DRIP IRRIGATION FUNDAMENTALS

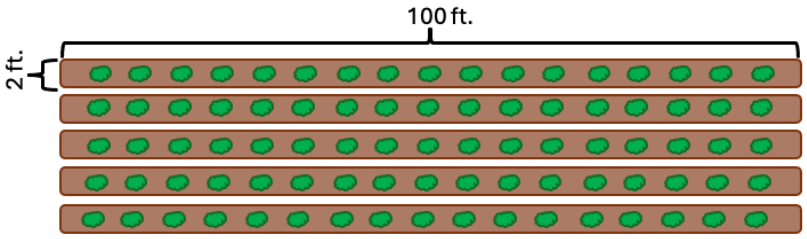
NUTRIENTS BY THE NUMBERS:
FERTIGATION CALCULATIONS THAT GROW RESULTS

When learning how to calculate fertilizer rates for drip irrigation, it is helpful to have an example to visualize where the numbers come from and how they fit in the calculations. This fact sheet will explain the process of calculating fertilizer rates for the following example field: For this field, there are five 100-foot rows of determinate tomato plants. Each row (or bed) is 2 feet (ft.) wide and has a single line of drip tape.

CALCULATING HOW MUCH FERTILIZER TO USE FOR EACH APPLICATION

Step 1: Determine what nutrients the plants need and how much they need

A pre-plant soil test is the best way to determine fertilizer needs. In Arkansas, soil testing is a free service. Soil samples can be sent to the Marianna Soil Testing lab through local county extension offices (https://www.uaex.uada.edu/counties/). If a soil test was not taken, reliable crop guides can provide recommended fertigation schedules for many specialty crops. Many crops can be leaf tissue nutrient sampled throughout the growing season to help adjust fertilizer rates if needed.



For this example, the soil test results recommend applying **200 pounds of nitrogen per acre for the growing season.**

Step 2: Calculate the size of the area being fertilized

Fertigation calculations should be based only on the area being irrigated. In drip-irrigated fields, the ground between planted rows is not irrigated and should not be included in rate calculations. To calculate the total fertilized area in a drip-irrigated field, use the following equation:

$$\text{Total fertilized area (acres)} = \frac{\text{Total row length (ft)* x Row width (ft)}}{43{,}560\ \text{ft}^2/\text{acre}}$$

$$\text{Total fertilized area (acres)} = \frac{500\ \text{ft} \times 2\ \text{ft}}{43{,}560\ \text{ft}^2/\text{acre}} \qquad \text{Total fertilized area (acres)} = 0.0229568411\ \text{acres}^{**}$$

**Total row length is the sum of all row lengths. For this example, there are 5 rows, each 100 feet long. This would have a total row length of 500 feet (100 ft x 5 = 500 ft).*
***More decimal places improves accuracy.*

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Step 3: Determine the number of fertigation applications

The frequency of fertigation influences how much fertilizer should be applied with each fertigation cycle. Some growers fertigate every time they irrigate, while others may fertigate only once a week. Both fertigation schedules will work, as long as the crops get the amount of fertilizer they need.

In this example, the tomato field will be fertigated once a week, though irrigation may be needed more often. From transplant to final harvest, the life of a determinate tomato plant is typically 4 – 6 months (depending on cultivar, climate, etc.). Based on this timeframe, plan for at least 12 fertigation events.

Step 4: Calculate the amount of nutrient(s) applied per application

For this example, 200 pounds (lbs.) of nitrogen per acre (see **Step 1**), should be applied in 12 applications (see **Step 3**).

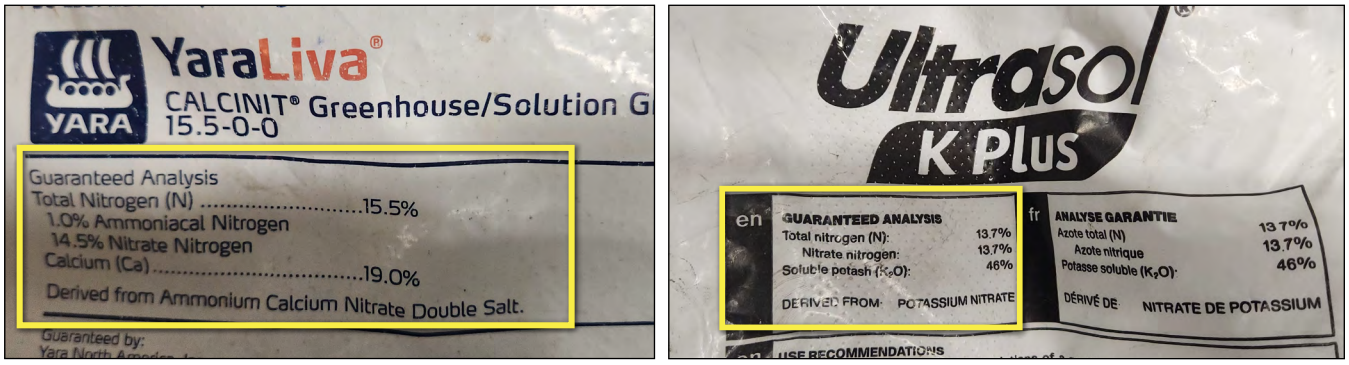
Nutrient applied per application (lbs./application) = $\frac{\text{Total nutrient applied (lbs./acre) x Total fertilized area (acres)}}{\text{number of applications}}$

Nutrient applied per application (lbs./application) = $\frac{\text{200 lbs. of N per acre (Step 1) x 0.0229568411 acres (Step 2)}}{\text{12 (Step 3)}}$

Nutrient applied per application (lbs./application) = **0.3826140183 lbs. of N per application**

Step 5: Calculate the amount of fertilizer to apply with each application

Each type of fertilizer will vary in the amount of nitrogen (and other nutrients) it contains. The fertilizer's label will indicate how much of its actual weight is a particular nutrient. For example, ammonium nitrate is 34 percent nitrogen, meaning 1 pound of ammonium nitrate fertilizer contains 0.34 pounds of actual nitrogen.



Bags of fertilizer with available nutrients listed

For the tomato field example, 0.3826140183 lbs. of nitrogen (N) are needed per fertigation event (see **Step 4**), and ammonium nitrate will be used as the fertilizer source.

Use the formula below to calculate the amount of fertilizer required per application to supply the desired amount of nitrogen.

Amount of fertilizer (lbs per area per application) = $\frac{\text{Amount of nutrient needed per application (lbs per application)}}{\text{amount of nutrient in fertilizer (lbs.)}}$

Amount of fertilizer (lbs per area per application) = $\frac{\text{0.3826140183 lbs. N/application (Step 4)}}{\text{0.34 lbs. of N (from fertilizer label)}}$

Amount of fertilizer (lbs./area x application) = **1.13 lbs. of ammonium nitrate per application**

This means 1.13 pounds of ammonium nitrate should be applied to the tomato field once a week for 12 weeks.

HELPFUL HINTS:

- Select a fertilizer that dissolves easily in water. Undissolved fertilizer particles can damage fertilizer injectors and clog emitters.
- For growers who prefer to fertigate every time crops are irrigated, there are two simple ways to apply the calculated amount of fertilizer from **Step 5** over multiple irrigation cycles:
  1. Divide-and-Apply: Divide the total weekly fertilizer amount from **Step 5** by the number of weekly irrigation cycles and apply that amount during each irrigation event.
  2. Prepare a Weekly Stock Solution: Dissolve the total weekly fertilizer amount in a stock tank and inject the solution proportionally throughout the week. This method reduces how often fertilizer must be measured and mixed, but it requires familiarity with the injection system to avoid over- or under-fertilizing.

Table 1: Fertilizers Commonly Used for Fertigation

Nitrogen Fertilizers:		
Ammonium Nitrate	34-0-0	
Ammonium sulphate	21-0-0	Never mix with nutrients containing calcium.
Calcium Nitrate	15.5-0-0	Never mix with nutrients containing phosphate or sulphate.
Potassium nitrate	13-0-44	Can be slow to dissolve.
Urea	46-0-0	
Phosphorus Fertilizers:		
Monopotassium phosphate	0-52-34	Never mix with nutrients containing calcium.
Phosphoric acid	0-52-0	
Potassium Fertilizers:		
Potassium chloride	0-0-60	
Potassium nitrate	13-0-44	
Potassium sulphate	0-0-50	Never mix with nutrients containing calcium.

Many types of fertilizers are compatible with fertigation; this product list does not contain all available fertilizers compatible with fertigation.

RUNNING A FERTIGATION CYCLE

Step 6: For each application, dissolve the calculated amount of fertilizer, from **Step 5**, in the appropriate amount of water. Ensure the fertilizer is fully dissolved. If fertilizer particles are visible in solution, it may be necessary to add more water.

Step 7: Start the irrigation system and run until the system is fully pressurized and all emitters are dripping. Depending on the size of the area being irrigated, this may take 5-10 minutes. This step is done with the fertilizer injector off.

Step 8: Once the system is fully pressurized, start the injection system and run until all the fertilizer has been injected.

Step 9: After all the fertilizer has been injected, shut off the injector but continue running the irrigation system for an additional 5-10 minutes to ensure all fertilizer has been pushed out of the emitters and none remains in the lines.

HELPFUL HINTS:

When designing a fertigation schedule, take some time to research fertigation scheduling recommendations for the crop. For example, for many specialty crops, it's recommended to start with lower rates of nitrogen when the crop is small, and slowly adjust upward as the crop grows. Rotating between two or more fertilizer sources may also be recommended to meet all the crops' nutritional needs. Soil tests, crop production handbooks, or local county extension agent are great sources of information and help when designing fertigation schedules.

For additional guidance on calculating fertigation rates for specialty crops, visit the Drip Irrigation for Specialty Crop Production website (www.uaex.uada.edu/drip-irrigation) or watch the "Calculating Spring Fertigation Rates for Plasticulture" video (https://www.youtube.com/watch?v=jUaQbcloSK8).

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