8 STEPS TO A SUCCESSFUL WATERING SYSTEM

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Do you spend much of your day holding the end of a water hose? An automatic watering system may be your answer to more uniform watering and less labor input.

1. How much water is needed?

Plants require an adequate supply of moisture for optimum growth and maximum flower production. For each ounce of dry matter produced by the plant as much as two gallons of water move through the plant. A first step in planning an automatic system or when planning to build new greenhouse space is to estimate the maximum water requirements. This varies with the type and size of crop and the local climate. Besides transpiration from the plants, evaporation from soil surfaces must be considered. Table 1. gives an estimate of the maximum daily water requirements for most types of crops. This maximum usage usually occurs on the hot days during the summer. The water needs for your greenhouse can be calculated by multiplying the square feet of growing area for each crop times the daily water requirement. For example, a 25' x 96' greenhouse with a crop of bedding plants on the floor could use up to 1200 gallons per day (2400 sq. ft. x 0.5 gal/sq. ft./day).

2. Is there adequate water available?

The water system for the greenhouse should supply the total daily needs in about a six hour period. This allows the plants to be watered during the morning and early afternoon and still have time for the foliage to dry before sunset. The peak use rate is the maximum flow rate needed during this six hour period.

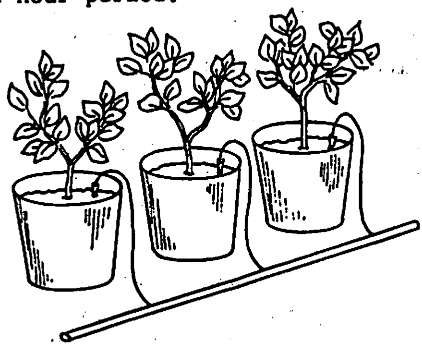


Table 1. Estimated Maximum Daily Water Requirements

Crop	Gallons of Water	Remarks
Bench Crops	.4 gal/ft	Based on twice a day watering
Bedding Plants	.5 gal/ft	
Pot Plants	.5 gal/ft	
Mums, Hydrangeas	1.5 gal/ft	Based on 3 times a day watering
Roses	.7 gal/ft of bed	
Tomatoes	.25 gal/ft of bed	Water on every other day

Peak use rates are needed to determine pump capacity, pipe size, type of distribution system and storage tank size. In the above example if the 1200 gallons were applied over the 6 hours you would need 200 gallons per hour (gph) or 3 1/3 gallons per minute (gpm). If the water was applied over a 30 minute period as might be the case with an automatic system, then a supply rate of 40 gpm is needed. Although streams, ponds and municipal systems can supply this rate, most wells cannot. Under these conditions an intermediate storage tank may have to be used.

3. How will the water be applied?

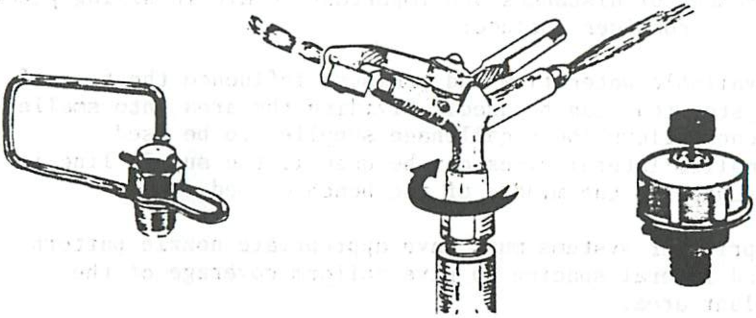
There are many devices for watering plants. These can be classified as low pressure, trickle systems that operate on less than 15 pounds per square inch (psi) and high pressure, sprinklers that operate on pressures above 15 psi. Because the application rate is much slower with a low pressure system this works better where a well supply rate is limited. High pressure systems on the other hand can give good coverage over a larger area in a shorter time period. A low pressure emitter may have a flow rate of one gallon per hour, whereas a typical sprinkler applies one gallon per minute.

Low pressure devices include drip tubes, emitters and perforated hoses. Drip tubes are widely used for watering pots and hanging baskets. This system consists of small diameter plastic capillary tubes connected to a hidden supply line to which "drop in" weights are attached. Some weights are available with a shut-off so that the water to individual pots can be stopped when the pot is removed. The diameter of the tube and its length determine the water flow.

Emitters are devices usually placed in a supply line at intervals that correspond to the pot or plant spacing. They are designed to dissipate the energy in the flow of water so that it emerges as drops at a rate of 1/2 to 1 gph. Some emitters accomplish this by creating a long flow path while others develop a turbulent flow condition.

Low flow porous or perforated hoses are designed for watering greenhouse benches, beds and capillary mats. Under low pressure, water dribbles from the seams or tiny holes. A hose within a hose is sometimes used to give more uniform pressure and flow along its length.

High pressure devices are sprinklers available in many designs, capacities and patterns.



Fixed spray heads, originally developed for lawn irrigation have been successfully used to irrigate bedding plants and for propagation of cuttings in small pots. Heads with various patterns - square, full circle, part circle and rectangular are available.

Rotating impact sprinklers revolve about one to two times per minute. Rotation is caused by an arm that oscillates in and out of the nozzle jet. For large open areas and containers up to 10 inches, impact sprinklers are the most efficient form of irrigation. Nozzles can be interchanged to vary flow rate and coverage.

Whirling, rotating sprinklers rotate by the reaction of the jet of water discharging from the nozzle. Sprinklers with single or double arms work well on small, closely spaced containers. Discharge rate and droplet size can be varied.

Sprinkler head spacing is usually 50 to 75 percent of the spray diameter to allow for more uniform coverage. Spray diameters from 3 to 80 feet are available.

With the shift to plugs, cell packs and small trays there is need for a system that will provide very uniform coverage. The watering boom supported over the plants by either a track system or a cart that travels along a central aisle works well. These can be purchased from several suppliers in both manually pulled and motorized models. A fact sheet on how to build your own is available from the Agricultural Engineering Department, Box U-15, University of Connecticut, Storrs, CT 06268.

4. Develop a system layout

A plan should be developed on paper and to show the location of the water supply and growing areas. Accurate measurement of distances are important to aid in sizing pipe. Things to consider include:

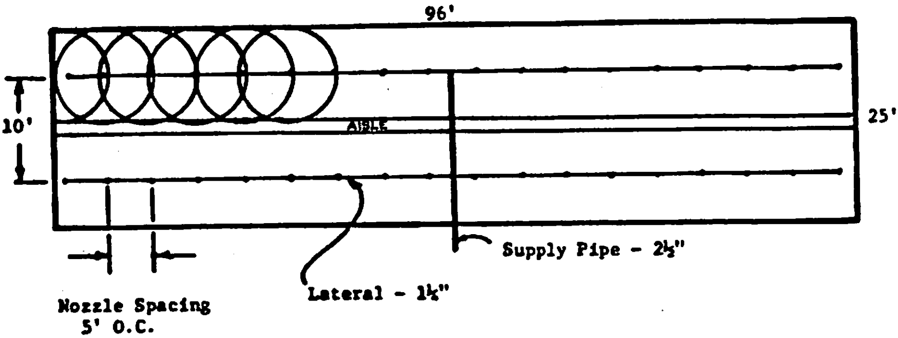
a. Available water flow and pressure influence the type of system that can be used. Dividing the area into smaller zones allows lower gallonage supplies to be used. Smaller lateral pipes can be used if the supply line is brought to the middle of the bench or bed.

b. Sprinkler systems must have appropriate nozzle pattern and lateral spacing to give uniform coverage of the plant area.

c. For Trickle systems emitters must supply water to each plant root zone.

The following are two possible system layouts to water our 25 x 96 example greenhouse filled with bedding plants.

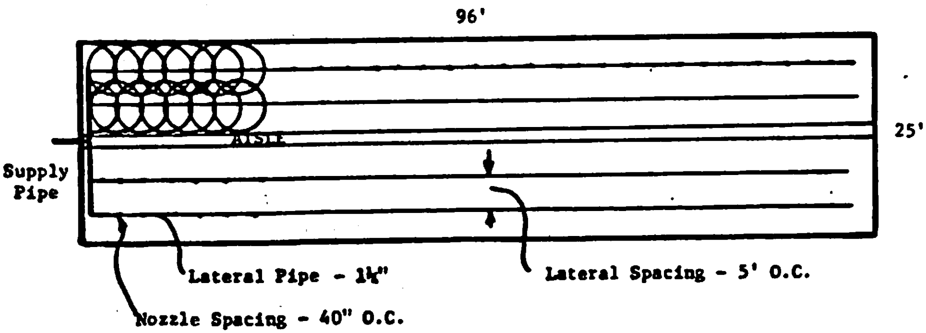
For this example an application rate of 0.2 gal/sq ft/day will be used. The amount of water needed is 480 gallons (0.2 gal/sq ft/day x 2400 sq ft).



<u>Design using 2 gpm nozzles</u> - whole greenhouse watered at one time.

Nozzle spacing - 5' on center, 2 laterals
Coverage - 12' diameter - double overlap
No. of nozzles - 36 (18 per row)
Water supply needs - 36 nozzles x 2 gpm = 72 gpm
Supply pipe size - 2 1/2" dia.
Lateral pipe size (each lateral supplies 18 gpm) - 1-1/4" dia.
Time needed to apply water - $\frac{480 \text{ gal}}{72 \text{ gpm}}$ = 6-2/3 min.

Controller should be used to sequence between greenhouses or bays.



<u>Design using 0.5 gpm nozzles</u> - Each lateral controlled by solenoid and sequenced so one lateral operates at a time.

Spacing - 40" O.C., 4 laterals
Coverage - 8' dia. - double overlap
No. of nozzles - 124 (31 per lateral)
Water supply needs - 31 nozzles x 0.5 gpm - 15.5 gpm per lateral
Supply pipe size - 1" dia.
Lateral pipe size - 1-1/4" dia.
Time needed to apply water (each lateral) - $\frac{120 \text{ gal}}{15.5 \text{ gpm}}$ = 7-3/4 min.
Time needed to water whole greenhouse - 31 minutes

5. Sizing pipe is important

Polyethylene and polyvinyl chloride (PVC) pipe are most commonly used for supply and distribution lines. The cost is low, the installation is easy and the service life good. Schedule 40 is commonly used for 1/2 and 3/4 inch pipe sizes and Schedule 80 for larger sizes.

Supply lines and laterals should be sized to carry the flow needed without excess friction loss. Friction loss is created when water flows through pipes, valves, fittings and sprinklers or emitters. Because friction loss is accumulative between the source and the nozzles, allowances have to be made to insure that each nozzle has an adequate supply or the coverage will be uneven. Tables are available that help determine what size pipe is needed.

6. Select good quality equipment.

Pumps should supply water under sufficient pressure to provide the required flow rate and coverage. The total pressure against which a pump must work is made up of four parts. They are: (1) suction lift or vertical distance water is lifted to the pump by suction, (2) the vertical distance from the pump to the point where water is to be delivered, (3) the required pressure at the outlet or nozzles and (4) the friction in the piping system. These values can be given in feet of water or psi. Multiply psi by 2.31 to obtain feet of water. For example: 40 psi is equal to 92 feet of water or a column of water 92 feet high.

Valves are needed in a water system to control the flow of water. Ball valves should be used for shut-off purposes, wherever possible because they have less friction loss and allow a greater flow than gate or globe valves.

All municipal and domestic water sources must be protected against contamination because of backflow. The most commonly used backflow preventer is the vacuum breaker. If you are connected to a municipal system check with the water company to see what is required.

7. Make the system automatic

Automatic control is desirable where several zones are used. It requires a controller and solenoid valves to turn each zone on or off. Controllers are available that will meet almost unlimited combinations of watering duration per zone, watering frequency per zone per day, override if more water is needed or skip if there are no plants in that zone.

With recent advances in solid state technology and the increased use of solar control computers more precise watering should be possible with lower fertilizer usage and less potential pollution.

8. No water system is any better than its installation

Supply pipes to the greenhouse should be buried below the frost line and in areas of heavy traffic be protected by placing in a rigid conduit. To avoid stress on connections allow for expansion of the pipe.

Provide adequate power to the pump. A common cause of failure is a low voltage condition caused by undersized wire.

Design the system to keep the number of fittings and valves to a minimum to reduce the friction loss.

A good installation is one where the pump and other components are easily accessible making inspection and maintenance easy. Make provisions for expansion by installing extra tees in critical locations.