



UNIVERSITY OF GEORGIA
EXTENSION

Common Agricultural Calculations Using Unit Conversions

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Circular 1313 published with minor revisions on July 7, 2026

Agricultural calculations—such as figuring out how much fertilizer to apply or how many seeds you need to plant a garden—are simple to do when using unit conversions, but few people learn these skills. Most people rely on premade charts or specialized calculators that have already accounted for these unit conversion steps. These tools work well until you need to solve a

problem that falls outside of the predetermined limits of these charts or calculators.

Learning how to use unit conversions will allow you to solve your specific agricultural calculation problems. In this publication, we show you the basic math behind common calculations to provide you with the tools for solving any equation using simple addition, subtraction, multiplication, and division.

No longer will you be dependent on what premade production guides, fertilizer charts, planter manuals, and spray nozzle catalogs tell you to do. If you are equipped with the Internet, then you can find any unit conversion value and calculate what you need to know using very basic math.

The examples here will help you figure out the information you need from what you can measure, and then show you how to use ***unit cancellation***—when the same units appear in the numerator (top) and denominator (bottom) of a fraction—to reach your solution. Examples include calculating planting densities, dry and liquid fertilizer applications, pesticide sprays, and soil amendments. Two things you will need to pay attention to are your ***custom variables*** and the ***constants*** in each example.

Custom variables: In the examples below the bold blue values are measured by you and can be changed or manipulated to achieve your desired result.

Constants: The red italicized values are unit conversion values that are constant and unchanging.

Section 1. Planting Density Calculations

Planting density in agriculture is a measure of the number of plants per unit of land area. It typically is expressed as seeds or plants per acre. The examples below will allow you to convert from seeds or plants per square foot (ft²) to seeds or plants per acre.

Custom variables: The values you will need to measure and can change are:

- **in-row spacing (measured in inches or feet)—the space between each seed or plant**
- **between-row spacing (measured in inches or feet)—the space between rows in your planting area**
- **for raised bed production, you will need to include the number of rows per bed**

Constants: You will use the following known *constants* in your calculations:

- *inches per foot: 12 in. = 1 ft*
- *square feet per acre: 43,560 ft² = 1 acre*
- *grams per pound: 454 g = 1 lb*

Examples of Planting Density Calculations

Example 1.1

Sweet corn planted on 36-in. (3 ft) rows with 6 in. (0.5 ft) between seeds. How many seeds per acre do we need?

Step 1: Convert inches into feet.

between-row space:

$$36 \text{ in.} \times \frac{1 \text{ ft}}{12 \text{ in.}} = 3 \text{ ft}$$

in-row space:

$$6 \text{ in.} \times \frac{1 \text{ ft}}{12 \text{ in.}} = 0.5 \text{ ft}$$

Step 2: Convert seeds per square foot (ft x ft = ft²) to seeds per acre.

seeds per ft² x ft² per acre = seeds per acre

$$\frac{1 \text{ seed}}{0.5 \text{ ft} \times 3 \text{ ft}} \times \frac{43,560 \text{ ft}^2}{1 \text{ acre}} = \frac{29,040 \text{ seeds}}{\text{acre}}$$

Step 3: If we increase the number of seeds per acre, we need to recalculate the within-row plant spacing. In this example, let's say your desired seed rate is 30,000 seeds/acre and your row spacing is still 36 in. (3 ft).

$$X \text{ ft} = \frac{1 \text{ seed}}{3 \text{ ft}} \times \frac{43,560 \text{ ft}^2}{1 \text{ acre}} \times \frac{1 \text{ acre}}{30,000 \text{ seeds}} = 0.484 \text{ ft}$$

$$\text{or } X = 0.484 \text{ ft} \times \frac{12 \text{ in.}}{1 \text{ ft}} = 5.81 \text{ in. in-row spacing}$$

Example 1.2

Green beans on 30-in. (2.5 ft) rows with 2.5 in. (0.208 ft) between seeds. How many seeds per acre do we need?

Note that we multiply ft x ft in the first part of the formula, giving us ft². We also have ft² on the top line of the constant (square feet per acre). When the fractions are multiplied out, the ft² units on the top and bottom cancel each other out, leaving just seeds per acre as our units of measurement.

$$\frac{1 \text{ seed}}{0.208 \text{ ft} \times 2.5 \text{ ft}} \times \frac{43,560 \text{ ft}^2}{1 \text{ acre}} = \frac{43,560 \text{ seeds}}{0.52 \text{ acre}} = \frac{83,769 \text{ seeds}}{\text{acre}}$$

Example 1.3

Watermelons planted with one row per bed on 8 ft bed spacing and 3 ft in between plants. How many plants per acre?

$$\frac{1 \text{ plant}}{8 \text{ ft} \times 3 \text{ ft}} \times \frac{43,560 \text{ ft}^2}{1 \text{ acre}} = \frac{1,815 \text{ plants}}{\text{acre}}$$

Example 1.4

Bell peppers planted with two rows per bed on 6 ft bed spacing and 10 in. (0.833 ft) between plants.

$$\frac{2 \text{ plants}}{6 \text{ ft} \times 0.833 \text{ ft}} \times \frac{43,560 \text{ ft}^2}{1 \text{ acre}} = \frac{17,431 \text{ plants}}{\text{acre}}$$

Example 1.5

Onions planted four rows per bed on 6 ft bed spacing with 4 in. (0.333 ft) between plants.

$$\frac{4 \text{ plants}}{6 \text{ ft} \times 0.333 \text{ ft}} \times \frac{43,560 \text{ ft}^2}{1 \text{ acre}} = \frac{87,207 \text{ plants}}{\text{acre}}$$

Example 1.6

Mustard cover crop with a desired seeding rate of 10 lb seed/acre on 6 ft beds with six rows per bed. How much seed per row will we use in a 50-ft calibration plot?

$$\frac{10 \text{ lb}}{\text{acre}} \times \frac{1 \text{ acre}}{43,560 \text{ ft}^2} \times \frac{6 \text{ ft} \times 50 \text{ ft}}{\text{plot}} \times \frac{454 \text{ g}}{1 \text{ lb}} \times \frac{1 \text{ plot}}{6 \text{ rows}} = \frac{5.21 \text{ g}}{\text{row}}$$

Section 2. Fertilizer Calculations

To figure the amount needed for granular or liquid fertilizer applications, you need to know the area of the application zone. The area is the length multiplied by the width. This can be calculated if you know your row width, row length, and number of rows.

Custom variables: You need to know your:

- **desired amount of nitrogen, phosphorus, and potassium (N-P-K) per acre**
- **percentage of N-P-K in the fertilizer analysis**

Constants: You will use the following known constants in your calculations:

- *square feet per acre: $43,560 \text{ ft}^2 = 1 \text{ acre}$*
- *grams per pound: $454 \text{ g} = 1 \text{ lb}$*

Examples of Fertilizer Calculations

Example 2.1

Calculate the total area in acres for 8 rows with 6-ft row width and 500-ft row length.

$$8 \times (6 \text{ ft} \times 500 \text{ ft}) \times \frac{1 \text{ acre}}{43,560 \text{ ft}^2} = 0.551 \text{ acre}$$

Section 2a: Granular (Dry) Fertilizer

Example 2.2

We need a preplant fertilizer application to deliver 50 lb of nitrogen/acre. How much fertilizer do we need?

We are calculating for 50 lb of N per acre, using a 10-10-10 granular fertilizer (10% N or 10 lb N in 100 lb fertilizer).

To figure out how much fertilizer per acre is needed, we use the following formula:

desired nitrogen × fertilizer analysis = fertilizer application

$$\frac{50 \text{ lb N}}{\text{acre}} \times \frac{100 \text{ lb fertilizer}}{10 \text{ lb N}} = \frac{500 \text{ lb fertilizer}}{\text{acre}}$$

From the example above, in one 6 ft x 50 ft calibration plot we would need:

$$\frac{500 \text{ lb fertilizer}}{\text{acre}} \times \frac{1 \text{ acre}}{43,560 \text{ ft}^2} \times \frac{6 \text{ ft} \times 50 \text{ ft}}{\text{plot}} = \frac{3.44 \text{ lb fertilizer}}{\text{plot}}$$

If we are using a six-row drop spreader, we would need the following amount of fertilizer per row in the same calibration plot noted above:

$$\frac{3.44 \text{ lb}}{\text{plot}} \times \frac{1 \text{ plot}}{6 \text{ rows}} = \frac{0.573 \text{ lb}}{\text{row}} \times \frac{454 \text{ g}}{1 \text{ lb}} = \frac{260 \text{ g}}{\text{row}}$$

Example 2.3

For a preplant fertilizer application, we want 100 lb K per acre using muriate of potash (0-0-60). How much fertilizer do we need?

$$\frac{100 \text{ lb K}}{\text{acre}} \times \frac{100 \text{ lb fertilizer}}{60 \text{ lb K}} = \frac{166 \text{ lb fertilizer}}{\text{acre}}$$

Example 2.4

To make a side-dress fertilizer application with 120 lb N per acre using ammonium nitrate (34-0-0), how much fertilizer per acre do we need?

$$\frac{120 \text{ lb N}}{\text{acre}} \times \frac{100 \text{ lb fertilizer}}{34 \text{ lb N}} = \frac{353 \text{ lb fertilizer}}{\text{acre}}$$

Section 2b: Liquid Fertilizer

Liquid fertilizer calculations are similar to granular fertilizer calculations. **However, you need to know the density of your liquid (pounds per gallon). To figure this out, look on the label or simply measure a gallon into a container and weigh it on a scale.**

Custom variables:

- **density of your liquid fertilizer (in pounds per gallon)**

Example 2.5

You want to inject 20 lb of N per acre weekly into drip tape using 7-0-7 liquid fertilizer, which weighs 11 lb/gallon. How many gallons of fertilizer will you need every week?

$$\frac{20 \text{ lb N}}{\text{acre}} \times \frac{100 \text{ lb fertilizer}}{7 \text{ lb N}} \times \frac{1 \text{ gallon fertilizer}}{11 \text{ lb fertilizer}} = \frac{26 \text{ gallons fertilizer}}{\text{acre}}$$

You can scale up the amount injected depending on your injection zone.

Here is an example of a 2-acre injection zone:

$$\frac{26 \text{ gallons/week}}{\text{acre}} \times 2 \text{ acres} = 52 \text{ gallons/week}$$

This is the amount for a 0.5-acre injection zone:

$$\frac{26 \text{ gallons/week}}{\text{acre}} \times 0.5 \text{ acre} = 13 \text{ gallons/week}$$

Section 3. Sprayer Calibration

Calculating sprayer output is straightforward using simple unit conversion. You will need to measure your output, speed, and nozzle spacing. Spray volume can be manipulated by nozzle selection (bigger or smaller orifice), speed (slower or faster), or pressure (higher or lower). With a tractor, gear selection will increase or decrease the speed. In addition, RPMs will change output by increasing or decreasing speed and pump pressure.

In vegetable crops, flat fan nozzles typically are used for herbicide applications, and cone tips are used for fungicide/herbicide applications to give better canopy coverage. Tractor speed is usually around 3–5 mph, while walking with a backpack sprayer is typically around 3 mph. The recommended operating pressures are in the range of 40–60 psi, with output in the range of 30–40 gallons/acre.

With taller crops, such as tomatoes, a drop boom is recommended. Spray volumes and pressure can be as high as 100 gallons/acre and 100 psi, respectively. The following examples will give you your spray volume (water) output in gallons/acre. After calculating spray volume, you need

to calculate the amount of chemicals to put in the sprayer based on labeled pesticide rates.

Custom variables: You will need to measure:

- **nozzle output (ml/s)**
- **speed (ft/s)**
- **nozzle spacing (ft)**

Constants:

- *square feet per acre: 43,560 ft²/acre*
- *milliliters per gallon: 3,785 ml/gallon*
- *1 mile = 5,280 ft*
- *1 hr = 60 min*

Calculate gallons/acre output using a simple unit conversion.

Examples of Sprayer Calibration Calculations

Example 3.1

Using a backpack sprayer with a 50-ft length for walking-speed calculation and a boom with 18-in. (1.5-ft) nozzle spacing. The output is measured from one nozzle for 30 seconds in milliliters. How many gallons per acre will be used?

You measured: Output (500 ml per 30 s), speed (11.36 s per 50 ft), and width (1.5 ft).

Unit conversions: ft² per acre; ml per gallon.

$$\frac{500 \text{ ml}}{30 \text{ s}} \times \frac{11.36 \text{ s}}{50 \text{ ft}} \times \frac{1}{1.5 \text{ ft}} \times \frac{43,560 \text{ ft}^2}{1 \text{ acre}} \times \frac{1 \text{ gallon}}{3785 \text{ ml}} = \frac{29.1 \text{ gallons spray volume}}{\text{acre}}$$

Example 3.2

How much chemical is needed for 0.5 acre at a labeled rate of 4 oz/acre?

$$\frac{4 \text{ oz}}{\text{acre}} \times 0.5 \text{ acre} = 2 \text{ oz}$$

To figure out how many acres need to be sprayed, you need to know the length and width of

your field or area to be sprayed. In this example, we will spray a field that is 500 ft long by 36 ft wide. **How many acres is that?**

$$(500 \text{ ft} \times 36 \text{ ft}) \times \frac{1 \text{ acre}}{43,560 \text{ ft}^2} = 0.41 \text{ acre}$$

Example 3.3

A tractor with a speedometer traveling at 4 mph with a boom sprayer with nozzles 20 in. (1.67 ft) apart; 800 ml is collected from one nozzle in 1 min. How many gallons will be sprayed per acre?

$$\frac{800 \text{ ml}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ hr}}{4 \text{ miles}} \times \frac{1 \text{ mile}}{(5280 \text{ ft} \times 1.67 \text{ ft})} \times \frac{1 \text{ gallon}}{3785 \text{ ml}} \times \frac{43,560 \text{ ft}^2}{1 \text{ acre}} = \frac{15.66 \text{ gallons}}{\text{acre}}$$

Example 3.4

In this example, you are using a drop boom sprayer. Drop booms are used with multiple nozzles that are mounted vertically on a drop line that is perpendicular to the boom, with the nozzles facing in toward the rows. These are used for taller plants, such as tomatoes, to get good canopy coverage and not spray only the top of the plant. In this circumstance, you will need to consider the number of nozzles per drop and the spray volume per drop to calculate the gallons/acre rate that is being sprayed.

If you have a drop every 3 ft with five nozzles per drop and you are collecting 500 ml/30 s per nozzle, then you will collect 2500 ml (5 nozzles x 500 ml) every 3 ft/30 s. You can use the same formula as Example 3.1 to calculate spray output, assuming you are traveling the same speed.

$$\frac{2500 \text{ ml}}{30 \text{ s}} \times \frac{11.36 \text{ s}}{(50 \text{ ft} \times 3 \text{ ft})} \times \frac{43,560 \text{ ft}^2}{1 \text{ acre}} \times \frac{1 \text{ gallon}}{3785 \text{ ml}} = \frac{72.6 \text{ gallons spray volume}}{\text{acre}}$$

Section 4. Soil Amendment Calculations

Lime, chicken manure, biochar, and seed meal soil amendments are usually applied as tons per acre.

Custom variables:

- **desired tons per acre**

Constants:

- *1 ton = 2000 lb*
- *1 acre: 43,560 ft²*

Examples of Soil Amendment Calculations

Example 4.1

A soil sample test result recommends applying 1 ton/acre of lime to increase soil pH. How much do you need to apply for a 20 ft x 50 ft garden?

$$\frac{1 \text{ ton}}{\text{acre}} \times \frac{1 \text{ acre}}{43,560 \text{ ft}^2} \times \frac{2000 \text{ lb}}{\text{ton}} \times \frac{(20 \text{ ft} \times 50 \text{ ft})}{\text{garden}} = \frac{45.9 \text{ lb}}{\text{garden}}$$

Conversion Tables

Table 1. United States (U.S.) Customary Units and Their Conversion to International System of Units (SI).

U.S. Customary/Imperial Unit	Equivalent SI/Metric Unit
Length	
1 inch (in.)	25.4 millimeters (mm)
1 in.	2.54 centimeters (cm)
1 foot (ft)	30.48 cm
1 yard (yd)	0.91 meter (m)
1 mile (mi)	1.61 kilometer (km)
Area	
1 square inch (in. ²)	6.45 square centimeters (cm ²)
1 square foot (ft ²)	0.09 square meter (m ²)
1 square yard (yd ²)	0.84 m ²
1 square mile (mi ²)	2.59 square kilometer (km ²)
1 acre	0.41 hectare (ha)
1 acre	4046.86 m ²
Mass	
1 ounce (oz)	28.35 grams (g)
1 pound (lb)	453.59 g
1 lb	0.45 kilogram (kg)
1 short ton (2,000 lb)	0.907 metric ton
Volume	
1 teaspoon (tsp)	4.93 milliliters (ml)
1 tablespoon (Tbsp)	14.79 ml
1 fluid ounce (fl oz)	29.57 ml
1 cup (c)	0.24 liter (L)
1 cubic inch (in. ³)	16.39 ml
1 gallon (gal)	3.79 L
1 gallon	3785.41 ml
1 pint (pt)	0.47 L
1 pint	473 ml
1 quart (qt)	0.95 L
1 quart	946 ml

U.S. Customary/Imperial Unit	Equivalent SI/Metric Unit
1 cubic foot (ft ³)	0.03 cubic meter (m ³)
1 bushel (bu)	35.2391 L
Speed	
1 mile/hour (mph)	0.44704 meter/second (m/s)
1 mile/hour (mph)	1.609344 kilometer/hour (km/h)
1 foot/hour (ft/h)	0.0003048 km/h

Table 2. Interconversion of U.S. Customary Units.

This larger unit converts to	This smaller unit
1 acre	43,560 square feet (ft ²)
1 foot (ft)	12 inches (in.)
1 gallon	4 quarts (qt) or 8 pints (pt)
1 gallon	128 fl oz or 16 cups
1 quart	2 pints or 4 cups
1 mile (mi)	5,280 feet (ft)

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Circular 1313

Published with Minor Revisions on July 7, 2026

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