DRIP IRRIGATION FUNDAMENTALS

THE MATH BEHIND THE DRIP

While every crop has unique water needs, most fruit and vegetable crops require about 1–2 inches (in) of water per week. But how does that translate into run time and run frequency for a drip irrigation system? By combining a few simple calculations with knowledge of the soil type, an efficient irrigation schedule can be generated. This step-by-step guide will walk through the steps to calculate how long and how often to run a drip irrigation system, using simple math.

STEP 1: CALCULATE RUN TIME TO APPLY 1 INCH OF WATER

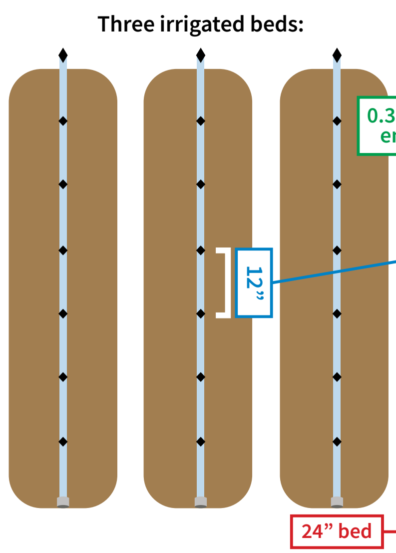
To calculate this, gather the following information:

1. The emitter flow rate in gallon per hour (gph)
2. Emitter spacing (in inches)
3. The area being irrigated by a single drip line (in inches)
   a. For beds with a single drip line, this would be the width of the bed
   b. For beds with multiple drip lines, this would be the distance between lines

Using this gathered information, use the following formula to calculate **how many inches of water is applied per hour.**

$$\text{Drip Rate (in/hour)} = \frac{(\text{emitter flow rate (gph)}) \times (231.1)}{(\text{emitter spacing (in)}) \times (\text{Bed width (in)})}$$

For example, a drip system irrigating three 24 in beds, with each bed having a single drip tape. Emitters have a flow rate of 0.3 gph and are spaced 12 in apart (see image below).



Example: Calculating inches of water applied per hour

$$\text{Drip Rate (in/hour)} = \frac{(\text{emitter flow rate (GPH)}) \times (231.1)}{(\text{emitter spacing (in)}) \times (\text{bed width (in)})}$$

$$\text{Drip Rate (in/hour)} = \frac{(0.3\ \text{gph}) \times (231.1)}{(12\ \text{in}) \times (24\ \text{in})}$$

Drip Rate = 0.24 inches/hour

This means you would need to irrigate for **250 minutes (4.2 hours)** to apply **1 inch of water**.

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STEP 2: CALCULATE DRIP TAPE (TUBE) FLOW RATES

A drip tape's flow rate is often found on the information label on the tape's packaging and is usually reported in gallons per minute (gpm) or gallons per hour (gph) per 100 feet (ft.). If the flow rate is not on the information label, or if point source emitters are being utilized, flow rates can be easily calculated using the following formulas:

Formula to calculate drip tape flow rates in both gpm and gph

$$\text{Drip tube flow rate } (\textbf{gpm}/100\text{ ft}) = \frac{\text{(Emitter flow rate (gph)) x (number of emitters in 100 ft tape)}}{60}$$

OR

$$\text{Drip tube flow rate } (\textbf{gph}/100\text{ ft}) = \text{(Emitter flow rate (gph)) x (number of emitters in 100 ft tape)}$$

Using the example drip system from Step 1, calculate the drip tape flow rate in gpm/100 ft:

- Emitter flow rate of 0.3 gph
- Emitters spaced 12 in apart

$$\text{Drip tube flow rate } (\textbf{gpm}/100\text{ ft}) = \frac{\text{(Emitter flow rate (gph)) x (number of emitters in 100 ft tape)}}{60}$$

$$\text{Drip tube flow rate } (\textbf{gpm}/100\text{ ft}) = \frac{\text{(0.3 gph) x (100*)}}{60}$$

$$\text{Drip tube flow rate } (\textbf{gpm}/100\text{ ft}) = \textbf{0.5 gpm/100 ft}$$

**In this example, the drip tape has emitters spaced every 12 in, so a 100-foot run of drip tape will contain 100 emitters.*

Helpful pre-calculated system run times to deliver 1 in of water:

Tables with pre-calculated run times for applying 1 in of water are available. The table below, from the 2026 Southeastern US Vegetable Crop Handbook, is one example of per-calculated irrigation run times (in **hours**) for different drip tape flow rates and row spacing.

Table 1: Hours required to apply 1 inch of water based on row spacing

Drip Tube/Tape Flow Rate		Row Spacing (feet)				
gph/100 ft.	gpm/100 ft.	4	5	6	8	10
11.4	0.19	21.9	27.3	32.8	43.7	54.7
13.2	0.22	18.9	23.6	28.3	37.8	47.2
20.4	0.34	12.2	15.3	18.3	24.4	30.6
27.0	0.45	9.2	11.5	13.9	18.5	23.1
40.2	0.67	6.2	7.8	99.3	12.4	15.5
80.4	1.34	3.1	3.9	4.7	6.2	7.8

Table from the 2026 Southeastern US Vegetable Crop Handbook

STEP 3: DETERMINE THE SOIL'S WATER HOLDING CAPACITY

To design an effective and efficient drip irrigation schedule, it's important to know a few things about the soil. A soil's infiltration rate (how quickly water moves through the soil) and its water-holding capacity (how much water the soil can retain) should guide the selection of emitter flow rates and emitter spacing, as well as how long and how often irrigation should run. Clay soils, for example, have low infiltration rates, but high water-holding capacity. This means they absorb water more slowly but retain it for longer periods. Soils like this usually perform best with emitters that have lower flow rates and less frequent irrigation cycles. Table 2 contains the infiltration rates and water holding capacity for different soil types.

Table 2: Infiltration rates and water holding capacity by soil type

Soil type	Rate of Water Infiltration (inches per hour)	Water Holding Capacity (inches of water per inch of soil)
Coarse sand	0.75 - 1.00	0.02 - 0.06
Fine Sand		0.06 - 0.08
Loamy Sand	0.50 - 0.75	0.08 - 0.09
Sandy loam		0.10 - 0.12
Loam		0.13 - 0.17
Silty loam	0.25 - 0.40	0.17 - 0.21
Silt		0.17 - 0.20
Sandy clay loam	0.10 - 0.30	0.15 - 0.21
Clay loam		0.15 - 0.21
Silty clay loam		0.15 - 0.17
Sandy clay	0.04 - 0.2	0.15 - 0.21
Silty clay		0.13 - 0.14
Clay		0.10 - 0.13

HELPFUL HINT: The USDA-Natural Resources Conservation Service Web Soil Survey can provide information on soil type (https://websoilsurvey.nrcs.usda.gov/app/). For Arkansas residents, while a standard soil test done through your county Extension office will not include soil type information, this information can be requested.

For the example field described in Step 1, assume a sandy loam soil.

Using Table 2, locate the infiltration rate and water holding capacity for a sandy loam soil.

Soil type	Rate of Water Infiltration (inches per hour)	Water Holding Capacity (inches of water per inch of soil)
Coarse sand	0.75 - 1.00	0.02 - 0.06
Fine Sand		0.06 - 0.08
Loamy Sand	0.50 - 0.75	0.08 - 0.09
Sandy loam		0.10 - 0.12

Infiltration rate: 0.50 – 0.75 inches per hour

Water holding capacity: 0.10 – 0.12 inches of water per inch of soil

STEP 4: DETERMINE THE MAXIMUM RUN TIME FOR A SINGLE IRRIGATION EVENT

Each soil type, with its unique infiltration rate and water holding capacity, can only absorb a certain amount of water at one time. Table 3 shows the maximum recommended run time (in minutes) for a single irrigation event, based on a soil's water holding capacity and the drip tape's flow rate.

Table 3: Maximum Run time for a single irrigation event in minutes for drip irrigated vegetables

Water Holding Capacity[1] (inch of water/inch soil depth)	Drip tube/tape flow rate (gpm/100 ft)				
	0.2	0.3	0.4	0.5	0.6
	Maximum number of minutes per application[2]				
0.02	20	14	10	8	7
0.04	41	27	20	16	14
0.06	61	41	31	24	20
0.08	82	54	41	33	27
0.10	102	68	51	41	34
0.12	122	82	61	49	41
0.14	143	95	71	57	48
0.16	163	109	82	65	54
0.18	183	122	92	73	61

[1]Refer to "Infiltration rates and water holding capacity by soil type" table above. [2]Assumes a 10in deep root zone and irrigation at 25% soil moisture depletion. *Table from the 2025 Southeastern US Vegetable Crop Handbook*

If this seems daunting, don't worry. The next section will explain how to use the water holding capacity from Table 2 in **Step 3**, and the drip tape flow calculations from **Step 2** to determine the maximum run time for a single drip irrigation event.

Using the water hold capacity of the sandy loam soil in **Step 3** (0.10 – 0.12 inches of water per inch of soil), and the calculated drip tube flow rate from **Step 2** (0.5 gpm/100 ft), Table 3 can be used to determine the maximum run time for this example system by locating where the water holding capacity row and drip tube flow rate column intercept.

Water holding capacity: 0.10 – 0.12

Drip tubing/tape flow rate: 0.5 gph/100 ft

Water Holding Capacity[1] (inch of water/inch soil depth)	Drip tube/tape flow rate (gpm/100 ft)				
	0.2	0.3	0.4	0.5	0.6
	Maximum number of minutes per application[2]				
0.02	20	14	10	8	7
0.04	41	27	20	16	14
0.06	61	41	31	24	20
0.08	82	54	41	33	27
0.10	102	68	51	41	34
0.12	122	82	61	49	41

Maximum run time for a single irrigation event

The maximum run time for a single irrigation event for this example system is 41 – 49 minutes. This means, for this example system, irrigation should not run longer than 41 - 49 minutes during a single irrigation event.

STEP 5: PUTTING IT ALL TOGETHER - BUILDING AN IRRIGATION SCHEDULE

Continuing to use the example system from **Step 1**, providing plants 1 in of water each week, requires running the drip system for a total of **250 minutes, or 4.2 hours**, each week (see **Step 1**).

However, the sandy loam soil should not be irrigated longer than **41 – 49 minutes** in a single irrigation cycle (see **Step 4**).

A possible irrigation schedule for this example field could be to run irrigation 5 – 6 times per week for 41 – 49 minutes per cycle. This would give plants the water they need while avoiding water runoff or muddy soil.

HELPFUL HINT: Remember, the 41 – 49 minute run time is the maximum run time for a single irrigation cycle. Shorter, more frequent cycles could be better for plants and water efficiency. With that in mind, another viable irrigation schedule for this system could be irrigating twice a day (morning and evening) for 20 – 25 minutes. Adjust your schedule to meet your crops' needs. An irrigation timer can automate this process and make it less work!

STEP 6: ADJUST THE WATERING SCHEDULE AS NEEDED

The calculations and tables above offer a good starting place when designing an irrigation schedule. However, irrigation frequency and duration will need to be adjusted based on the plant's needs and climate conditions. The generally warmer climate inside a high tunnel, for example, will likely increase a crop's demand for water, and it may be necessary to water more frequently or for longer cycles. While cool, cloudy weather may reduce a plants water needs. The growth stage and size of the crop also influence water needs. Small seedlings or new transplants may not require a full inch of water per week, while a mature, fruiting tomato plant may need closer to two inches per week. Nevertheless, the calculations described above do offer a good place to start when creating a drip irrigation schedule for specialty crops. A good, reliable soil moisture sensor is also a good tool to help dial-in when and how often to irrigate crops.

HELPFUL HINT: Pay close attention to the units used when calculating drip-irrigation schedules. Different resources may use different units–such as gallons per hour (gph), gallons per minute (gpm), or run time in hours, or minutes. To avoid over- or under-irrigating crops, always double-check the units used in the resource being referenced.

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