Drip Irrigation Made Easy!

The Complete Beginners Guide to Designing, Installing, Operating and Maintaining a Drip Irrigation System for Landscape and Garden with Step-by-Step Instructions for the Homeowner and Landscape Contractor

Why Use Drip Irrigation?

- It's easy to install and simple to use
- You can fertilize your plants directly through your drip system
- You'll save 20 - 80% on your water and fertilizer bills
- You'll control weed growth by watering only where you want
- Each plant can be watered individually
- You'll protect your property from erosion
- Reduce snail population
- You'll have healthier, faster-growing plants

If you're wondering how drip irrigation works,
why it works so well, or how to setup a drip irrigation system,
this handy guide has all the answers for you!

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A Division of *Strong Enterprises*
308 Melville Court, Roseville, CA 95747
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What is Drip Irrigation?

Drip irrigation can be traced back to the early Roman aqueduct period, when broken clay pipe distributed water along rows of plants. It was not until the formation of modern Israel, however, that the concept of placing a small amount of water only at the root zones when needed, and at an exact rate, began to be developed commercially. The Israelis were faced with an inadequate water supply, often of a saline nature, and a lack of prime agricultural land. They laid out lines of perforated polyethylene tubing. These early systems exposed many problems: plants close to the source received too much water, while plants at the end of the line wilted; the discharge orifices clogged easily; and elevation changes only complicated the obvious need for hydraulic engineering.

Widely used in irrigated farming, the drip method is an important irrigation technique which, while conserving valuable resources -- water, land, labor, energy, and fertilizers -- promotes improved plant growth and productivity. Larger yields, better crops, and earlier production are important benefits to the grower whose livelihood depends on his irrigation system.

The objective of drip irrigation is to continually provide even moisture only to the plant's root zone. Overhead sprinklers saturate entire areas followed by a drying out period. They are designed for lawns that need only shallow watering. Slow applications over long periods of time are required to get the deep water penetration required for deep-rooted vegetation.

Drip irrigation is a method of applying slow, steady, and precise amounts of water and nutrients to specific areas of trees, vines, ground covers, potted plants, or shrubs. At a slow application rate, water seeps into the soil and moves laterally by capillary action beneath the soil's surface. An adequate section of the root zone of the plant is maintained with moisture close to soil capacity, providing a soil-to-water-to-plant relationship which is conductive to better plant growth. Thus, smaller quantities of water are used to the utmost efficiency. And no more pulling around the garden hose or sprinkler!

Drip Irrigation for Landscape and Garden

Hundreds of thousands of acres of money-producing crops are now being irrigated exclusively with drip irrigation. Agricultural drip irrigation systems now have close to a forty year history since the early experiments began in Israel. Now with the experience gained through agricultural use, it is now possible for homeowners to better irrigate trees, shrubs, flower and vegetable gardens, ground cover, potted and hanging plants. Drip irrigation is now found in an increasing number of homes, highway and street median strips, and freeway landscaping, to mention just a few. The use of drip irrigation has dramatically increased as the public has been faced with rising water costs and scarcity of water.

Drip irrigation now provides homeowners with an exciting plant watering concept that not only conserves water, but also accelerates plant growth. Drip irrigation is very adaptable and is successfully used in a wide variety of climates, soil types, plants, and growing methods.

Utilizing a drip irrigation system involves the installation of a permanent plant watering system that enables the homeowner to place water where it is wanted, and in the exact amount that is necessary for optimum plant growth. Drip irrigation systems range in size from a few plants to several thousand acres, and permits the cultivation of slopes previously thought unusable and land left idle. In fact, the more difficult the installation, the greater the advantages of drip irrigation.

Of all the irrigation methods, drip irrigation is the most efficient. Sprinklers shoot water into the air, where much of the water is lost to evaporation and never reaches the plant. Flood irrigation transports the water in open trenches to the soil where the planting gets about half of the water supplied. Sprinklers are more efficient than flood irrigation, with only about one fourth of the water lost, but drip irrigation results in losses of less than 10 percent of the supply. With the water supply getting lower and lower throughout the country and the world, the conservation of this precious commodity by drip irrigation may eventually be the difference between adequate food and famine, or green yards and dirt.

In short, drip irrigation is the slow and precise delivery of water to chosen plantings. This is achieved by the use of flexible polyethylene tubing or PVC pipe with devices for dripping water (emitters) and low-volume sprays, drip tape, Laser Soaker Line, or Porous Pipe systems. The systems are easy to install, requiring no trenching and only shears for cutting polyethylene hose or tubing, and PVC pipe cutters for cutting PVC pipe. A hole punch is required for installing an emitter into the polyethylene hose. Drip irrigation can maintain near perfect moisture levels in the root zone of the plants, avoiding the too wet/too dry swings typical of overhead watering. Drip irrigation systems can be controlled manually or by the use of an automatic timer in conjunction with a tensiometer, and can be used to apply fertilizers directly to the roots of plants.

What are the Advantages of a Drip Irrigation System?

A drip irrigation system results in healthy, fast-growing plants, and is very efficient in its use of water. Little is lost to evaporation, and walkways and areas between plants remain dry. This also reduces weed growth, and makes cultivation possible during and immediately after an irrigation cycle. Drip irrigation allows a large area to be watered from a small water source, since it uses water more slowly than other methods. The biggest savings for the home gardener is time: you can now garden on a larger scale, and with an automatic timer, you can travel or deal successfully with a busy schedule while your garden or landscape flourishes.

What are the Specific Benefits of Drip Irrigation?

- Water savings, since only those areas directly around the plants root zone are irrigated.
- Plants undergo less stress from variations in soil moisture, therefore plant appearance is enhanced.
- Constant moisture improves plant growth.
- Slow application rate prevents excess surface water build-up and reduces evaporation.
- The low application rate and the use of automatic timers' results in precise water control.
- Weed growth is reduced because areas between plants are not irrigated.
- System can be designed for use in all types of terrain and soil conditions.
- System's low flow rate allows irrigation of larger areas and more plants can be watered at once.
- Drip irrigation systems are usually installed at costs considerably less than those of an underground sprinkler, bubbler, or shrub spray system.
- Through the use of fertilizer dispensers, chemicals and nutrients can be fed directly to the plant in controlled quantities.
- The water application rate can be tailored to fit each individual plant. This is accomplished by the use of different quantities of emitters and emitters with different discharge rates.
- Conversion to drip irrigation is easily accomplished since the hydraulic design of a sprinkler system is more than adequate.
- The drip system is economical to use with native landscapes in dry weather conditions.

Specifications

Landscaping

While drip irrigation was designed with commercial agriculture in mind, millions have already discovered the advantages of this type of irrigation system which applies water equally well to landscaping trees, shrubs, and container plants. Accurate amounts of water can be applied to the root zone of each plant. Water is kept off windows, sidewalks and driveways, and plants receive the water that they need to flourish. A common problem in landscape design has been that plants with different water requirements could not be planted together. Drip irrigation overcomes this problem by allowing different amounts of water to be delivered to different plants in the same area.

If the entire area being irrigated is to be set up in one system (i.e. water will be supplied by one valve), multiple or higher output emitters can be placed by the plants which require more water. A preferable solution is to set-up multiple systems, with plants that have similar watering needs being placed on the same system. This allows large plants, such as trees, to get the deep watering they require, while allowing the frequent shallow watering that small ornamentals prefer.

Lines can be buried or mulched to hide them from view. Emitters, however, should not be buried, but can be brought to the surface by either bringing the main polyethylene hose to the surface wherever the emitters are attached to the hose, or by attaching a small adaptor and tubing to the main line, and inserting the emitter, leaving only the emitter above ground.

Small "Mini-Sprays," are also useful in mixed landscape areas. A common design is to water the ground cover between shrubs with

"Mini-Sprays," while adding extra water near the base of each shrub with drip emitters. Another good use of "Mini-Sprays" is to water small plants or ground cover growing among rocks or bricks.

The flexibility of drip irrigation allows for the removal of an individual emitter or spray from a system and replacing it with a "goof" plug, or to add new emitters or entire lines to a system with little worry about design. If a line is accidentally cut, it can be easily repaired with a coupling.

Containers

Containers or hanging plants require frequent watering because of their size and the porous nature of potting soils. Sprinkler or sprays are usually inappropriate because most containers are located on patios or decks.

The set-up is simple. In most cases poly hose is run behind or below the plants, usually hidden by deck or railing or other structure, with smaller 1/4" tubing leading up to each container. In smaller containers or pots, a single emitter can be inserted into the end and secured. However, if you have a larger container with multiple plantings or a large shrub, and because water does not spread well laterally in loose potting soil, you will want the water evenly distributed around the outer perimeter, and not just placed in the center. Attach a 1/4" elbow to the tubing leading up to the container, and attach 1/4" laser soaker line. Encircle the container, using 'V' stakes to hold the laser soaker line in place, and cap the end with a "goof" plug. The laser soaker line has emission holes every 6", so the application of water to the container will be well distributed. Flow through 1/4" tubing should not exceed 6 gallons per hour (GPH).

Trees

Drip irrigation is now widely used for watering trees and orchards because it applies water slowly and encourages plant growth. The changing water needs of the tree can be easily accommodated. Saplings can start with one or two emitters at the base of each tree, and additional emitters can be installed as the tree grows. Remember, when designing a drip irrigation system, design the system for the flow of water that will be required when the tree is fully mature.

There are four common methods to use drip irrigation for a tree or group of trees: 1) run laterals down a row of trees with emitters placed on the lateral line at the base of each tree; 2) run two lateral lines along the row of trees, about 3 feet on either side of the tree to encourage a more balanced root growth; 3) "tee off" each lateral line with a loop around each tree equal to approximately three fourths of the circumference of the tree's canopy, and placing 3 emitters equally spaced on the loop; 4)in locations with sandy soil, mini-sprinklers or sprays are often used. One micro-sprinkler on a riser can cover the entire root zone of a tree.

Vines

Drip irrigation in vineyards provides excellent water management, allows better fruit production and reduces problems of unwanted mold growth. It is well suited to the slopes that are favored by grape growers. These slopes present problems of erosion and runoff when any other irrigation method is used. Even the largest and most traditional wine grape growers have converted to drip irrigation.

The preferred method of installation is to tie poly tubing to a trellis wire which is suspended about 18 inches above the ground. The wire is attached to the grape stakes. At this height, the tubing is above the area where ground work, such as weeding, is done. Once tied on, the tubing should be allowed to unwind for a few hours so that when the emitters are punched into the bottom surface of the tubing, they stay pointed down. This way, the drip falls where intended, instead of running along the tubing. Since vineyard rows are often long and on uneven terrain, pressure compensating emitters should be considered.

Vegetable and Flower Gardens

Vegetables prosper when the surrounding soil is kept quite moist, but frequent overhead watering tends to encourage rust, mildew, blossom damage and disease. Closely spaced drip emitters, drip tape, or porous pipe can balance these requirements by thoroughly watering an area of soil without wetting the leaves.

A 1/2 GPH emitter will generally suffice for an area 16 inches in diameter. In coarser soils, 1 GPH emitters should be used for more lateral coverage. If plants are more widely spaced and deeply rooted, such as tomatoes, squash, etc., a single emitter can be placed at the base of each plant. For row crops, such as carrots, radishes, etc., a drip tape, Dripperline™, Laser Soaker Line™, or Porous Pipe™ will give a continuous wetted pattern down the rows.

Drip tape and Dripperline can be run straight down rows for lengths up to 100 feet. However, laser soaker line can only be run in

lengths up to 15 feet, but can be wound around plants or around corners. Row crops similar to those listed above can be planted two or more deep on each side of the lateral line. With plants such as corn, strawberries, and peppers, one row on each side of the lateral line is preferred.

If intensive bed gardening is employed, the drip system should be set-up on a grid with laterals 18 inches apart and emitters placed every 12 inches on the lateral lines. If the bed is 4 feet wide, three laterals will give complete coverage. A system set-up like this one does not need to be changed when planting changes. However, Dripperline, laser soaker line, and porous pipe will give a continuous band of surface moisture, while an emitter system allows you to add emitter or sprays at desired intervals. It should be remembered that, if you are planting seeds in your garden, emitters alone will not adequately germinate the seeds unless supplemented with over-head watering with either micro-sprays or micro-sprinklers. Once seedlings are established, overhead watering will not be necessary.

Designing a Drip Irrigation System

Planning

To aid planning and design, all systems should be sketched out. This will allow you to determine the length of tubing and the number of other parts that will be required to complete system. If the locations of the plants are marked, then deciding on how to lay out the system is much easier.

Most home systems use less water than the hose bib or anti-siphon valve is capable of delivering. If, however, the system needs more that the hose bib can deliver at one time, divide the system into as many individual systems as necessary. You may also want to consider keeping certain plants with differing watering requirements on a separate system. Keep in mind that, in the future, you may want to add to the system such as adding more emitters to a tree as it grows, or when you add more emitters because you've decided that it would be nice to have an area of color out by the spa in the backyard. In other words, don't limit yourself. One of the many advantages of a drip irrigation system is the ease in which it can be changed or modified to suite your needs.

Provisions should be made to utilize the drip irrigation system for the application of fertilizers and/or additives on a frequent, or better yet, continuous basis. Fertilizers, micro-nutrients, additives, and system cleansers must be in liquid form when being used. There are many brands of liquid fertilizers already on the market that are premixed. All you have to do is pour them into the fertilizer injector. No mixing is required. If you have a favorite brand of fertilizer that you like using such as Scott's Miracle-Gro®, Scott's Peter's Professional®, or Bandini Pro Choice®, that's fine, too. These are totally water soluble fertilizers and can be premixed with water, at a rate of one pound (or small bag) of dry fertilizer to one gallon of water. In addition, a wetting agent can be dispensed to breakup compacted soils, compost tea which increases micro-organisms in the soil, micro-nutrients and Vitamin Institute's SUPERthrive™ containing vitamins and hormones for healthier plants, and vitamin B-1 when transplanting trees and shrubs.

Head or Valve Assembly

There are several components that I recommend be installed into all drip irrigation systems: 1) a backflow prevention device such as a pressure vacuum breaker, an anti-siphon, or atmospheric vacuum breaker is recommended for all watering systems that are connected to a drinking water supply. This eliminates the possibility of irrigation water backing-up into the drinking or potable water system; 2) a fertilizer injector like the Add-It® allows for the application of liquid or any dry, totally water soluble, fertilizer, 3) a filter to screen out small particles matter from the water and protects the small openings or orifices of emitters, micro-sprays, etc. from clogging. It contains a fine mesh screen or cartridge that can be rinsed and reused; 4) and a pressure regulator which reduces the higher pressures found in home plumbing systems, usually 45-100 PSI, down to 10 to 25 PSI, depending on the drip irrigation system being installed. The lower pressure greatly reduces the possibility of leaks and blowouts.

Automatic Systems

The first component is an on/off valve, which has female pipe thread connections on both inlet and outlet. This means that it will require a male pipe thread connector, rather than a hose thread. Next in line is the 24 volt automatic valve which may already have a built-in vacuum beaker or anti-siphon. If not, then one must be installed separately. Then comes the fertilizer injector, which is followed by the 'Y' filter. The last item needed before you complete the head assembly is the pressure regulator. Most pressure regulators for this size of system have female pipe threads on both sides, allowing them to connect to the filter without the use of an adaptor. The pressure regulator is placed on last so that the pressure going out to the lines is at the desired level. PVC pipe or poly tubing is connected to the pressure regulator. The regulator should be placed ahead of the 'Y' filter and fertilizer injector if you have pressures that exceed 60 PSI. Depending on the parts you decide to use, you may find that connections will need to be made between incompatible fillings. There are adaptors available to solve this problem.

Sometimes a canister filter and an adjustable pressure regulator are installed on the supply line leading to more than one automatic

valve with each control valve controlling a separate circuit. Be sure that the casing of the filter is strong enough to take full, constant water pressure, and use an adjustable brass pressure regulator. Also, if installing a fertilizer injector before of a manifold of valves, a reduced-pressure vacuum breaker is usually required. If you have any questions regarding what backflow requirements are in your area, give your local water company a call. You will also want a shut-off valve upstream (ahead) of the entire head assembly to facilitate working on the individual electric valves should they require maintenance, or to facilitate draining and filling the fertilizer injector.

Emitter Placement

Since a drip irrigation system should be designed starting from the plants and moving back to the source of water, start with how many emitters to use and where they should be placed. Two of the most important factors to remember are soil types, and the root structures of the plants.

In sandy soil, where spaces between grains are relatively large, gravitation pulls water down into the soil. In finer soils such as clay, the horizontal water movement is much stronger so water will tend to move laterally before penetrating very deeply. An emitter in sandy soil may suffice for an area of 16 inches in diameter, while the same emitter in clay soil may wet an area 24 inches or more across. When designing your system, take care to see that a sufficient percentage of the root zone is watered. Shallow roots require closer spacing of emitters. Deep roots allow for a much wider spacing. In small systems with mixed plantings, it is best to play safe and design for fuller coverage.

A soil test can be useful in making your decisions. This can be done by observing the effect of slow dripping of water on the soil from your garden hose. Be sure to dig down into the soil away from the obvious wet area on the surface to see the extent of coverage. Remember, you may only see a small wet area on top of the soil, but underneath, the water may be moving laterally further than you think.

Size Limitations

Pressure variations occur in all systems. Two factors affect pressure: elevation and friction. Elevation can add to the pressure if the tubing is running downhill or reduce it, if the tubing is running uphill. If the highest point in the system is not more than 10 vertical feet above the control valve, and pressure compensating emitters are used, then the pressure difference is within the acceptable range. With friction, pressure is always lost as water travels through the tubing. Friction is greater at high flow rates and in smaller diameter tubing.

Tubing should be sized properly to keep pressure loss due to friction within acceptable limits, while keeping the cost of the system down. There are many different sizes of polyethylene hose. The most common, however, is 1/2” (15 mm) which is used mainly as the supply line and can handle flow rates up to 200 GPH (or less than 3.5 GPM). 1/4” (4 mm) tubing is usually used to branch off the supply hose to carry water to any area that is too hard to reach with the supply hose. Because of its small size, it should not be asked to handle more than 8 GPH (or (8) 1 GPH emitters).

Most drip irrigation systems require little in the way of design beyond the most practical or aesthetic considerations. Remember that you can add to a system if flow rates allow. If not, dividing the system into two or more sections is also relatively simple. No matter how large or small your system is, the scale drawing is crucial in determining your needs.

Assembly of a Drip System

Lines

One of the advantages of using poly hose over PVC pipe is that the fittings require no glue or clamps. It comes in coils for easy handling and storage, and is resistant to the damaging effects of ultra-violet light so it can be laid on the surface. With either barbed or compression hose fittings, the tubing is pushed into place, and its elasticity and memory hold it securely. If many lateral lines feed off one main line, it is a good idea to use PVC pipe for the main line. Lateral lines are connected to the main lines with a tee fitting which split the flow of water. At the end of each line is an end cap to facilitate flushing on a semi-annual basis.

As the lines are laid out, the tubing may have to be staked down or secured in some fashion until it takes shape. Be sure to leave a little slack in the lines to allow for expansion and contraction due to temperature changes. This will also help prevent the emitters from moving out of place. Once the wet zone has been established beneath the emitter in the root zone, it is extremely important that the emitters are not moved, or else the water will fall on dry soil and will not penetrate when the system is turned on again.

Emitters

Once the lines are in place and flushed, the emitters (drippers) can be installed. There are two basic types, or styles, of emitters available; compensating and non-compensating. Most installations will require non-compensating emitters. The only time that you'll need to consider installing compensating emitters is if you have drastic elevation changes of 10 feet or more.

There are basically three ways that an emitter can be installed. The most common way is to make a hole on the top side of the hose with a hole punch, *not* a nail or sharp object, and insert or "pop" the barbed end of the emitter into the hole. If a hole is punched by mistake or in the wrong place, it can be fixed with a "goof" plug. Another way is to install a 1/4" barbed connector into supply hose, run 1/4" tubing from it to the location you wish to place an emitter, and insert an emitter into the end of the 1/4" tubing. A third way is to place the emitter into the poly hose and attach 1/4" tubing to the area to be watered. For control purposes, it is far better to have the emitter at the end of the 1/4" tubing if the distance from the supply hose to the emitter is over 10 feet.

Mini-Sprays

There are a wide variety of low volume sprays that can be used in a drip irrigation system. The smallest available is a "fogger" with a flow rate of 3 to 5 GPH.

A "Spray-Stake" is simply a small spray on the top of a stake that sprays approximately 2 feet in a 120° pattern at 6 GPH. It is attached to the supply line with a 1/8" coupling and tubing. Many professional rose growers use these because they get the entire area around the rose wet, yet do not get the foliage wet, which could cause mildew. Also, this spray allows you to broadcast dry fertilizers and systemic, and to have them leached into the soil with the fine, low profile spray.
"Micro-sprays" are a small fan type spray. A hose support stake can be utilized to hold the spray in an upright position. These sprays are available in many different flow rates and patterns. They are very useful for watering small areas of ground cover or slopes because erosion is virtually eliminated.

The largest of all sprays available for the drip irrigation system is what is called the Micro-Sprinkler. It is available only in 360° patterns, but will cover a very large area (up to 30' in diameter). It can also be used on slopes, large areas of wild flowers, or for watering large trees. It, too, must be mounted on a support stake. The support stake can be attached directly to the side of the supply line, or can be attached with a 1/4" coupling and tubing.

A simple reminder for all sprays: They all require more water flow than any of the emitters, so you cannot place as many on a single line. And, even if a "Mini-Spray" covers an area in the beginning, most plants grow taller in time. They could grow up and block the "Mini-Spray," which means that the plants on the far side get no water. Risers are available, however, to raise the "Mini-Spray" over the top of intruding plants.

How do I Use a Drip Irrigation System?

Watering Times

Times and intervals for watering differ according to the type of plant. The most important factor to remember is the depth of the root zone and soil composition. The deeper the roots and the finer the soil, the longer the watering time must be, but frequency of watering will be reduced. A finer soil such as clay, with which most of us are blessed, cannot absorb water very quickly, but will hold the moisture for a longer period of time. Shallow root zones and sandy soil types will require frequent watering of a shorter duration. Observe plant and soil moisture conditions and adjust watering times and intervals to maximize plant growth and minimize water use.

In a system with mixed plantings, some compromises may have to be made between plants that require occasional deep watering and those that prefer frequent shallow watering. This can be partly accomplished by using emitters of higher output on the deep-rooted plants. If this is not practical because of other factors, a compromise can be reached by doing shallow watering on a frequent basis as well as occasional deep watering. The first irrigation cycle should be a much longer one than normal. You will want to completely establish the wet zone in each plant's root zone. This cycle could be from as short as 15 minutes, all the way up to possibly 6 hours, depending on the plant material that you're watering and the type of soil.

Maintenance

Occasional maintenance should be carried out on all drip irrigation systems. To do this, you need to inspect the emitters, flush the lines by opening the end cap, and clean the filter. Depending on water quality, the frequency of filter cleaning may vary. The development of drip irrigation products has led to successful and trouble-free systems for both the commercial grower and the homeowner. The design of the system using filtration and quality emission components will make maintenance a simple yearly task. Visual inspection of the system is the best way to observe performance, and can be done in minutes while gardening.

If you are having trouble with your system, conduct the standard maintenance procedures first. Should the problem be a single emitter, replace it. If it is more widespread, look for a break in the lines. If the problem cannot be determined by observation, it may be the result of an inadequate water supply or faulty system design. "Goof" plugs can be used to plug holes from which emitters have been removed. They are very simple to use and are indispensable when doing repair work or changing your planting pattern. Likewise, couplings come in very handy when any repair needs to be made on a damaged section of line. Simply cut out the damaged section of line and install a new piece using the couplings to connect the two pieces together. And remember, each time you make a change or repair to your system, the lines need to be flushed to remove any debris that may have gotten into them as you worked.

"Goof" plugs and couplings should become a part of any repair kit. If they are not needed or used in the initial installation, they will be at some time in the future.

Operating a Drip Irrigation System

Applying water 5 to 7 days each week is preferable to maintain optimum soil moisture levels for most plant varieties. However, in some cases where plant varieties have a shallow root system in proportion to their height, and/or when "tight" (i.e. clay type) soils are present which promote wide shallow wetting patterns, applications of only 2 to 3 days per week may be preferred. In these cases, longer irrigation cycles are necessary in order to ensure that the plant's water needs are met. This will lead to deeper moisture penetration and promote a corresponding root profile.

Care should also be taken when adapting existing mature plants to drip irrigation from other forms of irrigation. In many cases, it may be necessary to closely copy the operation frequency of the previous system in order to avoid excessive stress and possible plant loss. It should be noted, that plants requiring different irrigation frequencies should be placed on separate control valves. However, when necessary, by adding and subtracting the number of emitters you place on each plant, it is possible for all the plants in a given area to be placed on the same irrigation line or system.

Watering Schedule

Type of Plant	Time (In Hours)	Intervals (In Days)
Low Shrubs (2' - 3')	2	3
Shrubs and Trees (3' - 5')	3	4
Shrubs and Trees (5' - 10')	4	5
Shrubs and Trees (10' - 20')	5	6
Shrubs and Trees (20' and over)	6 (or more)	7
Containers (potted plants) - 1 gallon	1/4	1
- 2 gallon	1/2	1
- 3 gallon	1	2
Flower Beds	1	2
Ground Cover	1	2
Vegetables, closely spaced	1	2
Vegetables, widely spaced	1-1/2	2

Assembly Tips

- Start the installation at the water source and work your way out to the laterals.

- Be aware of the type of thread on the fittings which you use. Forcing a hose thread fitting onto a pipe thread fitting can result in stripped threads that can cause leaks.

- When pipe thread connections are made, wrap the male threads with two to three wraps of Teflon tape before making the connection.

- Check for the correct direction of flow on valves and other components before making the final connections. Usually all pipe threaded components will have an “arrow” on them that points in the direction of the water flow. Hose threaded parts are even easier to work with. All inlets are female and all outlets are male.

- Do not over tighten plastic fittings by using a wrench or pliers. Hand tightening, or one half turn with a wrench, should be sufficient if Teflon tape is used.

- Try to be as careful as possible in keeping dirt out of the lines when you are installing your system, even though you will be flushing out the entire system once you have it totally installed.

- Allow the tubing to “relax” or sit in the sun. This will make it easier to work with and assemble. If it’s cold outside when you’re installing your system, dip the end of the tubing into a container of warm water.

- Do not stretch or pull the poly hose taut. Allow the hose to “snake” along the ground. This will allow for expansion and contraction due to weather conditions.

- When punching a hole for an emitter, spray, or connector, be careful to hold the punch perpendicular to the tubing while supporting the back side of the tubing with your other hand.

- Flush all tubing lines before closing, removing any debris that may have gotten into the system during installation.

Glossary of Terms

Backflow Prevention Device - Any number of items such as a reduced pressure vacuum breaker, atmospheric vacuum breaker, anti-siphon valve, vacuum breaker, etc. can be used to prevent contaminates from going back into the potable water system. Backflow prevention devices should be used in all irrigation systems, especially those utilizing a fertilizer injector.

Emitter - The discharge device that is attached to the lateral line and delivers water, at a set rate, to the base of a plant. Available in compensating and non-compensating styles, depending on the topography and water quality.

Evaporation - The process of turning water into a vapor.

FHT - Female hose thread (as found on the beginning of a garden hose).

FPT - Female pipe thread.

Filter - A device for removing foreign particles from water.

GPH - Refers to water flow; gallons per hour.

GPM - Refers to water flow; gallons per minute.

Lateral Movement - Refers to the movement of water in the soil in a horizontal direction.

Laser Soaker Line - 1/4" tubing with preset emission holes equally spaced along its entire length, providing a continuous wetted pattern.

Laterals - The actual drip lines, either polyethylene hose with emitters attached at desired intervals, or Laser Soaker Line.

MHT - Male hose thread (as found on the end of a garden hose).

MPT - Male pipe thread.

Mainline - PVC pipe or polyethylene hose that carries the water from the supply, or source, to the laterals.

Mini-Spray - A variety of low volume overhead sprays which cover larger areas than an emitter.

PSI - Referring to water pressure; pounds per square inch.

PVC - Refers to material of pipe, polyvinyl chloride.

Pressure Regulator - A device that regulates and ensures that the water pressure is kept within design limits for the drip irrigation system.

Tensiometer - A device that measures the moisture content of soil. Usually hooked-up in conjunction with an automated system with a controller.

Timer/Controller - A device operating in conjunction with electric valves to automatically control your drip irrigation system. Can set watering days of the week, run time per station, and length of time to run each station. Battery operated valves are also available for hose bib connections.

Comments from our Customers....

For 17 years, our irrigation 'system' was to drag the hose around the yard. Then we installed our drip system and the difference is dramatic. Not only can we spend our time on more enjoyable pursuits, but our plants and flowers are thriving. Even in winter, our yard is easily the nicest on the block. I wish I had discovered this many years ago!

Bob M.
Monrovia, CA

I am a senior citizen, and it has become increasingly difficult to take proper care of my flower gardens, which are my pride and joy. My neighbor recently put in one of your drip systems, and was so happy with it that he offered to install one for me. It's all on an electric timer now, so I don't even have to worry about turning the system on or off. I can't begin to tell you how pleased I am.

Jeanne H.
Tampa, FL

I knew that drip irrigation would cut down on my watering costs, but I had no idea that it would also mean fewer weeds and snails. That is a real bonus, and I think it is a real selling point.

Connie B.
Vancouver, B.C.

Thank you, thank you, thank you! My vegetable garden is the envy of the neighborhood, thanks to the drip irrigation system I recently installed. I am now planning to add drip lines to other parts of my landscape as well. I also wish to compliment you on your outstanding sales staff. The young man I spoke with was very patient in answering my questions, and most helpful in helping me decide which components best suited my needs.

Jeffrey D.
Dallas, TX

I can't believe how much I've saved, both in time and money, since installing my drip system. My water bill has decreased considerably, which is very important to me because I am on a fixed income. My initial investment has already paid for itself, and my system isn't even a year old yet!

Judi W.
Mesa, AZ