Estimating Corn Grain Yield Prior to Harvest

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Fancy colored yield maps are fine for verifying grain yields at the end of the harvest season, but bragging rights for the highest corn yields are established earlier than that down at the Main Street Cafe, on the corner of 5th and Earl. Some patrons of the cafe begin "eyeballing" their yields as soon as their crops reach "roasting ear" stage. Some of the guys there are pretty good (or just plain lucky) at estimating yields prior to harvest, while the estimates by others are not even close to being within the proverbial ballpark. Interestingly, they all use the same procedure referred to as the Yield Component Method.

Yield Component Method

Other pre-harvest yield prediction methods exist (Lauer, 2002; Lee & Herbek, 2005; Thomison, 2013), but the Yield Component Method is probably the most popular because it can be used well ahead of harvest; as early as the so-called "roasting ear" or milk (R3) stage of kernel development. Under "normal" conditions, the kernel milk stage occurs about 18 to 22 days after pollination is complete (Nielsen, 2013). Estimates made earlier in the kernel development period risk being overly optimistic if subsequent severe stresses cause unforeseen kernel abortion (Nielsen, 2013).

The Yield Component Method was originally described by the University of Illinois many years ago and is based on the premise that one can estimate grain yield from estimates of the yield components that constitute grain yield. These yield components include number of ears per acre, number of kernel rows per ear, number of kernels per row, and weight per kernel. The first three yield components (ear number, kernel rows, kernels/row) are easily measured in the field.
Final weight per kernel obviously cannot be measured until the grain is mature (kernel black layer) and, realistically, at harvest moisture. Consequently, an average value for kernel weight, expressed as 80,000 kernels per 56 lb bushel, is used as a proverbial "fudge factor" in the yield estimation equation. The equation originally used a "fudge factor" of 90, but kernel size has increased as hybrids have improved over the years. Consequently, a "fudge factor" of 75 to 85 is a more realistic value to use today.

Crop uniformity greatly influences the accuracy of any yield estimation technique. The less uniform the field, the greater the number of samples that should be taken to estimate yield for the field. There is a fine line between fairly sampling disparate areas of the field and sampling randomly within a field so as not to unfairly bias the yield estimates up or down.

1. At each estimation site, measure off a length of row equal to 1/1000th acre. For 30-inch (2.5 feet) rows, this equals 17.4 feet.

   **TIP:**
   For other row spacings, divide 43,560 by the row spacing (in feet) and then divide that result by 1000 (e.g., \([43,560/2.5]/1000 = 17.4 \text{ ft}\)).

2. Count and record the number of ears on the plants in the 1/1000th acre of row that you deem to be harvestable.

   **TIP:**
   Do not count dropped ears or those on severely lodged plants unless you are confident that the combine header will be able to retrieve them.

3. For every fifth ear in the sample row, record the number of complete kernel rows per ear and average number of kernels per row. Then multiply each ear's row number by its number of kernels per row to calculate the total number of kernels for each ear.

   **TIPS:**
   Do not sample nubbins or obviously odd ears, unless they fairly represent the sample area. If row number changes from butt to tip (e.g., pinched ears due to stress), estimate an average row number for the ear. Don't count the extreme butt or tip kernels, but rather begin and end where you perceive there are complete "rings" of kernels around the cob. Do not count aborted kernels. If kernel numbers are uneven among the rows of an ear, estimate an average value for kernel number per row.

4. Calculate the average number of kernels per ear by summing the values for all the sampled ears and dividing by the number of ears.

   **EXAMPLE:**
   For five sample ears with 480, 500, 450, 600, and 525 kernels per ear, the average number of kernels per ear would be \((480 + 500 + 450 + 600 + 525)\) divided by 5 = 511.

5. Estimate the yield for each site by multiplying the ear number (Step 2) by the average number of kernels per ear (Step 4) and then dividing that result by the number below that best represents the kernel set and grain fill conditions this year for the field whose yield you are estimating. The values below represent the range in numbers of kernels (thousands) in a 56# market bushel that correlate to growing conditions during grain fill and subsequent yield. See first image below for an illustration of that relationship.
Grain yield versus kernels per bushel.

Random sample of ears.

Poor tip fill due to N deficiency.

Kernel size differences due to N deficiency.

Table 1.
Range in kernel numbers per 56 lb. bu. relative to growing conditions during the grain fill period.

<table>
<thead>
<tr>
<th>Growing conditions</th>
<th>Range in kernel number per bu. (thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>less than 75</td>
</tr>
<tr>
<td>Average</td>
<td>75 to 85</td>
</tr>
<tr>
<td>Poor</td>
<td>greater than 85</td>
</tr>
</tbody>
</table>

Example:
Let's say you counted 30 harvestable ears at the first thousandth-acre sampling site. Let's also assume that the average number of kernels per ear, based on sampling every 5th ear in the sampling row, was 511. Let's also assume that growing conditions during grain fill were average. The estimated yield for that site would (30 x 511) divided by 80, which equals 192 bu./ac.

Repeat the procedure throughout field as many times as you deem to be representative. Calculate the average yield for all the sites to estimate the yield for the field.

Remember that this method for estimating pre-harvest grain yield in corn indeed provides only an estimate. Since kernel size and weight will vary depending on hybrid and environment, this yield estimator should only be used to determine “ballpark” grain yields. Yield can easily be overestimated.
in a year with poor grain fill conditions (e.g., low kernel size and weight from a drought year) and underestimated in a year with excellent grain fill conditions (e.g., larger kernel size and weight from non-stress grain fill periods).

Recognize that the Yield Component Method for estimating corn grain yield is probably only accurate within plus or minus 30 bushels of the actual yield. Obviously, the more ears you sample within a field, the more accurately you will "capture" the variability of yield throughout the field. Use the yield estimates obtained by this method for general planning purposes only.

**The Pro Farmer Midwest Crop Tour Method**

The Pro Farmer group of Farm Journal Media sponsors an annual Midwest Crop Tour that sends out teams of "scouts" to visit corn fields throughout the Midwest to estimate yields. The method used in that effort is a variation of one described years ago by University of Minnesota agronomist Dale Hicks (now Professor Emeritus) that combines the use of several yield components (ears per acre and kernel rows per ear) with a measurement of ear length (a proxy for kernel number per row).

The focus of the crop tour is not to necessarily estimate the yields of specific fields, but rather to more broadly estimate the yield potential within regions of the Midwest, so one probably should exercise caution in using this method for estimating yields within an individual field. Nevertheless, folks who have heard about the Pro Farmer Tour may be interested in trying the method themselves, so here are the steps involved with the Pro Farmer method (Flory, 2010). I would certainly suggest that these steps be repeated in several areas of an individual field because of natural spatial variability for yield.

1. Measure and record the row spacing (inches) used in the field.

   **Example:**
   
   30 inches

2. Walk through the end rows into the bulk of the field, then walk about 35 paces down the rows to the first sampling area.

   **Tip:**
   
   For subsequent yield estimates within the field, I would suggest walking even further into the field and crossing over multiple planter passes to sample different areas of the field.

3. Measure or step off 30 feet down the row, then count all ears in the two adjacent rows. Divide that number by two and record it.

   **Example:**
   
   \[(42 \text{ ears in one row } + 45 \text{ ears in other row}) \div 2 = 43.5\]

4. Pull the 5th, 8th and 11th ears from plants in one row of the sampling area.

   **Tip:**
   
   Frankly, I would suggest harvesting up to 5 ears from each of the two adjacent rows to better sample the area and minimize the effect that one oddball ear could have on the calculated average ear lengths and kernel row numbers.

5. Measure length of the portion of each ear that successfully developed kernels. Calculate the
average ear length of the three ears and record it.

**Example:**

\[
\frac{6 \text{ inches} + 7 \text{ inches} + 5 \text{ inches}}{3} = 6
\]

6. Count the number of kernel rows on each ear. Calculate the average kernel row number and record it.

**Example:**

\[
\frac{16 \text{ rows} + 14 \text{ rows} + 16 \text{ rows}}{3} = 15.3
\]

7. Grain yield for the sampling area is calculated by multiplying the average ear count by the average ear length by the average kernel row number, then dividing by the row spacing.

**Example:**

\[
\frac{43.5 \text{ ears} \times 6 \text{ inches} \times 15.3 \text{ rows}}{30\text{-inch rows}} = 133 \text{ bu/ac yield estimate}
\]

**Related Reading**


