Trickle Irrigation for Home Gardens

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Introduction

Extended periods of dry weather may appreciably reduce the yield potential of a home garden. If good quality water for irrigation is not available, a much larger dryland area may be needed to obtain the desired production. Trickle irrigation may be the answer for those home gardeners who do not have sufficient good quality water for sprinkler irrigation.

Trickle irrigation involves frequent applications of small amounts of water directly to the root area of the plants. Water is applied under low pressure and irrigations are accomplished with considerable reduction in total water usage. With trickle irrigation, only a small area immediately around each plant is wetted, leaving the remaining soil surface dry. Weed control is more easily maintained because weed seeds are discouraged from germinating in the dry soil.

Foliage (leaf diseases are less apt to develop under trickle irrigation since plant leaves are not wetted as with sprinkler irrigation. Free water on plant leaves is a necessary ingredient for growth and development of many foliar diseases. In addition, chemicals applied for disease and insect control are not washed from the plants except when rainfall is received.

Providing the water quality is satisfactory for irrigation, the water requirements of the average home garden can be easily supplied from the faucet of a home water supply. The quantity needed will vary with climatic conditions and growth state of the vegetable crop.

Water Requirements

Water conservation is the primary reason for considering trickle irrigation. On the average, trickle irrigation will reduce the water required to less than one-half of the gallonage used with sprinkler irrigation, as shown in Table 1.

Table 1. Water Consumption Comparing Trickle vs. Sprinkler Irrigation

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                          Water Required
                           (in gallons)      Water
                              when           Losses
           Area of Soil    1" of water      Through
Type of     Wetted When   is applied on    Evaporation
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Irrigation	Irrigated	1,000 sq. ft.	or Drift
Trickle	50% or less	300 gallons	Very Little
Sprinkler	100%	625 gallons	15-20% Lost

Considerably less water is required because the entire soil surface is not wetted during trickle irrigation; water is applied directly to the base of the growing plant. Assuming one-half or less of the soil is wetted, a 1-inch application on a 1,000-square-foot area of garden would require 300 gallons of water. A 1-inch application to a 1,000-square-foot area of a garden with an overhead sprinkler system would require 625 gallons. Approximately 100 gallons or more of that 625 gallons would be lost to evaporation or drift as the water travels through the air. This would leave .80 to .85 inch of that 1 inch available for plant use. Losses to evaporation or drift can be much higher during hot, windy conditions with sprinkler irrigation .

Connecting the Water Supply to Trickle Irrigation System

A mainline runs from the water source and delivers water to the garden site. One-half or 1-inch black polyethylene pipe is an excellent water delivery source to use for this purpose. See Tables 4, 5, 6, and 7 for selection of mainline size. It is advisable to select good quality pipe which is resistant to deterioration from exposure to sunlight. A short piece of garden hose with a female faucet fitting on one end and a plastic coupler on the other can be used to connect the faucet to the mainline.

To eliminate damage from lawnmowers and other equipment, the mainline may be buried. This can be done easily by cutting a narrow trench with a spade and burying the pipe 2 to 4 inches deep.

Since water emitters will plug easily, water quality must be watched. The water used for irrigation must be kept sand and silt free or filtration must be provided. A 100-mesh screen water filter may be installed directly in the mainline. This will adequately filter out any trouble-causing particles.

At the garden edge, a flow regulating valve or a pressure regulator should be installed (Figure 1). This valve or pressure regulator is especially important because it controls the operating pressure of the system. An accurate pressure gauge should be installed downstream of the regulating valve in order to set operating pressure. It may be desirable to install a bypass around the pressure regulator for easy flushing of laterals and to allow quick filling of a zone or zones so all air is removed and emitters operate properly. Farm water systems generally operate at an average of 40 pounds per square inch (psi) where a drip system will operate successfully at 2� to 5 psi. Once the system is full of water, simply adjust the valve to obtain the desired cut in pressure. A pressure regulator will automatically maintain the preset pressure. If a hand controlled regulating valve is used, pressure will fluctuate, depending on water use on the supply system. If a pressurized farm water system is not available, an elevated tank may be used as a water source (Figure 2--alternate water supply). The operating pressure is dependent on the height of the tank. For each 1 psi desired, elevate the tank 2.31 feet. A pressure gauge may be installed directly behind the gate valve to monitor the operating pressure.

Figure 1. **Typical Trickle Irrigation Layout Using Zones and a Pressure Water Supply** (12KB b&w diagram)

Figure 2. **Elevated Water Supply** (7KB b&w diagram)

Row lateral pipe size will depend on the lateral length, the kind of emitters used and the spacing along the lateral. Guidelines for determining lateral size are found in Tables 2 and 3. Laterals should be sized so there is not more than a 10 percent difference in discharge between the first and last emitter on the line or zone. The discharge should not vary more than 10 percent if the pressure difference from the first to the last emitter varies 20 percent or less.

Guidelines for selecting pipe for mains and submains are given in Tables 4, 5, 6, and 7. It is recommended that the total pressure loss should be divided between the submain and the laterals.

Table 2. Maximum Lateral Lengths 1 Gallon Per Hour Emitter Flow Rate Pressure Loss (PSI) for Laterals

Emitter Spacing	**1 ft.**	**1.5 ft.**	**2 ft.**
Nominal Pipe Diameter			

Nominal Pipe Diameter in Inches	3/8	1/2	3/4	3/8	1/2	3/4	3/8	1/2	3/4
Length of Lateral in Feet:									
25	.25	.02	.00	.10	.01	.00	.06	.00	.00
50	1.57	.97	.02	.65	.04	.01	.31	.03	.00
75	4.79	.30	.07	1.99	.13	.03	1.09	.08	.02
100		.65	.16	4.39	.30	.07	2.40	.17	.04
150		2.00	.48		.91	.23	7.33	.53	.13
200		4.41	1.07		2.00	.50		1.16	.29
250			1.97		3.69	.92		2.14	.54
300			3.26		6.00	1.51		3.53	.90
350			4.98			2.31		5.40	1.36
400						3.34			1.96
450						4.62			2.71
500									3.62
550									4.71
600									
650									
700									

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Emitter Spacing	**2.5 ft.**			**3 ft.**		
Nominal Pipe Diameter in Inches	**3/8**	**1/2**	**3/4**	**3/8**	**1/2**	**3/4**
Length of Lateral in Feet:						
25	.04	.00	.00	.03	.00	.00
50	.25	.02	.00	.17	.01	.00
75	.69	.05	.01	.52	.04	.01
100	1.52	.11	.03	1.06	.08	.02
150	4.65	.35	.09	3.23	.25	.06
200	10.26	.76	.19	7.13	.55	.14
250		1.42	.36		1.01	.26
300		2.33	.59		1.66	.42
350		3.56	.90		2.54	.65
400		5.14	1.30		3.67	.93
450			1.80		5.70	1.29
500			2.40			1.73
550			3.13			2.24
600			3.97			2.85
650						3.55
700						4.36

Table 3. Maximum Lateral Lengths 2 Gallons Per Hour Emitter Flow Rate Pressure Loss (PSI) for Laterals

Emitter Spacing	**1 ft.**			**1.5 ft.**			**2 ft.**		
Nominal Pipe Diameter in Inches	**3/8**	**1/2**	**3/4**	**3/8**	**1/2**	**3/4**	**3/8**	**1/2**	**3/4**
Length of Lateral in Feet:									
25	.85	.05	.01	.35	.02	.00	.19	.01	.00
50	5.29	.33	.08	2.19	.15	.04	1.30	.09	.02
75		1.00	.24	6.69	.45	.11	3.66	.26	.07
100		2.20	.53		1.01	.25	8.08	.58	.15
150		6.72	1.63		3.05	.76		1.27	.44
200			3.60		6.73	1.68		3.90	.98
250			6.64			3.09		7.20	1.81
300						5.09			2.99
400						7.78			4.57
450									6.59
500									

550
600
650
700

(continued)

Emitter Spacing	**2.5 ft.**			**3 ft.**		
Nominal Pipe Diameter in Inches	**3/8**	**1/2**	**3/4**	**3/8**	**1/2**	**3/4**
Length of Lateral in Feet:						
25	.14	.01	.00	.09	.01	.00
50	.83	.06	.02	.57	.04	.01
75	2.32	.17	.04	1.75	.13	.03
100	5.13	.38	.10	3.56	.27	.07
150	15.64	1.16	.30	10.86	.83	.21
200		2.57	.65		1.83	.47
250		4.74	1.20		3.39	.86
300		7.83	1.99		5.59	1.43
400			3.03		8.54	2.18
450			4.38			3.14
500			6.06			4.35
550						5.80
600						
650						
700						

Table 4. Main and Submain Lengths Pressure Loss (PSI) for Mains and Submains Pipe Size 3/8 Inch

Flow Rate GPH	**25**	**50**	**75**	**100**	**150**	**200**	**250**
Flow Rate GPM	**(.41)**	**(.83)**	**(1.25)**	**(1.66)**	**(2.50)**	**(3.33)**	**(14.16)**
Pipe Length In Feet:							
3	.05	.18	.36	.60	1.23	2.03	3.00
6	.09	.32	.65	1.07	2.17	3.59	5.31
9	.14	.46	.93	1.53	3.12	5.15	
12	.18	.59	1.21	2.00	4.06		
15	.22	.73	1.49	2.46			
20	.29	.96	1.96	3.24			
25	.35	1.19	2.42	4.01			
50	.70	2.34	4.76				
75	1.04	3.49					
100	1.38	4.64					
150	2.06						
200	2.75						
250	3.43						
300	4.12						
350							
400							

(continued)

Flow Rate GPH	**300**	**350**	**400**
Flow Rate GPM	**(5.00)**	**(5.83)**	**(6.66)**
Pipe Length In Feet:			
3	4.13		
6			
9			
12			
15			
20			
25			
50			
75			
100			
150			

200							
250							
300							
350							
400							

Table 5. Main and Submain Lengths Pressure Loss (PSI) for Mains and Submains Pipe Size 1/2 Inch

Flow Rate GPH **Flow Rate GPM**	**75** **(1.25)**	**100** **(1.66)**	**150** **(2.50)**	**200** **(3.33)**	**250** **(4.16)**	**300** **(5.00)**	**350** **(5.83)**
Pipe Length In Feet:							
3	.03	.05	.09	.16	.23	.32	.41
6	.05	.09	.18	.30	.44	.60	.79
9	.08	.13	.26	.44	.65	.89	1.17
12	.10	.17	.35	.58	.86	1.18	1.54
15	.13	.21	.44	.72	1.06	1.46	1.92
20	.17	.28	.58	.96	1.41	1.94	2.54
25	.21	.35	.72	1.19	1.72	2.42	3.17
50	.43	.70	1.43	2.37	3.49	4.81	6.30
75	.64	1.05	2.14	3.54	5.24		
100	.85	1.40	2.85	4.72			
150	1.27	2.10	4.28				
200	1.69	2.80					
250	2.12	3.50					
300	2.54	4.20					
350	2.96						
400	3.39						

(continued)

Flow Rate GPH **Flow Rate GPM**	**400** **(6.66)**	**450** **(7.50)**	**500** **(8.33)**	**550** **(9.16)**	**600** **(10.00)**	**650** **(10.83)**	**700** **(11.66)**
Pipe Length In Feet:							
3	.52	.64	.77	.91	1.06	1.22	1.39
6	1.00	1.23	1.47	1.74	2.03	2.33	2.66
9	1.47	1.81	2.18	2.57	2.99	3.44	3.92
12	1.95	2.39	2.88	3.40	3.96		
15	2.42	2.98	3.58	4.23			
20	3.21	3.95					
25	4.01						
50							
75							
100							
150							
200							
250							
300							
350							
400							

Table 6. Main and Submain Lengths Pressure Loss (PSI) for Mains and Submains Pipe Size 3/4 Inch

Flow Rate GPH **Flow Rate GPM**	**200** **(3.33)**	**250** **(4.16)**	**300** **(5.00)**	**350** **(5.83)**	**400** **(6.66)**	**450** **(7.50)**	**500** **(8.33)**
Pipe Length In Feet:							
3	.04	.06	.08	.11	.13	.16	.20
6	.08	.11	.16	.20	.26	.32	.38
9	.11	.17	.23	.30	.38	.47	.57
12	.15	.22	.31	.40	.51	.62	.75
15	.19	.28	.38	.50	.63	.78	.93
20	.25	.37	.51	.67	.84	1.03	1.24
25	.31	.46	.63	.83	1.05	1.29	1.55
50	.62	.92	1.26	1.65	2.09	2.57	3.09
75	.93	1.38	1.89	2.48	3.13	3.85	4.63
100	1.24	1.83	2.52	3.30	4.17	5.13	
150	1.86	2.75	3.78	4.95			
200	2.48	3.66	5.04				

250	3.10	4.58
300	3.71	
350	4.33	

(continued)

Flow Rate GPH	**600**	**700**	**800**	**900**	**1000**	**1100**
Flow Rate GPM	**(10.00)**	**(11.66)**	**(13.33)**	**(15.00)**	**(16.66)**	**(18.33)**
Pipe Length In Feet:						
3	.27	.35	.44	.55	.66	.78
6	.52	.69	.87	1.07	1.28	1.52
9	.78	1.02	1.29	1.58	1.90	2.25
12	1.03	1.35	1.71	2.10	2.52	2.98
15	1.29	1.68	2.13	2.62	3.14	3.72
20	1.71	2.24	2.83	3.48	4.18	
25	2.13	2.79	3.53	4.34		
50	4.25	5.56				
75						
100						
150						
200						
250						
300						
350						

Table 7. Main and Submain Lengths Pressure Loss (PSI) for Mains and Submains Pipe Size 1 Inch

Flow Rate GPH	**500**	**550**	**600**	**650**	**700**	**750**
Flow Rate GPM	**(8.33)**	**(9.16)**	**(10.00)**	**(10.83)**	**(11.66)**	**(12.50)**
Pipe Length In Feet:						
3	.06	.07	.08	.09	.11	.12
6	.12	.14	.16	.19	.21	.24
9	.18	.21	.24	.28	.32	.36
12	.23	.28	.32	.37	.42	.48
15	.29	.35	.40	.46	.53	.60
20	.39	.46	.54	.62	.70	.79
25	.49	.58	.67	.77	.88	.99
50	.98	1.15	1.34	1.55	1.76	1.99
100	1.47	1.73	2.02	2.32	2.64	2.98
150	1.95	2.31	2.69	3.09	3.52	3.97
200	2.93	3.46	4.03	4.64	5.28	
250	3.90	4.62				
300	4.88					

(continued)

Flow Rate GPH	**800**	**850**	**900**	**1000**	**1100**	**1200**
Flow Rate GPM	**(13.33)**	**(14.16)**	**(15.00)**	**(16.66)**	**(18.33)**	**(20.00)**
Pipe Length In Feet:						
3	.13	.15	.16	.20	.23	.27
6	.27	.30	.33	.39	.47	.54
9	.40	.46	.49	.59	.70	.81
12	.53	.59	.66	.79	.93	1.09
15	.67	.74	.82	.99	1.64	1.36
20	.89	.99	1.09	1.31	1.55	1.81
25	1.11	1.28	1.37	1.64	1.94	2.26
50	2.22	2.47	2.73	3.28	3.88	4.52
100	3.34	3.70	4.10	6.57		
150	4.45	4.94				
200						
250						
300						

(continued)

Flow Rate GPH	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**
Flow Rate GPM	**(21.66)**	**(23.33)**	**(25.00)**	**(26.66)**	**(28.33)**	**(30.00)**
Pipe Length In Feet:						
3	.31	.36	.40	.45	.50	.55
6	.62	.71	.80	.90	1.00	1.10
9	.94	1.07	1.20	1.35	1.50	1.65

12	1.25	1.42	1.60	1.80	2.00	2.21
15	1.56	1.78	2.00	2.24	2.50	2.76
20	2.08	2.37	2.67	2.99	3.33	3.68
25	2.60	2.96	3.34	3.74		
50	5.20	5.92				
100						
150						
200						
250						
300						

(continued)

Flow Rate GPH	**1900**	**2000**	**2100**	**2200**
Flow Rate GPM	**(31.66)**	**(33.33)**	**(35.00)**	**(36.66)**
Pipe Length In Feet:				
3	.61	.66	.72	.78
6	1.21	1.33	1.44	1.57
9	1.82	1.99	2.17	2.35
12	2.42	2.65	2.89	3.13
15	3.03	3.32	3.61	
20				
25				
50				
100				
150				
200				
250				
300				

Example:

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Select the lateral and submain for a zone consisting of:
  Pressure at submain         = 5 psi
  Length of laterals          = 50 ft.
  Number of laterals          = 9
  Distance between laterals   = 3 ft.
  Emitter discharge rate      = 2 gph
  Emitter spacing on lateral  = 1.5 ft.

Submain connects to zone submain at center lateral
  Allowable pressure loss
   (5 psi x 20 percent allowable psi loss)    = 1.0 psi
  Gallons per hour each lateral               = 66 gph
    50 ft.
  --------- = 33 emitters x 2 ghp = 66 gph
   1.5 ft.
  Gallons per hour for zone                   = 594 gph
    66/lateral x 9 laterals = 594 gph
  Lateral size selected (Table 3)             = 1/2 inch
  Lateral pressure loss (Table 3)             = .15 psi
  Submain size (Table 5)                      = 1/2 inch
   Submain consists of four 36-inch pipes
   either side of the point at which it is
   connected to the mainline.
  Gallons per hour into each 1/2 of submain   = 264 gph

    594 gph - 66 gph center lateral
   -------------------------------- = 264 gph
                  2
  Pressure loss in submain                    = .60 psi
    From Table 5
  PSI loss first 3 feet of submain            = .32 psi
    264 GPH (used 300 gph loss)
  PSI loss second 3 feet of submain           = .16 psi
    264 - 66 = 198 gph (used 200 gph loss)
  PSI loss third 3 feet of submain            = .09 psi
    198 - 66 = 132 gph (used 150 gph loss)
  PSI loss fourth 3 feet of submain           = .03 psi
    132 - 66 = 66 gph (used 75 gph loss)
  Total PSI loss submain                      = .60 psi
  Plus PSI loss lateral                       = .15 psi
  Total pressure loss in submain and lateral  = .75 psi
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For special drip emitters follow the manufacturers instructions for design and size of laterals and submains.

Submains and Zoning

From the mainline, the proper size black plastic pipe is continued across the garden as a submain. Lateral lines are then tied into the submain at the desired row spacing. The submain should be sized so submain and lateral pressure loss does not exceed the maximum allowed. Each lateral may supply water for one or two rows. When irrigating two rows per lateral, row spacing should not exceed 10 inches. The ends of the laterals may either be capped or plugged with dowels, or laterals may be connected at both ends.

Emitters, or any outlet device that delivers water to the crop, are placed along the lateral lines. Black plastic pipe will stretch when warm and contract when cool, so if the lateral is 25-30 feet or more in length, it should be cool when emitters are placed for hilled or spaced crops. This can be accomplished by filling the system with water before installing emitters to insure that the water will be applied where it is needed.

Zoning vegetables of like water requirements and season length will additionally aid in water conservation. Simply place a valve between the zoned areas in the submain line, and when a particular area no longer needs irrigating, close the valve to that zone.

Emitters and Microtubes

Emitters are installed along the lateral lines and should be spaced between 16 and 18 inches for solid seeded rows or they may be installed at individual hills for spaced crops. They come in many sizes and are color coded as to their output. They may also have single or multiple outlets and are manufactured and sold by a number of companies. One-to-two gallon-per-hour emitters are generally recommended for home garden use. Some problems with plugging may be encountered with emitters if the water is high in soluble salts or iron. Filtering will ease this problem.

Microtubes are long spaghetti-shaped tubes used to direct the application of water away from the hose to an individual hill or plant. They are very popular for irrigating distant spaced plants. Microtubes are cut to length to control the amount of water emitted. The shorter the length of the microtube, the higher the application of irrigation water per tube.

Dew Hose

Dew hose may be either sewn plastic film, where drops of water are emitted through the seam, or it may be a porous material formed into a tube that emits water droplets along the entire surface. Dew hose works both on the surface or subsurface. However, it appears to work best if covered with some soil. To reduce the effects a hard wind might have on this light material, it is advisable to cover it slightly with soil. Dew hose is quite susceptible to plugging from iron bacteria activity.

Twin-Wall Tube

Twin-wall tube is molded from plastic and is a tube within a tube. Water seeps from the inside tube to the outside tube and is then released to the crop. Spacing of openings from outer tubes can vary from as close as 4 inches to more than 18 inches. The spacing should be specified when ordering. Twinwall tube is also subject to clogging from iron bacteria.

Alternate Water Supply

An elevated tank may be used as a water source (Figure 2). The size of the water supply should be sufficient to make one complete irrigation of the garden. (A rule of thumb: About 300 gallons will trickle irrigate a 1,000 square-foot area with 1 inch of water, assuming only one-half of the area is wetted.)

To obtain the desired pressure, elevate the base of the water tank or pressure control box 2.31 feet for every pound per square inch required.

An alternative to an elevated tank could be ground level storage or cistern with a low pressure pump to provide the minimum pressure of 3 to 5 pounds per square inch.

Area Requirement and Row Spacing

If the garden area is limited, considerably greater production can be obtained by using trickle irrigation. Since the water needs of the crop are being supplied, the area between rows need only be wide enough to accommodate plant growth and harvest. A little experimentation will allow you to determine the best spacing for your situation.

Automation

A trickle irrigation system lends itself to automation quite easily. It may be as simple as a time clock and solenoid valve to shut the system off to the point of turning the system on and off as well as regulating the irrigation of each different zone. Using a time clock to automate a drip system is convenient for daily use.

Maintenance

Before irrigating for the first time each year, the system should be flushed to clean any accumulated dirt or rust out of the pipes. This can be done by removing the end caps to each lateral or by removing a portion of the end header line, depending on which method of capping is used, and turning on the water.

Maintenance of a drip system mainly involves keeping the emitters working properly. If an emitter should become plugged, remove it and replace it with a spare. Soaking the plugged emitter in water a short time will usually loosen the material inside the emitter orifice. Blowing air through the emitter orifice will sometimes also free the passageway and the emitter will work as good as new.

If water quality is a problem, the water filter screen will also have to be inspected periodically. Some water filters are designed for easy removal of the screen for cleaning purposes.

At the end of the irrigation season the drip system should be gathered and placed inside for the winter. This will protect the plastic pipe from rodent damage and also will help keep dirt out of the emitters. Black plastic electricians' tape can be wrapped around the pipe at intervals to keep it gathered for winter storage.

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