

What is Drip Irrigation?

Drip Irrigation is the **slow application of water directly to a plant's root zone** through "emitters". The plant roots stay moist avoiding the "flood and dry-out" cycle. Water is pushed deeper into the soil thus helping to promote root growth downward not just laterally, as happens with shallower watering. This encourages faster, steady growth early in the season which develops into disease-resistant deep-rooted plants later. Water is delivered below the surface keeping the top of the ground dry. This is important for two reasons:

1. You water only the plants, not the path or between plants. Weeds are left high and dry, which means less WEEDING!
2. The leaves also stay dry. Plants are less susceptible to fungus and insects. You can water any time of day even when the sun is high without damaging the plants.

Deep, even moisture levels under the soil surface **benefits worms and microorganisms** that help build your soil and keep it loose and full of air. Roots need air and drip irrigation keeps this vital air in the soil around the roots. The slow drip delivery of water doesn't displace all of the air in the soil. The plants avoid the stress of being submerged. Most plants will drown if the roots are submerged for an extended period of time.

Sprinklers and hand watering can produce puddles which displace the air in the soil saturating the ground. If these puddles don't drain quickly, any plants with their roots under water can be stressed or die. Furthermore, sprinklers and hand watering deliver water to the surface of the soil where much of the water is lost to evaporation. The rest never penetrates the soil more than an inch or two, so the entire root system doesn't get watered. This also encourages shallower root systems.

Sprinkler water is not absorbed deep into the soil, because of the way water travels through soil by gravity and capillary action. (*What is capillary action? If you repeatedly wet the corner of a towel, eventually the entire towel will become wet. That's capillary action. Water moves slowly from thread to thread, wetting the strands as it goes. The same thing happens in soil.*) Water moves down, sideways and even up against the force of gravity by capillary action, but it can only move slowly in all but very sandy soils. **Capillary water is important because it is the only water** in the soil available to plant roots. Sprinkler water doesn't penetrate soil well because it delivers too much water (as much as 400 gallons per hour) at once for capillary action to work as it should. Since the soil cannot absorb this water uneven watering occurs and puddles form in low spots and little water is absorbed in high spots.

With drip irrigation there are no puddles, no wasted water, no oversaturated, no overspray, and no loss due to evaporation.

Drip irrigation also allows you to fertigate (fertilizing through your irrigation system), adding the nutrients right to the root zone. This precise application of fertilizer through your drip system uses less water and fertilizer. Very little fertilizer is lost due to leaching. You aren't fertilizing the weeds or non productive areas. Fish emulsion or compost tea can be introduced into the irrigation system in front of the filter so they can remove any emitter clogging particles. (For our purposes, your compost tea or fish emulsion is added directly to the rain barrel. Be aware that adding it prior to a rain storm may dilute the solution and fertilizer may flow out of your overflow tube of the rain barrel into a storm drain or onto the lawn or wherever you have your overflow directed.

Using drip irrigation is GREEN. Not only does it save up to 50% of your gardening water, you save money on your water bill or pumping costs if you are using your well. Using a rain barrel with your drip system saves you even more! Fertigating with compost saves money, reduces the use of chemical fertilizers and even better protects the environment.

What are the disadvantages to using drip irrigation?

- The initial cost of a system may be higher compared to a garden sprinkler or soaker hose.
- Effective management of the system is necessary. Drip tape or tubing must be checked to avoid leaking or plugging. Drip emitters can be plugged by particles not filtered out of the irrigation water, by algae growing in the tape, or by chemical deposits.
- Leaks can occur unexpectedly as a result of damage by insects, rodents, or gardening tools.
- Rodent damage is possible especially if the system is over-wintered in the garden.

- Drip tape takes longer to cleanup after harvest. Y
- You may need to plan for drip tape storage for reuse.

Planning Your System

The descriptions below are for use with a rain barrel. Gravity systems can operate as low of 3PSI (pounds per square inch). Low flow drip systems do not need high pressure to efficiently supply water to the emitters or drip tape. Most drip systems are recommended to run at about 15 to 30 PSI (pounds per square inch). For comparison most homes have water pressure between 40 PSI to 60 PSI. Because these are low pressure systems, they do not require glue or clamps to connect tubing, components, or t-tape. This makes the system easy to modify, add on to, move or reuse.

Water Supply



The first step in planning a system is figuring out what you want to water. To do this you must decide which garden makes sense to water with the rain barrel. Factors include proximity to the barrel, height of the barrel, capacity of the barrel, fertigation, and watering needs of the plants in the area you wish to water (also called a watering zone.) A rain barrel watering zone is a 100-200 square foot garden. (By adding mainline valves, you can attach two or more zones to a mainline, more on this later)



It is good to have a water supply (faucet and hose) able to reach your drip system or fill your barrel during dry times. If you attach your hose to the drip system, you *must* use a pressure regulator to decrease the water pressure.

Drip Irrigation Rules

You cannot exceed your water supply!

We recommend a 100-200 square foot garden for the rain barrel. If you find your plants are not getting enough water. You may need to leave the water on longer or increase the pressure. To increase your water pressure when using a rain barrel, you will need to raise the barrel higher. Your system may also be larger than you can effectively water due to soil type or watering needs of the plants.

You must have enough water pressure, but not too much!

This is especially true when using a rain barrel or a gravity-feed system (3-10 PSI) (Pounds per Square Inch). Place your barrel on cinder blocks or a sturdy box as a full 55 gallon barrel weighs 400 pounds (One gallon of water weighs 8 pounds) so beware of uneven surfaces and flimsy construction. A rain barrel must be elevated 2.3 feet to gain 1 PSI.



If your barrel is dry and you would like to use your home water, remember that household pressure is usually between 40 to 60 PSI. For a low flow drip system the maximum pressure is 20 to 30 PSI. For a gravity flow systems the maximum pressure is normally 10 PSI. If you use your home/well water, you must use a pressure regulator to reduce the pressure. Since low flow or gravity drip components do not use glue or clamps, pressure over 10-25 PSI may have your emitters and fittings popping out.

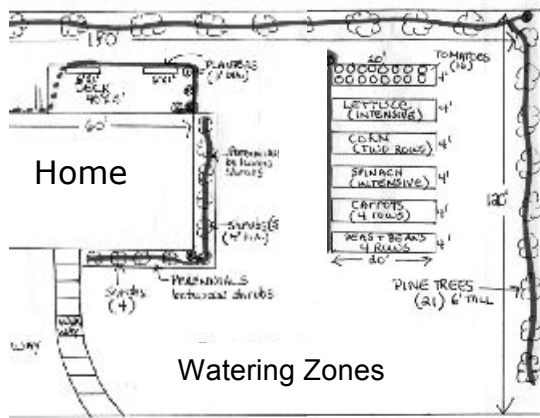


If your barrel is empty, fill the barrel from your household/well water. Let it stand for a few hours to warm to ambient temperature so as to not shock your plants. You can then continue to fertigate or water without worrying about leaving the water faucet turned on.

Watering Zones

A watering zone is a single drip system supplied by your rain barrel. You can have multiple watering zones by using valves to regulate which zone is receiving water. Simply turn off all but one zone. When using a rain barrel your pressure is low and volume predetermined; so you will want to open or run only one watering zone at a time. If you switch to household/well water, you will have to determine how many systems can open and run at the same time.

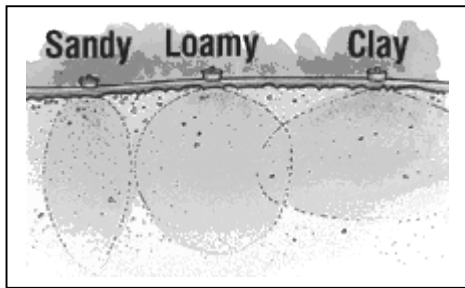
Remember that a rain barrel can water a 100-200 square foot garden. To see how much of an area you can water with your single watering zone, take a look at how you will water each area. It is a good idea to make a quick sketch of your plants and their location.



One thing to keep in mind when planning your zones is the watering duration; each zone will be watered for a set amount of time. It is wise to divide your zones into plants that will need the same amount of water on the same frequency. The watering frequency would be how often the watering zone would be turned on, for example, once every three days, every day... Next divide up your plants into groups that should be watered with the same frequency. A good example would be a row of shrubs, like privets, that could be watered once every three days for two hours (example only).

Compare this to young vegetables that may need water every day. Obviously, these two different groups should not be on the same watering zone. You will either waste water by giving the shrubs too much or the vegetables will die.....not good in either case. Therefore, plan out the different zones so they make sense to you and the plants watering need.

Soil Types and Watering Zones



Another consideration is the type of soil in your garden. If you have clay soil, water from emitters will tend to move farther than if you have a sandy soil. This will affect the spacing and flow of emitters that you choose for your system. If you have loam, that wonderful perfect soil, you would choose the emitter to match the plants needs. For sandy soil, you might use a higher flow (1 to 4 GPH) emitter while in a clay soil you might use a lower flow emitter (1/2 GPH to 1 GPH).

Your First System

Start Small

The best way to begin is to install a single watering zone to become familiar with all of the parts of the drip system and see how they go together. Working on a small section will give you experience and confidence. You will find they are very easy to install. Once you see how it works, you can plan the rest of the garden.

Drip Irrigation Kits

Most drip irrigation companies offer starter kits to introduce you to drip irrigation. Each kit has all the components included to simply hook the system up to a faucet and start watering. These kits give you the basics and you can add other items later to modify your watering zone or add new zones.

Rain Barrel Drip System

The following are the basic components of a Rain Barrel Drip System using drip tape (t-tape) or individual drip emitters inserted into a mainline (emitter line).

Filter

Filters are used to keep debris out of the drip system and maintain clog-free emitters and t-tape.

Pressure Regulator

These are necessary if you run out of water in the barrel and need to begin using your house or well water. The Pressure Regulator lowers your household pressure to 10-25PSI for use with the low flow/gravity drip systems. If the PSI is too high it can blow the emitters and barbs out.

Mainline Tubing and Fittings

Most home systems use 1/2" tubing as the mainline. Mainline tubing is blank tubing (no emitters built in) and is used throughout a drip system. The 1/2" tubing is designed to have holes punched into it for emitters and transfer barbs, or to be used to bring the water to the garden. Mainline tubing can

last 8 years or more when exposed to sunlight and longer if composted over or buried. Sharp garden pruners can be used to cut the tubing. A kink in mainline tubing will not cause a weak spot and will disappear under pressure unless the line is bent too sharply. If this occurs insert an elbow to make the sharp turn.

Mainline Fittings include a hose fitting to connect your mainline tubing to a faucet or garden hose, and a hose end to close the mainline. To create the skeleton of your system you will need tees, elbows and possibly couplings. Valves can be added to change between watering zones or to turn off individual lines.

Stakes

Stakes help to lay out the system as the tubing comes coiled. They also keep the system in place as tubes and t-tape may creep with the cooling and warming of the sun. Additionally if the system isn't buried, it may be windblown or people/animals may trip or catch the lines.

Emitters

Emitters are drippers inserted into the mainline tubing to water individual plants or spaced to water the root zone of larger plants. They give you a regular amount of flow depending upon the pressure at each dripper. The higher the pressure the more flow each dripper has; the lower the pressure the less flow the emitter has. These emitters are not self flushing but can be taken apart to be cleaned. They require a 150 micron filter and work well for smaller systems where water quality is good and no elevation differences occur along the line. Elevation differences cause pressure to fluctuate creating slightly different flows from each emitter.

These emitters are inexpensive, easy to install, reliable and accurate. All drip emitters may be inserted directly into 1/2" poly tubing or extended with 1/4" micro tubing. These work well with low pressure gravity systems as their operating pressure is 3 to 20 PSI. They work well with low pressure gravity systems or rain barrels.

T-Tape

T-Tape is an economical dripline for raised beds or individual rows. A perfect t-tape for home gardens is the 8" On Center (An outlet or internal drip outlet is built into the tape every 8 inches on a line down the center of the tape). A specially designed slit outlet reduces insect damage, impedes root intrusion and virtually eliminates start up plugging. This t-tape will wet up to a one foot diameter area on the surface and up to two feet underground, depending on soil type and duration of watering.

T-Tape has a number of advantages:

1. **Lowest cost** drip system for rows and raised beds.
2. Suitable for all sizes of **backyard gardening** and commercial agriculture.
3. Operates at very **low pressures** (down to 2 PSI) or **up to 15 PSI** (15 mil T-Tape® only)
4. Works great for **low pressure gravity systems**
5. **Equal water distribution** makes long rows possible
6. Ideal for **above ground or buried applications**

T-tape lasts up to 7 years when covered or 2-5 years when left on the surface. You can leave the system out all winter, though you must drain the water out of the system. For small systems, it is easy to remove the tape and store it in a rain barrel in the garden shed for the winter.

A 200 mesh filter MUST be used on any T-Tape system.

Punch

An essential for installing a drip system. Don't even think about using a nail...they can cause major leaking which is important with a system that regulates water like a drip system! For larger systems the deluxe punch is easiest to use though more expensive.

1/4" Tubing

The 1/4 inch tubing allows you to water plants with larger root systems, individual pots, or an individual plant a distance from the mainline. Staking this tubing is recommended.

Bug Plugs

Bug Plugs go into the 1/4" tubing to keep bugs from crawling into the tubing and plugging the outlet.

Goof Plugs

These are used to seal holes made by the punch. If you want to move an emitter, have harvested a plant or row of plants, or made a booboo use one of these to seal the old hole.

Line Ends

A Figure 8 is used to seal the mainline tubing and t-tape ends are used to seal the t-tape. Both work by crimping the tube or tape back on itself to stem the flow of the water. They are easy to install and easy to remove to flush the system.

Installation

Here is a quick synopsis of how to install your system; Read the entire section on installation before beginning.

1. The system begins by taking you from the spigot/faucet/rain barrel/garden hose to your watering zone.
2. Create a backbone or skeleton to attach the rest of your system
3. Install the first section or mainline skeleton and get it complete and working correctly.
4. Flush the system to remove all bits of tubing or debris.
5. After flushing the skeleton, place emitters/t-tape as needed. As you install the emitters/t-tape place stakes in the line to keep it from moving. This will keep the drippers in place next to plants.
6. Flush again and close all ends.

Laying out the System

This is basically laying down the tubing in your garden. (Hints on how to lay the initial mainline tubing are included later) Remember that having plants with the same watering needs on the same zone is easier. Sometimes this just does not work, and you will end up with different types of plants on a single zone. You will need to make adjustments to water the different plants.

Flower Garden

This system might start at the faucet and have only one mainline which may weave throughout the garden. To lay the mainline tubing out the most economical way, you will want to have the 1/2" tubing next to as many plants as possible. Emitters are best inserted directly into the 1/2" tubing. If you have a few individual plants the 1/2" tubing cannot reach, use 1/4" tubing attached to an emitter to reach the plant. Add a bug plug at the end of the 1/4" tubing to prevent earwigs or dirt from getting into the system. Use a stake to keep the 1/4" tube in place.

If there are many plants away from the mainline tubing, use tee's and elbows to create a 1/2 inch line with emitters that can directly reach each plant.

Once the tubing is laid out, walk along or follow with your eyes the entire length to see if you can spot anything that looks out of place.

Vegetable Garden or Raised Bed Layout

Most vegetable gardens are planted in parallel rows. This makes the layout of a drip system very easy.

Mainline: Run a single mainline along one end of all the rows (perpendicular to the rows). This concept applies to 1/2" emitter line or T-Tape.

1/2" Emitter Line (1/2" tubing with emitters inserted for individual plants)

If you are using an emitter line, place a tee in the mainline at the head of each row and run the emitter line down the row. Make sure you place emitters next to each plant. You will need to stake down the line ends so that heat and cold do not cause it to move because of expansion and contraction of the tubing.

For plants a short distance from the emitter line, insert an emitter and add 1/4" tubing to reach the plant. Stake the 1/4" tubing also.

T-Tape

Use the same mainline layout. Lay the t-tape down each row. There are two types of barbs that attach the t-tape to the mainline. A **regular barb** attaches the t-tape to the mainline. The other is a **barb plus valve** which gives you the ability to shut off the individual row of t-tape. This is great for water zones with plants with varying water needs.

T-tape walls are much thinner allowing the tube to "collapse" when there is no water pressure. When installing in an odd shaped garden, the tape must make gradual turns or the tube kinks easily and stops the flow of water. If the turn is too sharp, add a T-tape Tee or Elbow. Stake the t-tape down and bury it to keep the tube from snaking and drawing away from the plants.

The tape is made to be buried. The wetting pattern of water in the soil from the drip irrigation tape must reach plant roots. The drip tape must be close enough to the surface to germinate seeds if necessary, or use a portable sprinkler for early watering. Depth of tape placement, distance between tapes, emitter spacing and flow, and irrigation management all must be chosen carefully based on plant water requirements and the type of soil.

Densely Planted Crops

For densely planted gardens, the entire area will need to be watered. With an **emitter line**, place emitter emitters 10" apart. Stagger the starting position of the first emitter in each row. In the first row, place the first emitter 12" from the mainline: the second row place the first emitter 6" is from the mainline; the third 12": the fourth 6", etc. This grid with row lines spaced 10" apart allows you to wet the entire area. Be aware of your soil type; sandy soil needs closer spacing while very good loam type soil needs lesser spacing.

If you are using **T-tape** for a dense planting the lines should be placed no closer than 12".

Trees & Shrubs

These systems are the easiest to lay out.

1. For shrubs that are planted close together like a hedge, run your 1/2" emitter line along the base of the plants and install an emitter next to each plant. If they are very close, place an emitter between each plant.
2. For shrubs with more distance between them, run 1/2" emitter line close to them. You can either place an emitter directly into the 1/2" mainline tubing next to the plant, or add a tee and circle the plant with the 1/2" tubing and place two or more emitters around the plants base. Be aware of how much water this will give the plant and use lower flow emitters if you need to.
3. The size of the tree and future growth of the tree are important considerations. You can run the 1/2" emitter line near them and place emitters that will need to circle the tree's trunk about midway between the outside leaf canopy and the trunk. The emitters will be evenly spaced around the circle so the entire area will get water.

This can be accomplished by placing a 1/2" tee in the mainline. Then circle the tree with the 1/2" emitter line starting from the tee. You can make your system fit the tree now or circle the tree about 1-1/2 times allowing for expansion of the circle as the tree grows.

Potted Plants

This system is similar to the other 1/2" mainline systems. Run the 1/2" mainline close to all the potted plants. Place an emitter near the pot on the mainline; run a short length of 1/4" tubing attached to an emitter into the pot. Attach a pot dripper to each 1/4" line and put it into the pot. If your pots are on patios, wooden decks, or porches you may want to hide the lines. If you have a wooden deck/patio or porch, run the tubing along the edges of the patio framework by using C clamps. These hold the tubing in place keeping it really tight along the wood.

Initial Tube Layout

1. Warm the tubing in the sun before you start as it becomes more flexible. It will lay flat much easier and can be held in place with fewer stakes.

2. Unroll the tubing!!! If you just pull one end out of the coil without unrolling it you create kinks in the tubing that are hard to get rid of! Kinks in the tubing block or slow the water passage.
3. Take the coil of tubing, weight one end under a large rock or cinder block where you want to begin. Roll the coil of tubing along the ground or hold the coil in your hand to avoid making kinks in it until you reach the end or this particular line.
4. Cut the tubing with a good sharp pair of pruning shears or heavy scissors. Cuts need to be good clean square cuts; the fittings do not work properly with angled cuts.
5. Weight the tube where you need to make a turn. Use stakes to hold the tube in the final position.
6. Always lay out lengths of tubing a little longer than you think you need.
7. Adjust the system and do the initial flush of the system.
8. Install the emitters or t-tape and flush the system again.
9. Close all of the ends and test the system. If you are happy with the layout, cut the ends at the final length and add the figure eight or hose end.

Installing the Emitters

Always use a Punch made for drip irrigation tubing

The barbed end on an emitter goes into the 1/2" mainline tubing and needs an exact size hole to seal correctly and not leak. Good punches take out a small round piece of the tube. The sharp points of the punch push through the tube. Dull punches tear the hose causing drippers to leak around the stem or leave a flap of plastic inside the tubing obstructing the water inlet on the emitter.

Installing emitters into 1/2" tubing

Use the right punch for the barb so the emitter fits tight and seals correctly. DO NOT use a nail, or other device, to make the holes in your tube. Make sure you are making the hole on the side of the tube where you want the emitter. Hold the tubing in one hand (good to wear a leather glove) to place pressure on the opposite side from the hole. Push the tip of the punch against the tubing and twist it back and forth while pushing. This helps the tip of the punch cut through the tubing instead of ripping through it. Push the barbed end of the emitter into the hole while still supporting the opposite side of the tubing with your hand. Push the emitter in until you hear a slight "Pop". The barbed end has gone past the tubing wall. If the tubing is warm you may not hear anything but just "feel" the barb push past the tubing wall.

Replacing Emitters

For 1/2" tubing you can just pull out the emitter. Try to pull it straight out, otherwise it may "rip" or "tear" the tubing around the hole. You can insert another emitter in the same hole. (Test the seal by looking for leaks) If it leaks, take out the emitter and install a goofplug to seal the hole. Make a new hole within a couple of inches and install the emitter.

To use a goof plug to seal a hole, note there are two ends on the goof plug. First try using the smaller end. If the hole has been ripped or enlarged and the hole still leaks, use the larger end. Grip the goof plug by the opposite end that you want to install, support the back side of the tubing, push the small end other end straight into the hole. If this doesn't work, cut the tubing, removing the section with the hole, and install a coupling to reattach the ends of the tubing.

Flushing the System

The worst thing for your drip system is to get dirt into it. This can easily happen during installation.

1. Begin at the faucet and make sure water is able to flow through the filter prior to attaching the line. *If you are using your well or household pressure, the pressure regular needs to be attached to the filter.* Turn the water on for about 5 seconds. If you are using household water, the water will come out with a good amount of force.
2. Take apart the filter and check to see if there is there is any dirt in it. This is especially important when your water source is a rain barrel.
3. Connect the mainline to the filter. (or pressure regulator)
4. Connect all the mainline and emitter lines. Flush BEFORE inserting any emitters.
5. Turn on the water and let it run a few minutes.

Note: If you have multiple line ends the majority of water will only flow out of one line end (water will find the route with the least resistance). Close this line end first and then find the next line end where the water flows and close this one off. Repeat until you have checked them all. Make sure to let enough water flow through each end so any dirt will be flushed out.

6. Turn off the water. Install all your emitters and/or T-Tape.
7. Open all the line ends flush again. This removes any pieces of the tubing and/or dirt which might have fallen inside the tubing when punching holes.
8. Close all of the lines.

Testing the System

Once you have flushed your complete system and closed the line, turn on the water and walk along the system checking that all the connections are not leaking and that emitters and t-tape are dripping.

Mainline Tubing Check all the 1/2" mainline fittings and line ends to make sure there are no leaks. Normally the only leak you would see is a dripping or a small spray coming out of the fitting. This can be caused by a nick in the outside of the tubing wall or an uneven cut in the tubing. Remove the fitting, check the end of the tube, cut the end if necessary, and reinstall the tube.

Emitters Check all the emitter's barbed connections to the mainline or 1/4" tubing and make sure there is water coming out of the emitters.

If emitters leak at the connections, make sure the emitter is pushed in all the way. If this doesn't work, take the emitter out and reinsert it. If it still leaks, seal the old hole with a goof plug and punch a new hole.

Maintaining the System

Winterizing

Water can freeze in any of the components. To empty the water out of the system, first remove the filter and pressure regulator (if you have been using one). Open all the 1/2" mainline ends (figure 8's) and the ends of the T-Tape to allow the water to drain out. If this does not drain all the water use a LOW PRESSURE air hose or blow into the tube to push out the remaining water. You do not need to get every little bit of water out, just enough so the hose is empty. Remember water expands when it freezes, so it could split the tube if too much is left inside.

Once you have all the water out, replace the line ends to keep dirt from getting in. Remove the filter and store it inside. Seal the mainline end that attached to the filter-a baggie does the trick. In the spring, make sure to flush out the system just like a new system. For small systems, drain the system and store it in a shed or garage.

Filtration

Filters should be checked and flushed on a regular basis. How often you flush your filter depends on how dirty your water is. With a new system, check after a few days to see what kind of dirt has been caught in the filter. If you are using well or house water, check in 3-4 of weeks. Check regularly if you are using a rain barrel. Take out the screen and rinse with clean water. If it is really dirty, use an old toothbrush. Even household water can have invisible small particles that are big enough to plug drippers.

Emitters

These come apart and can be cleaned by simply taking them apart and rinsing under clean water. For stubborn dirt use an old toothbrush. If the emitters clog cannot be cleared, replace them.