FIELD FACTS

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Estimating Corn Yields by the Kernel Count Method

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Introduction

Corn yield estimations prior to harvest are helpful in planning harvest operations, including drying, storage and marketing of grain. They may also be useful in making preliminary hybrid selections and buying decisions for next year's crop, as seed-corn discounts are often greater with early purchases. Yield estimate accuracy increases with crop maturity, but early estimates provide more time for developing strategies to deal with the expected volume of grain, and also satisfy a grower's most basic curiosity – how is my corn crop going to do?

Counting kernels to estimate yield under a high yield environment (left) and a drought environment (right).

Components of Crop Yield

Ultimate corn yield depends on number of ears per acre, number of kernels per ear, and average weight per kernel. Though the first two components may be evident three weeks after silking, the weight per kernel is unknown until five or six weeks later. This is because kernel depth and density (test weight) continue to increase until black layer. Consequently, early estimates have to account for kernel weight by using a broad average. This kernel weight component contributes most to yield estimate variability, especially if growing conditions deviate from normal after the estimate, or a hybrid's intrinsic kernel weight is much higher or lower than average.

General Theory of Yield Estimation

Yield estimation procedures for reproductive growth stages R3 through R5 (milk through dent) involve a random sampling procedure to approximate ears per acre and kernels per ear. An estimate of kernel weight (kernels per bushel) is then applied to determine bushels/acre. The broad average applied in original yield estimation procedures was 90,000 kernels per bushel of corn at 15.5% moisture, or approximately 1600 kernels per pound. Upgraded procedures have allowed users to input a different kernel weight that may be more accurate for the hybrid or growing environment.

Sampling Procedure

Yield estimation methods vary in their sampling procedures, but the goal of sampling is the same; that is, to reasonably represent the field without making the process excessively arduous or time-consuming. This can be accomplished in a number of ways, but will ultimately depend on field uniformity. A uniform field requires relatively few samples; a field that varies due to topography, soil type, compaction, uneven emergence, water damage, drought stress, nitrogen deficiency or other factors requires more samples. In extreme cases, a variable field can be split into two or more fields if the borders of non-uniform areas are clear and the size of each part can be easily determined.

General Procedure (see more details in next section)

1. Sampling Intensity:
   - In uniform fields, conduct 5 to 8 individual samples, or about one sample for every 10 to 15 acres.
   - In non-uniform fields, conduct 8 to 12 individual samples, or about one sample for every 6 to 10 acres.
2. Choose each sample location at random.
3. For each sample, measure 1/1000 acre.
4. Count number of ears in each 1/1000 acre sample.
5. Count kernels per ear on 3 ears from each 1/1000-acre sample.
6. Average the number of ears across all sample locations of the field.
7. Average the kernels per ear across the 3 ears of each sample and across all the sample locations of the field.
8. Multiply number of ears x kernels per ear x 1000.
9. Divide the answer from step 8 above by number of kernels per bushel to get bu/acre (at 15.5% moisture). *See step 9 in section below for more explanation*.

Details of Procedure

1. **Sampling Intensity** should be commensurate with the purpose of the yield estimate and time available. Determining if a field is uniform or non-uniform and whether to split

a field into two or more fields will have a large impact on the accuracy of the overall field estimate.

2. **Choose a sample location.** Use a pre-determined method to avoid bias when picking a sample spot in the field. For example, walk 20 paces into the field and begin exactly there.

3. **Measure 1/1000 acre.** Use a tape or pre-measured rod to measure 1/1000 acre. For **30-inch rows**, 1/1000 acre = 209 inches (**17 feet 5 inches**).

   For other row widths, divide 6273 by the row width. For example, for 36-inch rows: 1/1000 acre = 6273/36 = 174 in. = 14 ft. 6 in.

4. **Count number of ears per 1/1000 acre.** If there are two ears per plant, count them both. But do not count "nubbin" ears that have less than 5% of the kernels of normal ears.

5. **Count kernels per ear on three ears from each 1/1000 acre sample.** Pick the three ears using a pre-determined procedure to avoid bias. For example, take the 5th, 15th, and 25th ears. Do not use nubbin ears that were not included in the ear counts. (For greater accuracy, you may sample and count kernels on more than 3 ears. For example, use five ears or six ears.)

   It is likely easiest to count number of rows and number of kernels per row and multiply to arrive at kernels per ear. With irregular ears such as pinched ears or drought-stressed ears, you may need to adjust that process. Do not count aborted kernels that will contribute little to yield.

6. **Average the number of ears across all sample locations of the field**. Simply add the number of ears in all samples (from step 4 above) and divide by the number of samples.

7. **Average the number of kernels per ear.** Simply add the number of kernels from all ears for which kernels were counted (from step 5 above) and divide by the number of ears for which kernels were counted.

8. **Multiply number of ears x kernels per ear x 1000.** Multiply the average number of ears by the average number of kernels/ear (from steps 6 and 7 above). Multiply this number by 1000 to get number of kernels per acre.

9. **Divide the answer from step 8 by number of kernels per bushel.** For example, the broad average for number of kernels per bushel is 90,000. Divide the answer from step 8 by 90,000 to get average bu/acre for the field (at 15.5% moisture). *90,000 may not be the best number to use – see section below to help determine the best number.*

What Number to Use for Kernels per Bushel?

Though the original procedure used a broad average of 90,000 kernels per bushel, this is not always the best estimate to use. Hybrids intrinsically differ in kernel size and test weight, and the growing environment also significantly impacts this trait. Much accuracy can be gained in the estimation process if the number of kernels/bu is chosen to better fit the particular hybrid or environment. For this reason, Pioneer Hi-Bred provides average kernel weights (kernels/bu) for its hybrids to use in the yield estimation process (Table 1).

Table 1. Average** kernels per bushel (at 15.5% moisture) for Pioneer® brand hybrid platforms.

Pioneer Hybrid Platform	Average** kernels/bu		Pioneer Hybrid Platform	Average** kernels/bu
31G98	67,000		33T56	81,200
31N27	68,000		33W82	78,500
31P41*	64,700		34A15	79,800
32B10	71,400		34A92*	71,800
32B81	70,100		34D71*	79,000
32N89	74,400		34H31	75,000
32T83	87,100		34K77	81,400
33A84	71,500		34N43	83,200
33B50	76,800		34P88	82,700
33D11	81,300		34P93	77,100
33F12	75,900		35A30	69,100
33G58	67,500		35D28	81,100
33H25	75,800		35F38*	79,600
33H82	73,100		35P12	68,100
33K39	82,800		36B08	73,200
33N09	81,100		36V74	79,400
33N56	78,600		37Y12*	75,400
33R77*	84,800			

* Limited observations.

** This average value should be used for ballpark yield estimates only. Kernel weights may vary from the indicated average value primarily due to environmental conditions and hybrid response.

Reference

Univ. of Illinois. 2005. Estimating corn yields (an online calculator). Illinois Agronomy Handbook. Online at:

http://iah.aces.uiuc.edu/index.php?ch=ch2/est_corn_yield.html