

Drip Irrigation for the Yard and Garden

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Drip irrigation has many advantages over sprinklers. The application efficiency of sprinklers is typically about 70%. This means that while 70% of the water that leaves the sprinkler nozzle ends up in the soil for potential use by the plants, 30% is lost to wind-drift and evaporation. Drip irrigation is 90-95% efficient. The 5-10% water loss comes from water evaporation from the small portion of the soil surface that gets wet. Because only a small area of the soil surface gets wet, fewer weed seeds germinate. Drip irrigation also allows the plant's leaves to stay dry, reducing the risk of plant diseases that thrive in wet conditions. Drip irrigation will typically allow a much higher degree of control over the soil water content. Unlike flood irrigation or sprinkler irrigation, drip is also suitable to any soil type or slope.

Drip irrigation does have drawbacks. It costs more per unit of irrigated area than any of the other irrigation system alternatives and the potential for plugging is a major concern. To achieve slow application rates, the water must travel through a very small orifice (opening). Consequently, tiny bits of organic or inorganic material in the water will plug the drip emitters. When that happens, the plants around that particular emitter get no water at all.

Drip Irrigation System Components

The following are components of typical drip irrigation systems. Listed in order starting at the water source, the system consists of (1) a backflow prevention/anti-siphon device, (2) a control valve to turn the water on and off, (3) a filtration system, (4) a pressure regulator (if required), (5) the mainline, submains and individual drip lines, (6) drip emitters, and (7) air and vacuum release valves. All of these components can be found at an irrigation supply store. Not all are required in every landscape or garden situation and some may be combined.

1. The *backflow prevention* or anti-siphon device is required to protect the integrity of the water supply. They are required by law in many municipalities and are always a good idea in order to prevent contaminated water from reentering the domestic water system after the water has been shut off.
2. *Control valves* are often set up to be opened and closed automatically using a timer or other irrigation control device. Hose-end timers combine a timer and an automatic valve into one device. They are manufactured by many different companies and offer a practical alternative for simple irrigation systems that are typical of smaller yards and gardens.
3. Plugging is the biggest problem of drip irrigation. To combat this, good *filtration* is an absolute necessity. In fact, the filtration system should be considered the most important

part of the whole system. Most home drip systems use a simple screen filter to remove small particles of debris from the water. These screen filters need to be cleaned out periodically, either manually or through some sort of back-flush system. Larger water users will want to consider sand-media filters, disk filters, separators, or a combination of these.

4. *Pressure regulators* are required if your water source produces pressures that are higher than what the drip system components are rated for. Excessive pressure may cause components to come apart, leak, or not function correctly. Pressure regulators will reduce the pressure to that specified by the regulator.

5. Depending on the complexity of the drip system, there may be a *mainline and submains* that distribute the water to the heads of the laterals. The laterals carry the water to the individual emitters where the water is applied to the root zones. Most mainlines are made of PVC, while submains and the drip laterals themselves are most often made from polyethylene. Drip laterals can be buried or covered by mulch. This will help to protect the laterals from sun, insect, and traffic damage. The only draw-back in covering the laterals is that it's difficult to find and fix problems such as plugged emitters.

6. There are many different *emitter* types that operate on different principles and are made by a wide number of manufacturers. The most common are orifice emitters and turbulent flow emitters.

Orifice emitters are simply a small hole that the water flows through. Although these are the least expensive they are the most prone to plugging since the flow rate is determined by the size of the orifice, and this must be small to create the slow dripping action required.

Turbulent-flow emitters force the water through a tortuous path before it is released out to atmospheric pressure. Because all of the pressure is dissipated through friction as it travels through the labyrinth inside the emitter, larger diameter passageways can be used and they are less prone to plugging.

Emitters are typically rated in units of gallons per hour (gph) with 0.2 to 4 gph being typical. If there are large pressure differences along the drip line due to very long laterals, or if the drip lines go up and down steep slopes, then pressure-compensating emitters are available which will help ensure that the same amount of water comes out of each emitter regardless of the pressure at that point in the line.

7. *Air and vacuum release valves* are also a good idea. They allow air out of the system as it fills with water, and allow air back into the system after the water is turned off. These should be placed at the high points and/or at the end of long runs in the system (places where air would accumulate as the system is filled).

8. To help combat plugging, it is also a good idea to have a way to open up the end of the drip lateral to periodically *flush out* any particles in the system. This should be done before use in the spring and then periodically throughout the season as required.

System Design and Operation

Drip systems can essentially be grouped into two categories: line-source and point-source. A line source system has emitters or drippers spaced at regular intervals along the line. Water can be considered to be coming from the line as if it were one source instead a series of drippers. Drip tubing with pre-installed emitters, drip tape, and soaker hoses can all be considered line-source. Point source consists of individual emitters that are placed such that water is emitted precisely in discrete locations such as right at the base of the plant. Line source systems are a good option for lawns and gardens while point-source systems fit better with irregularly shaped flower beds, potted plants, and individual, isolated plants.

As water is dripped onto the soil surface it moves into the soil in an inverted dome-shaped pattern. Since the soil pulls on this water it moves both vertically (as gravity and the soil draw it down) and horizontally (as it is drawn to the sides by the soil). Usually the water's sideways movement in the soil is not visible to the eye because it happens underneath a dry soil surface. This means that the dripper irrigates a much larger area than it appears to. Remember that this is a good thing because wet, unmulched soil surfaces are ideal for germinating weed seeds. How far water is moved horizontally in a soil depends mostly on the soil's texture and the dripper flow rate. Clay soils will move water 2½ - 4 feet away from the emitter. This would create a circular wetted diameter of 5 – 8 feet, although maybe not on the soil surface where it is visible. Loams and silt loams will move the water 1½ - 3 feet horizontally, and sandy soils can only move water 1 - 2 feet horizontally through in the soil. After a long irrigation event, dig down next to an emitter to see how far the water has moved horizontally in your particular soil. This will give you an idea of where the water is in the soil, and consequently where emitters should be placed and how many to use.

The number of emitters per plant should be chosen so that at least ¾ of the plant's root zone area is covered by the wetting pattern of the dripper (including below-surface water movement). Therefore on sandier soils more emitters will be required per plant than on clay or loam soils. In general one emitter should be adequate for small plants, including annuals and herbaceous perennials. For trees and shrubs, keep in mind that the active root zone is usually 2-3 times the diameter of the crown. This means that most large shrubs and trees would require so many emitters as to make drip irrigation impractical. The flow rate of the emitters should be determined based on the water requirements of the plant, the weather-induced water demands, and on how you wish to operate the system.

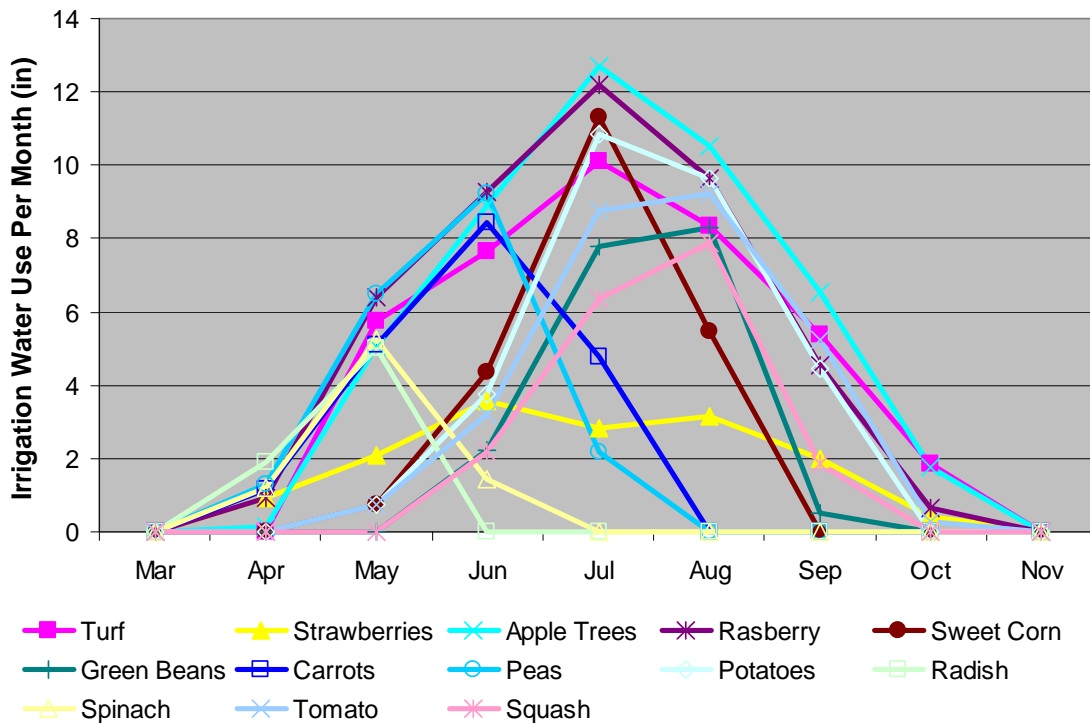
Just like for sprinkle irrigation, drip irrigation designs should be divided into "zones" based on the water needs of the plants in that zone. For example, it would make sense to put the flower beds in a different zone from the vegetable garden or lawn. An area of the

yard with larger shrubs and trees may need to be in a different zone from small flowers in a bed in the front yard. It may also make sense to break up a vegetable garden into different zones based on the varying water demand rates and growing times of different vegetables. For example, since carrots, radishes and lettuce germinate and grow in cooler temperatures and are planted and harvested earlier than plants like corn, beans and tomatoes, they should be in a separate zone, if possible.

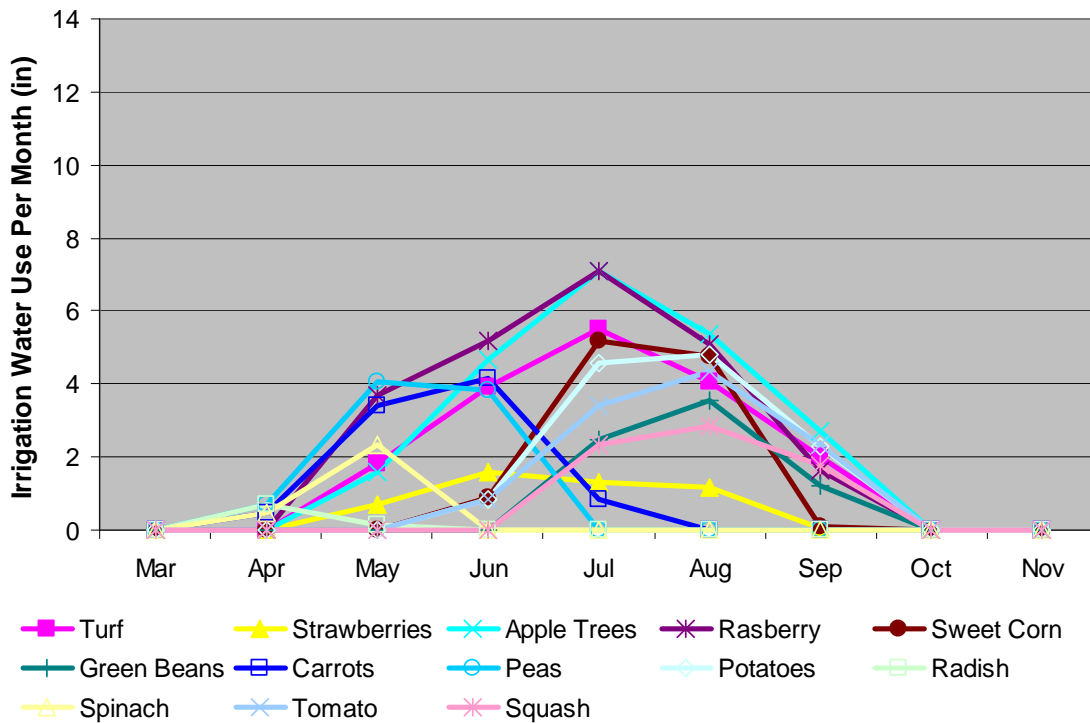
Knowing when to turn them on, and how long to leave them on is important. Drip irrigation systems can just as easily be mismanaged as flood or sprinkler irrigation systems. Plant water use changes greatly over the growing season. Typically the irrigation water requirements in April and October are less than half of the irrigation water requirements of the same plants in July and August. Plants use much less water in the spring and in the fall than during the hot parts of the summer. The summer is also the time of year with the lowest precipitation. It is important to adjust watering schedules accordingly. Timers should be adjusted at least once a month. It is also important to know how much water is being applied and when the best time to apply the water is. This can be done by measuring or estimating soil moisture content, or by doing a soil water balance. For more help on this contact your county extension agent.

A web site will be released to the public by the end of June that will provide information on how to do irrigation scheduling and soil water moisture testing. On-line calculators will also be included for irrigation related questions that require more mathematical knowledge such as determining application rates for line-source drip irrigation systems, and how much water to apply to individual plants. This web site is all a part of a WSU Extension program of irrigation planning and management education. Look for it at <http://irrigation.wsu.edu/>.

The best thing about good irrigation management is that when it is done right, both the environment and gardener are better off. The environment has more water left for alternate uses and fertilizers and pesticides stay in gardens and fields where they are wanted, and stay out of streams, rivers and water bodies where they may cause environmental damage.



Typical irrigation water needs of different garden plants in Eastern Washington based on 30 year averages (irrigation water needs vary widely based on a particular area's climate). Actual water needs vary greatly with the weather. The water needs of individual plants change drastically over the season. Setting irrigation timers on a single schedule all season will typically cause both over-watering in the spring and fall and under-watering in the summer. Grouping garden plants into zones according to their water use is a good idea to avoid over-watering some plants to get adequate water to others.



Typical irrigation water needs different garden plants in Western Washington based on 30 year averages. (irrigation water needs vary widely based on a particular area's climate). The total irrigation water needs in Western Washington are much lower because typical precipitation meets much of the plant's water needs. During dry winters irrigation may be required for evergreen shrubs and trees.