UNIVERSITY OF GEORGIA
EXTENSION

Common Agricultural Calculations Using Unit Conversions

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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.

Contents

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 (ft^2) 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 ft^2 = 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? The example below shows how, once multiplied, the units cancel each other out in step 2.

1. Convert inches into feet.
    a. between-row space: 36 in × 1 ft 12 inches = 3 ft
    b. in-row space: 6 in × 1 ft 12 inches = .5 ft
2. Convert seeds per square foot (ft x ft = ft^2) to seeds per acre. 1 seed 0.5 ft × 3 ft × 43,560 ft^2 acre = 29,040 seeds ft^2 acre ft^2
3. 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).
    1 seed 3 ft × 43,560 ft^2 acre × acre 30,000 seeds = 0.484 ft or 0.484 ft × 12 in 1 ft = 5.81 inches 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?

1 seed 30 in × 2.5 in × 43,560 ft² acre = 83,769 seeds acre

Example 1.3

Watermelons planted with one row per bed on 96-in (8 ft) bed spacing and 36 (3 ft) in between plants. How many plants per acre?

1 plant 96 in × 36 in × 43,560 ft² acre = 1,815 plants acre

Example 1.4

Bell peppers planted with two rows per bed on 72-in (6 ft) bed spacing and 10 in. (0.833 ft) between plants.

2 plants 72 in × 10 in × 43,560 ft² acre = 17,431 plants acre

Example 1.5

Onions planted four rows per bed on 72-in (6 ft) bed spacing with 4 in. (0.333 ft) between plants.

4 plants 72 in × 4 in × 43,560 ft² acre = 87,207 plants acre

Number of Plants:	
In-Row Spacing (in):	
Between-Row Spacing (in):	

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?

Pounds of seed:

Total area (acre):

Number of plots:

Rows:

In-Row Spacing (in):

Between-Row Spacing (in):

This intermediate step of the same calculation above shows how the units cancel out:

1,362,000 g lb acre ft² plot 261,360 rows acre ft² plot lb = 5.21 g 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 ft² = 1 acre*
- *grams per pound: 454 g = 1 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 rows × (6 ft × 500 ft) × acre 43,560 ft² = 0.551 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

50 lb N acre × 100 lb fertilizer 10 lb N = 500 lb fertilizer acre

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

500 lb fertilizer acre × acre 43,560 ft² × (6 ft × 50 ft) plot = 3.44 lb fertilizer 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:

3.44 lb plot × plot 46 rows × 0.573 lb row × 454 g lb = 260 g 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?

100 lb K acre × 100 lb fertilizer 60 lb K = 166 lb fertilizer 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?

120 lb N acre × 100 lb fertilizer 34 lb N = 353 lb fertilizer 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?

20 lb N acre × 100 lb fertilizer 7 lb N × 1 gallon fertilizer 11 lb fertilizer = 26 gallons fertilizer acre

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

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

26 gallons/week acre × 2 acres = 52 gallons/week

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

26 gallons/week acre × 0.5 acres = 13 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.

500 ml 30 s × 11.36 s 50 ft × 43,560 ft² acre × gallon 3785 ml = 29.1 gallons acre

Example 3.2

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

4 oz 0.5 acre = 2 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 ft × 36 ft × acre 43,560 ft² = 0.41 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?

800 ml 1 min × 60 min 1 hr × 1 hr 4 miles × 1 mile 5280 ft × 1.67 ft × 1 gallon 3785 ml × 43,560 ft² acre = 15.66 gallons 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.

2500 ml 30 s × 11.36 s 50 ft × 3 ft × 43,560 ft² acre × 1 gallon 3785 ml = 72.6 gallons spray volume acre

Section 4. Soil Amendment Calculations

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

Custom Variables: You will need to measure:

- **desired tons per acre**

Constants:

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

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?

1 ton acre × acre 43,560 ft² × 2000 lb ton × 20 ft × 50 ft garden = 45.9 lb garden Table 1. United States (U.S.) Customary Units and Their Conversion to International System of Units (SI).

	Equivalent SI/
Length	
1 inch (in.)	25.4 millimeters (mm)
1 inch (in.)	2.54 centimeters (cm)

U.S. Customary/Imperial Unit	Equivalent SI/Metric Unit	
	1 foot (ft)	0.48 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 (cm²)
	1 square foot (ft²)	0.09 square meter (m²)
	1 square yard	0.84 m²

U.S. Customary/Imperial Unit	Equivalent SI/Metric Unit	
	(yd²)	
	1 square mile (mi²)	2.59 square kilometer (km²)
	1 acre	0.41 hectare (ha)/ 4046.86 (m²)
	Mass	
	1 ounce (oz)	28.35 grams (g)
	1 pound (lb)	0.45 kilogram (kg)/ 453.59 (g)

U.S. Customary/Imperial Unit	Equivalent SI/Metric Unit
short ton (2,000 lbs)	907 metric ton o.
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

U.S. Customary/Imperial Unit	Equivalent SI/Metric Unit	
	llon (gal)	L/3785.41 (ml)
	1 pint (pt)	0.473 liter (L)/473 ml
	1 quart (qt)	0.95 L/946 ml
	1 cubic foot (ft³)	0.03 cubic meter (m³)
	1 bushel (bu)	35.2391 L
	Speed	

U.S. Customary/Imperial Unit	Equivalent SI/Metric Unit	
		)
1 mile/hour (mph)	0.44704	1.609344 kilometers/hour (km/h)
1 foot/hour (ft/h)	0.0003048	km/h

Table

2. Interconversion of U.S. Customary Units.

1 acre	43,560 square feet (ft²)
1 foot (ft)	12 inches (in.)
1 gallon	4 quarts (qt)/8 pints (pt)
1 gallon	128 fl oz/16 cups
1 quart	2 pints/4 cups
1 mile (mi)	5,280 feet (ft)

function updatePlantingDensityCalculation() { let numPlants = parseFloat(document.getElementById('numPlants').value) || 0; let inRowSpacing = parseFloat(document.getElementById('inRowSpacing').value) || 1; let betweenRowSpacing = parseFloat(document.getElementById('betweenRowSpacing').value) || 1; let denominator = (Math.round(inRowSpacing / 12 * 1000) / 1000) * (Math.round(betweenRowSpacing / 12 * 1000) / 1000); let fraction = numPlants / denominator; let result = fraction * 43560; let seeds = numPlants > 1 ? 's' : ''; let mathExpression = ` ${Math.round(inRowSpacing / 12 * 1000) / 1000} ft × ${Math.round(betweenRowSpacing / 12 * 1000) / 1000} ft × 1 ft 12 in = ${Math.round((inRowSpacing / 12) * (betweenRowSpacing / 12) * 100) / 100} ft2 ${numPlants} seed${seeds} ${Math.round((inRowSpacing / 12) * (betweenRowSpacing / 12) * 100) / 100} ft2 × 43560 ft2 1 acre = ${Math.round(result)} seeds per acre `; // Update MathML & screen reader alternative document.getElementById('mathOutput').innerHTML = mathExpression; } function updateSeedDensityCalculation() { let poundsOfSeed =

```
parseFloat(document.getElementById('poundsOfSeed').value) || 10; let totalArea =
parseFloat(document.getElementById('totalArea').value) || 1; //acre let inRowSpacing =
parseFloat(document.getElementById('inRowSpacingSeed').value) || 1; let betweenRowSpacing
= parseFloat(document.getElementById('betweenRowSpacingSeed').value) || 1; let acres =
totalArea > 1 ? 's' : ''; let plotCount = parseFloat(document.getElementById('plotsSeed').value)
|| 1; let plots = plotCount > 1 ? 's' : ''; let rowCount =
parseFloat(document.getElementById('rowsSeed').value) || 6; let rows = rowCount > 1 ? 's' : '';
let numerator = (Math.round(inRowSpacing / 12 * 1000) / 1000) *
(Math.round(betweenRowSpacing / 12 * 1000) / 1000); let fraction = numerator *
poundsOfSeed; let result = fraction / 43560; let mathExpression = ` ${poundsOfSeed} lb
${totalArea} acre${acres} × 1 acre 43560 ft2 × ${Math.round(inRowSpacing / 12 * 1000) /
1000} ft × ${Math.round(betweenRowSpacing / 12 * 1000) / 1000} ft plot × 454 g 1 lb ×
${plotCount} plot${plots} ${rowCount} row${rows} = ${Math.round( 100 * (poundsOfSeed /
totalArea) * (1 / 43560) * ((Math.round(inRowSpacing / 12 * 1000) / 1000) *
(Math.round(betweenRowSpacing / 12 * 1000) / 1000)) * (454) * (plotCount / rowCount)) /
100 } g row `; // Update MathML & screen reader alternative
document.getElementById('mathOutput-2').innerHTML = mathExpression; }
updatePlantingDensityCalculation(); updateSeedDensityCalculation();
```


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