SDSU Extension

iGrow Corn

BEST MANAGEMENT PRACTICES

Chapter: 38
Estimating Corn Yields

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Corn yield estimates can be used for a variety of purposes including: marketing; planning storage requirements; organizing harvest equipment; and making decisions about pests. The purpose of this chapter is to provide guidance and examples on how to convert field measurements into estimated corn yields.

Table 38.1 Basic steps to estimate yields:

1. Yield estimates start with tracking seed germination, assessing planter effectiveness, and determining your plant density. Many of these measurements can occur shortly after seedling emergence.
2. As you approach plant maturity, grain yields can be estimated by assessing the number of kernels/ear and kernel weight. The basic steps include:
   a. Estimating the ears/acre.
   b. Estimating the kernels/ear.
   c. Calculating kernels/acre = (ears/a × kernels/ear).
   d. Estimating kernel size (kernels/bushel).
   e. Calculating bu/acre = [(kernels/a)/(kernels/bu)].

Estimating Yield after Emergence

As the corn plant grows, it is important to identify problems that could reduce yields. This requires that the fields be routinely scouted (by ground or through aerial imagery) and calculations conducted to convert point measurements to common yield units, usually bushels/acre. To estimate yield following emergence, you need to make many assumptions, which include:

1. The number of rows of kernels on an ear.
2. The number kernels in each of the rows.
3. The number of kernels per bushel (weight/kernel).

Example 38.1 provides steps for determining yield estimates. These estimates are based on plant population and do not consider how yield may be reduced due to planting date, or pest or nutrient stresses. For example, Carter et al. (1989) and Nafziger et al. (1989) reported that a 1.5-week delay from the "normal" planting date decreased yield 5% and that a 3-week delay reduced yield 12%.

Example 38.1 Calculations for yield potential based on seedling number or plant population prior to the reproductive growth stages.

This calculation is based on the assumptions that: 1) the average grain contained on an ear is 0.28 lb/ear and 2) there is one ear per plant.

$$\text{Estimated yield} = \frac{\text{plants}}{\text{acre}} \times \frac{\text{ear}}{\text{plants}} \times \frac{0.28\ \text{lb}}{\text{ear}} \times \frac{\text{bu}}{56\ \text{lbs}}$$

$$\frac{35{,}000\ \text{plts}}{\text{acre}} \times \frac{\text{ear}}{\text{plt}} \times \frac{0.28\ \text{lb}}{\text{ear}} \times \frac{\text{bu}}{56\ \text{lbs}} = \frac{175\ \text{bu}}{\text{acre}}$$

This calculation is based on kernels per ear and assumes that there are 90,000 kernels in 56 lbs of grain.

$$\text{Estimated yield} = \frac{\text{plants}}{\text{acre}} \times \frac{\#\text{kernels}}{\text{ear}} \times \frac{\text{bu}}{90{,}000\ \text{kernel}}$$

$$\text{Estimated yield} = \frac{35{,}000\ \text{ears}}{\text{acre}} \times \frac{16\text{row} \times 28\ \text{kernel/row}}{\text{ear}} \times \frac{\text{bu}}{90{,}000\ \text{kernel}} = \frac{175\ \text{bu}}{\text{acre}}$$

Both approaches make assumptions about the size of the ear. Different assumptions will influence the expected yields. The number of rows on the ear is impacted by the plant's genetic capacity, whereas the number of kernels in a row is impacted by the environment and population density.

Yield Estimates During the Early Reproductive Stages of Corn Growth (R1-R3)

As the season progresses, the yield estimates become more accurate. The R1 growth stage occurs when silks are visible outside the husk (Chapter 5). At this growth stage, the silks catch the falling pollen grains and fertilization occurs after the pollen moves down the silk to the ovule. Each ovule has the capacity to become a kernel. Yield is estimated by measuring the plant population and then estimating the number of kernels per ear. An approach similar to Example 38.1 can also be used to estimate yield.

Yield Estimates from R4-R6 Growth Stages

The R4 growth stage is called the dent growth stage and the R6 stage is physiological maturity (black layer) (Chapter 5). At these growth stages, yield estimates become more accurate.

Step 1. Determine the number of ears per acre. Measure off 1/1000 of an acre (Table 38.1). A tape measure is the most accurate way of measuring off the indicated length of row. A faster way, but less accurate method, is to step off the row length. With practice and calibration, it is possible to step off the indicated length with an accuracy of plus or minus a few inches. As an example, if you are working in 30-inch rows, the plants are counted along a length of row measuring 17 feet, 5 inches (Table 38.1). Then, estimate the plant population per acre by multiplying the number of plants per row length by 1000. Note: Across a field, you may want to take several estimates and average them, or if population is variable by area, each area may need its own estimate. These estimates would then be averaged based on the percent area that is expected to have a similar population.

Table 38.1 The length of row to count for 1/1000 of an acre depending on row width (in inches)

Row width	Row length	
inches	feet	inches
22	23	9
26	20	1
30	17	5
34	15	5
38	13	9

Figure 38.1 Example of an ear used to calculate the number of kernels per row. Only fully filled kernels along fully filled rows should be counted. The lines indicate the kernels that should be included in the count. This ear contains ~34 rows of kernels.

Step 2. Determine the number of kernels/ear by counting the number of kernels/row and the number of rows/ear. If the ear size in the field appears

Example 38.2 Based on a plant population of 35,500 plants/acre, estimate your yield at the tasseling (R1) stage of development.

Step 1. Estimate your plant population by:

1. Counting the number of plants in 1/1000 of an acre.
2. Multiplying your count by 1000.

Step 2. Estimate the yield by multiplying your plant population by the estimated weight of grain per ear, and dividing the lbs grain/acre by 56 lbs/bu. This example assumes that each ear weighs 0.4 lbs.

$$\frac{35{,}500 \text{ ears}}{\text{acre}} \times \frac{0.4 \text{ lbs}}{1 \text{ ear}} \times \frac{\text{bu}}{56 \text{ lbs}} = \frac{254 \text{ bu}}{\text{acre}}$$

Note: Reduce your estimate if you know the crop has been stressed. For example, weeds present during the weed-free period can reduce yield from 5% to 100% depending on species present and density. Similar yield reduction calculations can be conducted for nutrient deficiencies, or insect and disease damage. Examples for estimating yield losses are available in Clay et al. (2011). At the early reproductive growth stages, yield estimates are not accurate and typically overestimate actual yield. As the crop matures, kernel-based assessments become more accurate.

uniform, select 4 or 5 "average ears" and count the number of kernels/row. Include only the kernels and rows that are fully filled (see Figure 38.1 and count only the kernels inside of the marked lines). This ear contains ~36 kernels/row.

Count the number of rows/ear. For this step break the ear in half, which makes it easier to count rows (Fig. 38.2). The count for the ear below is ~18 rows/ear. The rows/ear will almost always be an even number. The number of kernels/ear can be calculated or determined using Table 38.2. If the number of kernels/row is highly variable, we suggest that at least 10 ears be counted from each area.

$$\frac{\text{Kernels}}{\text{ear}} = \frac{36 \text{ kernels}}{\text{row}} \times \frac{18 \text{ rows}}{\text{ear}} = \frac{648 \text{ kernels}}{\text{ear}}$$

Step 3. Calculate the kernels/a from the data collected in Steps 1 & 2. To determine the number of kernels/a, the calculations are shown below. Assume that the number of plants counted along the 17'5" length = 35 plants. Therefore, 35 x 1000 = 35,000 plants (ears) per acre.

$$\frac{\text{ears}}{\text{acre}} \times \frac{\text{Kernels}}{\text{plant}} = \frac{\text{Kernels}}{\text{acre}}$$

$$\frac{35{,}000 \text{ Ears}}{\text{acre}} \times \frac{648 \text{ Kernels}}{\text{ear}} = \frac{22{,}680{,}000 \text{ Kernels}}{\text{acre}}$$

Step 4. Estimate the number of kernels/bu.
The mass/kernel of corn varies greatly (see Chapter 36, Table 36.2). The number of kernels/bu can range from 70,000 kernels/bu to 105,000 kernels/bu (assume a bushel to be 56 lbs at 15.5% moisture). The kernel weight is very sensitive to climatic conditions between August and September. During wet conditions, a bushel may contain 70,000 kernels, whereas if August and September are hot

Figure 38.2 Count the number of rows. On this ear, there are ~20 kernels per row (Courtesy authors).

Table 38.2 A table for estimating the number of kernels/ear. In the above example, the number of kernels/row was 36 and number of rows/ear was 18. Using this table, the value would be estimated to be 630 kernels/ear, whereas the calculated value was 648. Because there was 1 kernel/row extra (36 vs. 35) = 630 + 18 = 648.

Rows/ear	Kernels/row					
	20	25	30	35	40	45
	----------------*Kernels/ear*----------------					
12	240	300	360	420	480	540
14	280	350	420	490	560	630
16	320	400	480	560	640	720
18	360	450	540	**630**	720	810
20	400	500	600	700	800	900
22	440	550	660	770	880	990
24	480	600	720	840	960	1080
26	520	650	780	910	1040	1170
28	560	700	840	980	1120	1260

Example 38.3 Determine the number of corn kernels per bushel if 200 field dry kernels weigh 56.3 g (2 ounces). In this example, it is assumed that the kernels are at 15.5% moisture and that 1 bushel weighs 56 lbs. 1000 grams = 1 kilogram; 1 kg = 2.21 lbs; 16 ounces/lb.

$$\frac{200 \text{ kernels}}{0.0563 \text{ kg}} \times \frac{1 \text{ kg}}{2.21 \text{ lbs}} \times \frac{56 \text{ lbs}}{\text{bu}} = \frac{90{,}000 \text{ kernels}}{\text{bushel}} \quad \text{OR}$$

$$\frac{200 \text{ kernels}}{2 \text{ oz}} \times \frac{16 \text{ oz}}{1 \text{ lb}} \times \frac{56 \text{ lbs}}{\text{bu}} \approx \frac{90{,}000 \text{ kernels}}{\text{bushel}}$$

Example 38.4 Using Tables 38.2 and 38.3, what is the estimated yield if the plant population is 29,000 ears/acre and 30 kernels/row and 22 rows/ear.

Based on Table 38.2, each ear contains 660 kernels.

Based on Table 38.3, 29,000 plants containing 650 kernels/ear will yield 209 bu/a and 29,000 plants/acre containing 700 kernels/ear will yield 226 bu/a. Therefore, the yield would be estimated to be between 209 and 226 bu/a. To calculate the "exact" value:

$$\frac{660}{650} \times \frac{209 \text{ bu}}{\text{acre}} = \frac{212 \text{ bu}}{\text{acre}}$$

and dry, a bushel may contain 105,000 kernels. The producer's management (variety, plant population, fertility, tillage system, etc.) also impacts the number of kernels/bu. The kernel weight per bushel can be estimated by weighing a known number of kernels that are representative of the kernels (see Example 38.3)

Step 5. Calculate the bu/acre.
The estimated yield per acre can be determined by calculating the bu/a (see below) or by using a Table 38.3.

$$\frac{\text{kernel}}{\text{acre}} \times \frac{\text{bu}}{\text{kernel}} = \frac{\text{bu}}{\text{acre}}$$

$$\frac{22{,}680{,}000 \text{ kernels}}{\text{acre}} \times \frac{\text{bu}}{90{,}000 \text{ kernels}} = \frac{252 \text{ bu}}{\text{acre}}$$

Using Table 38.3, the information needed includes: 35,000 plants/acre and 648 kernels/ear. At 650 kernels/ear and 35,000 plants/a, the value from Table 38.3 is 253 bu/a.

Table 38.3 Table for converting kernels/ear and ears/acre to corn yield in bu/a. In this calculation, it was assumed that a bushel contains 90,000 kernels.

Ears/ acre	Kernel/ear											
	250	300	350	400	450	500	550	600	650	700	750	800
**1000*	*bu/acre*											
15	42	50	58	67	75	83	92	100	108	117	125	133
17	47	57	66	76	85	94	104	113	123	132	142	151
19	53	63	74	84	95	106	116	127	137	148	158	169
21	58	70	82	93	105	117	128	140	152	163	175	187
23	64	77	89	102	115	128	141	153	166	179	192	204
25	69	83	97	111	125	139	153	167	181	194	208	222
27	75	90	105	120	135	150	165	180	195	210	225	240
29	81	97	113	129	145	161	177	193	209	226	242	258
31	86	103	121	138	155	172	189	207	224	241	258	276
33	92	110	128	147	165	183	202	220	238	257	275	293
35	97	117	136	156	175	194	214	233	253	272	292	311
37	103	123	144	164	185	206	226	247	267	288	308	329

References and Additional Information

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