

# Procedure for Calculating Grain Yields of Agronomic Crops

---

## Overview:

This protocol describes the procedure for calculating grain yields from plot weights. Grain yields are a mass per area measurement – typically reported as bushels per acre ( $\text{bu ac}^{-1}$ ) or megagrams per hectare ( $\text{Mg ha}^{-1}$ , SI units). Differences in reporting units between crops, as well as harvested grain moisture and harvested area (plot or strip dimensions) require standardization for reporting purposes.

The order of operations can vary but this procedure calculates yields via the follow steps: 1) adjust harvested grain moisture to standard moisture, 2) convert harvested area to acres, 3) calculate pounds per acre, 4) calculate  $\text{bu ac}^{-1}$  (or convert to SI units). Yields need to be calculated independently for every experimental unit (e.g., plot).

Yield data provided by farmers or farm managers often include:

- Grain weight (most often in lbs)
- Grain moisture (percent of water in grain when harvested)
- Test weight (weight of grain for given volume,  $\text{lbs bu}^{-1}$ )

Harvested plot dimensions are also needed. This is not plot area, but actual plot harvested. Combine header widths can vary and plots or strips are often trimmed back before measuring, so ***it is critical to obtain (or verify) actual harvested area dimensions from operators.***

## Detailed Calculations:

### I. Adjust grain moisture to standardized percentage

1. Calculate coefficient ratio of measured vs. standard biomass without moisture
  - a. Calculate ratio of  $(100 - \text{measured moisture}) / (100 - \text{standard moisture})$
  - b. Standard moisture should be taken from Table 1 below.
  - c. If measured moisture is greater than standard moisture, then the ratio will be  $<1$ , if not, the ratio will be  $>1$ .
2. Adjust measured moisture content in grain to standard reporting moisture
  - a. Multiplying total plot weight (lbs) by biomass ratio above
  - b. This provides pounds of grain at a standardized moisture

### II. Convert harvested area size from square feet to an acre basis

1. Calculate actual harvested area (not the plot size) in square feet ( $\text{ft}^2$ )
  - a. For example, a plot size could be 10 ft x 50 ft. But harvested area may be 5 ft x 40 ft = 200  $\text{ft}^2$
2. Convert actual harvested area from square feet to acre
  - a. Divide harvested area by the number of square feet in acre (43,560  $\text{ft}^2$ ) to get acres per harvested area

- III. Calculate pounds of grain at standardized moisture per acre
  1. Divide lbs at standardized moisture from step I by harvested area in acres from step II
    - a. This provides a standardized measurement in lbs of grain  $\text{ac}^{-1}$ , but this is not the most commonly reported unit.
- IV. Convert lbs per acre to bushel per acre
  1. Divide  $\text{lbs ac}^{-1}$  from step III by bushel weight in Table 1 to get bushel per acre.
- V. Convert grain yields to megagrams per hectare for scientific reporting purposes (optional)
  1. Multiply value derived in step III by 0.00112085.

### Example Calculation for Corn Grain:

#### Measured:

- Plot grain weight: 93.1 lbs
- Plot grain moisture: 17.4%
- Plot dimensions: 20 ft x 40 ft = 800  $\text{ft}^2$
- Harvested area dimensions: 10 ft x 40 ft = 400  $\text{ft}^2$

#### Standard corn measurements from Table 1:

- Bushel Weight: 56 lbs/ bushel
- Moisture: 15.5%

- I. Adjust grain moisture to standardized percentage
  1.  $(100-17.4)/(100-15.5) = 0.98$
  2.  $(93.1 \text{ lbs}) \times 0.98 = \mathbf{90.97 \text{ lbs grain at standardized moisture/ harvested area}}$
- II. Convert harvested area size from square feet to acre basis
  1.  $10 \text{ ft} \times 40 \text{ ft} = 400 \text{ ft}^2$
  2.  $(400 \text{ ft}^2/ 43,560 \text{ ft}^2) = \mathbf{0.00918 \text{ acres}}$
- III. Calculate pounds of grain at standardized moisture per acre
  1.  $90.97 \text{ lbs}/ 0.00918 \text{ acres} = \mathbf{9,906.69 \text{ lbs ac}^{-1}}$
- IV. Convert lbs per acre to bushel per acre
  1.  $(9,906.69 \text{ lbs/acre})/ (56 \text{ bushels/acre}) = \mathbf{176.9 \text{ bushels ac}^{-1}}$
- V. Convert lbs per acre to megagram per hectare (optional)
  1.  $9,906.69 \text{ lbs/ acre} \times 0.00112085 = \mathbf{11.10 \text{ Mg ha}^{-1}}$

**Table 1. Standard reporting units for agronomic grains**

<b>Crop</b>	<b>Bushel Weight (lbs/bushel)</b>	<b>Grain Moisture (%)</b>
Corn	56	15.5
Soybean	60	13
Wheat	60	13.5
Barley	48	14.5
Rye	56	14
Oats	32	14

**Useful Conversions:**

- lbs/acre → Mg/ha = multiply by 0.00112085
- lbs/acre → kg/ha = multiply by 1.12085
- kg/ha → lbs/acre = multiply by 0.89218
- Mg/ha → lbs/acre = multiply by 892.18
- Mg/ha → kg/ha = multiply by 1,000
- kg/ha → Mg/ha = divide by 1,000

**Additional Notes:**

- There is an accompanying excel calculation template for this protocol.
- Some combines will take multiple measurements (weight and moisture) per plot because the weigh bucket cannot accommodate a full plot worth of grain. In this case, add plot weights together and calculate the average moisture measurements within each plot. Then perform yield calculations on these on a per plot basis.
- Most small plot corn combines harvest 2 rows of corn (5ft), while small plot soybean and small grain combine headers can vary from 4-6 ft.
- We typically do not use test weight (TW) in reporting.

Questions can be directed to Steve Culman at [culman.2@osu.edu](mailto:culman.2@osu.edu)