yield components and how and when yield components are influenced by crop stresses such as drought.

Disciplines
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There are five components of corn yield that can be measured: plants per acre, ears per plant, rows per ear, kernels per row, and kernel weight. These components are generally determined in this sequence during the growing season. Measuring these factors in order to determine corn yield is called the Yield Component Method, which was described by the University of Illinois many years ago. This method is popular because it can be used before harvest, as early as the milk stage of kernel development. It is important to quantify these components when plant stressors occur so you know which components are affected.

Plants per acre
The number of plants per acre is usually determined by seed rate, seed quality, and the environment of the soil at planting and germination. Other factors can change the number of plants per acre as well, including crusting, cultivator damage, insect feeding, hail, green snap, stalk lodging, and any other kind of damage. As for ears per plant, most hybrids commonly grown in Iowa have one dominant ear. Corn develops more than one ear shoot per plant, but usually only the primary ear shoot produces kernels.
Ears per plant
Oftentimes, the observance of ears per plant and plants per acre are combined (ears per acre). This is done by determining ears per acre similarly to plants per acre, omitting barren plants. Barren plants can be a result of too high of a plant population, moisture stress, nutrient deficiency, or a combination of these factors. On that same note, multiple ears per plant can be realized if populations are low or neighboring plants are nonexistent. This could happen at a field border where plants have access to more water, nutrients, and sunlight.

Determination of ears per acre cannot be made before pollination. To measure ears per acre, it is important to determine this at multiple places within a field, especially if crop uniformity is low. At each estimation site, measure off a length of a single row equal to \( \frac{1}{1000} \) acre (for 30-inch rows, this is 17 feet, 5 inches). Then, record the number of harvestable ears.

Kernel rows per ear
Developmentally, kernel row number is determined by the 6th leaf stage (V6). Hybrid genetics is the most important factor in determining the number of potential kernel rows. However, plant stresses can reduce the actual number of kernel rows produced. The number of kernel rows on an ear will usually be an even number because the first kernel initials are split, forming two rows from one. Kernel rows can be visually observed by dissecting ear shoot as early as the mid to late vegetative stages.

Kernels per row
Kernels per row are determined, developmentally, at approximately the 6th leaf stage (V6) up to tasseling (VT), with the maximum number of ovules set about one week before silks begin to emerge. Plant stress at this time can reduce the number of ovules that develop. It has been estimated that there are up to 1,000 ovules per ear. The number of ovules that are fertilized and retained ultimately determines kernels per row. Kernel abortion will occur as late as the milk stage (R3) if plant stress occurs to the point where insufficient resources become available. Kernel abortion occurs starting from the tip of the ear. The measurement of kernels per ear can be determined as early as the milk stage (R3).

To determine kernel rows per ear and average kernels per row, record the number of complete kernel rows per every fifth ear in the row. Then multiply each ear’s row number by its number of kernels per row. This will give you the number of kernels per ear. Don’t sample nubbins or otherwise deformed ears unless they represent the sample area well. If row number changes from butt to tip, estimate an average row number for the ear. Don’t count the extreme butt or tip kernels or aborted kernels. If kernel numbers per row are uneven among the ear rows, estimate the average value for kernels per row.
Kernel weight
Kernel weight is largely determined from the blister (R2) through dent (R5) stages. It is common to use a generic, assumed value for kernel weight when determining yield estimates. Common kernel weights range from 0.26-0.27 grams per kernel. For yield estimation, a correction factor of 65,000 to 100,000 kernels per 56-pound bushel is used; 90,000 is most commonly used. If your crop is subject to stress before R6, starch accumulation in the kernels is reduced, so you will have a lower kernel weight. In this case, you will want to adjust the value downward. If your crop grows in nearly perfect conditions, the value can be adjusted upward.

Yield estimation using yield components
Yield estimation can be made by accurately determining the 5 yield components (Yield = Plants/acre * Ears/plant * Kernel rows/ear * Kernels/row * Kernel weight). However, often times the determination of ears per acre is made and an assumption of 90,000 kernels per 56-pound bushel is used, and the equation is modified to:

\[
\text{Corn Yield} = \frac{\text{Ears/Acre} \times \text{Kernel Rows/Ear} \times \text{Kernels/Row}}{90,000 \times \text{Kernels/Bushel}}
\]

This equation can be used to accurately estimate corn yields within +/- 20 bushels per acre. The accuracy of the estimation depends on the frequency of estimations made within a field. It is recommended to make estimations in at least 5 places within in a field and from at least 10 ears for each estimation. If fields are highly variable, making more yield estimates is advised.

Test weight
Kernel weight, along with kernel size, shape and density all affect test weight. Test weight measures how many pounds of corn will fit into a certain volume (a bushel). It is one factor that is used to measure the quality of a crop. Test weight is grain weight/volume of grain (i.e. pounds per bushel). Corn test weights can range from 45 pounds per bushel to 60 pounds or more per bushel. The market standard is 56 pounds per bushel for No. 2 Yellow Dent corn.

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