

# Drip Irrigation Systems

Leo A. Martin

January 2003

"What is wrong with my \_\_\_\_\_ plant?" (fill in the blank)

"Well, the leaves are brown and crispy, the twigs are brittle, and the ash from your cigarette just ignited it. I'd say it's not getting enough water."

"But it's on the drip!"

"How much are you watering it?"

{Blank stare} "It's on the drip."

"How is it programmed?"

(Blank, horrified look suggesting the questioner might be asking for money.)

Drip irrigation (DI) is a term used to refer to irrigation systems carrying water at relatively low pressures via flexible pipes to calibrated water emitters that are placed near plants. The principles of DI were worked out long ago, but too often homeowners (and professional landscapers) install or operate systems incorrectly, and plants suffer. DI is extremely useful here in the desert if used properly. All our favorite landscape cactus and succulents will grow fine with DI. I will try to explain some of the concepts.

DI has several potential advantages:

- Water is applied only where it is needed, thus preventing water waste, and weed growth in non-irrigated areas.
- DI systems are somewhat easier to assemble than are rigid cemented polyvinyl chloride (CPVC) systems. Connections require mostly snapping, plugging, or screwing in of components.
- DI is easier than CPVC to modify when irrigation needs change as plants and landscape change and grow.

It has several disadvantages:

- Because one of its goals is to limit water use, under watering is quite easy.
- Exposed DI components suffer accidental and sun damage more frequently than buried CPVC. Thirsty rabbits may chew DI tubing.
- DI emitters must be moved and frequently added as plants grow. They must be checked regularly for clogging. DI systems require more upkeep than CPVC.
- Improperly programmed systems allow salt buildup in the soil.

The basic parts of a DI system are:

- a shut-off valve between the water main and the DI, allowing DI maintenance without shutting off water to the house
- a backflow preventer (BP), to prevent garden water from being siphoned into the home drinking water pipes
- a filter to keep the system from clogging
- an on-off valve which is usually controlled by an automatic programmable time, but can also be controlled manually
- a pressure limiter to reduce water pressure from the high-pressure water main to the low-pressure DI pipes
- a large conduit tubing to carry water from the on-off valve to the garden
- a smaller "spaghetti" tubing to carry water from the conduit to the plants
- emitters at the ends of spaghetti tubing to measure water to the plants

The unit consisting of an automatic valve, filter, conduit tubing, spaghetti tubing, and all emitters, is often referred to as a line.

Since most of us are doers rather than talkers, I'll start by talking about how to build the systems, and leave the boring thinking part to the end. That way those of you who get too excited to read this whole article and want to run out and convert your entire home to DI this weekend will have systems we can all laugh at. There are lots of mistakes to be made, so pay attention. I've never made any of them myself, of course, but I read about it on the Internet. Before you start, though, remember: You can't be too rich, too thin, or have too much capacity in your drip lines.

Shut-off valves between the home water supply and any irrigation system are not necessary, but housemates of clumsy gardeners will not appreciate weekend days spent without water while the irrigation system is installed or changed. The Uniform Building Code requires a BP between all garden spigots and the home water supply. Imagine returning home from vacation. The hose has had warm water in it for a week. Pick up the end of the hose to water your thirsty plants, open the hose valve, and some of that water (now populated with lots of microscopic garden creepy-crawlies) might be siphoned into your kitchen pipes.

The best solution is to install a metal T from the water main, downstream from the shutoff to the whole house, then a threaded ball valve, then PVC piping to the automatic valves. Some install one BP near the water main, and others rely on the BP built into each automatic valve.

Valves are made of rigid PVC. They have threaded inlets and outlets. Generally, the water supply to the valve is rigid PVC with a threaded fitting at the end, which has been cemented onto the end of the pipe. To this, the valve is attached. Banks of valves are usually placed side-by-side in a manifold. Be sure to leave a good length of supply pipe projecting after the last valve; almost everybody wants to install more lines down their road. For automatic systems, the on-off knob of each valve is unscrewed and removed and an electromechanical on-off device called a solenoid is inserted. A low-voltage wire

bundle runs to the automatic controller nearby with one color-coded wire from each solenoid in the manifold and one (normally white) common ground wire.

The pressure limiter is screwed into the outlet of the valve. Most pressure limiters have filters built in. Use Teflon pipe tape for all threaded connections; this will prevent almost all leaks. Pressure limiters are made in different flow rates in gallons per hour (GPH.) During your planning, you will select these based on the requirements for that line. You didn't think you could irrigate your entire garden without planning, did you? Lots of people try, but CACSS members are much too intelligent (or experienced) to do something like that. We'll come to planning after this brief rundown of components.

If you try to save money and leave out the pressure limiter, your emitters will probably blow off the spaghetti tubing when you are on vacation for a week, and all the water will run out of two or three open tubing ends, leaving most of the emitters dry. If this doesn't happen, one of the connections in your conduit tubing will blow and you will have a lagniappe fountain someplace in your garden. In either event, your plants will suffer, especially since most people tend to install irrigation systems in the spring when it's hot already, and then promptly go on vacation.

Conduit and spaghetti tubing is black and made of soft, somewhat flexible PVC. It is sold in long rolls, 50 to 100 feet or more. The material has a "memory" for shape, and for ease of handling on the day I use it, I anchor one end, unroll the entire roll in the sun, and anchor the other end. It is much easier to work with straight conduit.

It is usually cheaper per foot if you buy bigger quantities. Buy enough (after you calculate how much you need in your planning session) to allow for goofs, more goofs, and major goofs. An extra 50 feet probably costs less than the gas to drive to Home Depot plus the impulse purchases you'll make in the garden section. ("I know I can rescue this Hawaiian tree fern here in the desert!")

Conduit tubing is soft enough for gentle curves but so soft, it will kink at 90 degree bends. It is often necessary to branch conduit lines or join them together. Connectors are sold for these purposes: 90 degree elbows, straights, and Ts. There is also a capped, threaded connector used as an end piece for lines. The cap is screwed on to terminate the line. If the gardener wants to extend the system in the future the cap is removed, and the connector can be screwed into a connector on the new extension. Or, you can do what I do: Just bend the end of the conduit over and use a small hose clamp, tightened down, to seal. It makes professionals cringe, but looks so nice when the metal pokes up through the decomposed granite.

Heat-softened conduit ends, cut neatly and squarely, are pressed into the connectors. Now you can see why a pressure reducer is needed for the line. Savvy DIers carry a thermos filled with boiling water. We dip conduit ends to be joined into the hot water for a few seconds to soften them up, one at a time, and then press the ends into the fitting, one end at a time. If you try to do both at once, you'll find out why I don't. Quality

ittings have ridges on the inside to prevent pushing conduit out the other side of the fitting.

There are connectors for spaghetti tubing, as well. You are better off not using connectors to join spaghetti tubing. Each tiny joint is susceptible to getting clogged. Be a big spender and cut another section off the roll.

Although you are certainly going to plan first, don't cut any tubing until the trench is dug. It's amazing how hard it is to properly measure a trench that isn't there yet. If you cut tubing before you dig the trench, and the tubing winds up being too short, it will still be too short no matter how much more you cut. Moral: If you're impulsive, buy lots of extra straight connectors.

Spaghetti tubing is attached to conduit with small plastic devices like hollow two-ended darts. These connectors are sold in small bags and big bags. You will be using a lot, so buy them in big bags. They last a long time in your storage shed, and you will be using more of them in the future as you make changes to your system.

Conduit is soft enough to puncture with almost any sharp object, but for the sake of your median nerve, please spring for the \$3 conduit puncher rather than using an ice pick, pocket knife, or steak knife. While it is macho (for the men... I've been informed the feminine adjective is facha) to use bare hands to push the sharp connector into the hole you just made, please hold the connector with a wrench. At the end of the day you'll be glad you did.

Spaghetti tubing is cheaper than conduit, probably because it is 1/4 inch in diameter and most conduit is 3/4 or 1/2 inch. Don't be tempted to save money by running multiple emitters from one length of spaghetti or by branching spaghetti. There is only so much water that thing can carry. Impress the kids and run one piece of spaghetti tubing per emitter. If you planned carefully, your conduit will run right along your plants, and you can connect emitters directly to the conduit. You were going to plan first, right?

Oh, I forgot the most important part--goof plugs. These small plastic plugs fit in holes made where they aren't supposed to be. The plugs have two ends, big and little. For a nice clean hole made with a conduit punch, the small end fits tightly. For a hole made with teeth, or fingernails or a connector that's been worked over, the big end is more useful. Buy a big bag of goof plugs.

Emitters are sold in 1, 2, and 4 gallons of water per hour delivered. In general, it's better to use larger-capacity emitters and run the system for less time, so long as the water is actually soaking in and not running off. If the water is running off, shift to lower-capacity emitters and run the system longer. Lower-capacity emitters tend to clog more easily with dirt. You did spring for a filter, didn't you?

As you're assembling the system, keep the tubing clean and don't let anything get in through open ends or holes you just punched. Tiny particles of soil clog emitters and

soon it's a plug rather than an emitter. Don't install any emitters and don't cap the end until all the conduit and spaghetti are connected for the whole line. Turn on the water, and let it flush out any dirt in the lines. Then cap the end. Water will continue to flow out the spaghetti tubing. Begin attaching emitters at the openings closest to the valve. This will allow the water to keep dirt moving on down the line. When all but a few emitters are attached, open the end, flush the line once more, and recap. Then attach the last few emitters. Leave the end accessible; you should flush dirt out of the entire system from time to time.

Inspect your system at least monthly. Turn on each line in sequence and walk each line. Inspect each emitter and all parts of the tubing visible. Emitters become clogged. Rabbits chew them off, and chew holes in tubing. Any time a plant isn't looking right, inspect the emitters right away.

As your plants grow larger they will need more water. Adding more emitters to growing plants is better than running the system for more time. Smaller plants may be receiving adequate water at the original setting and would be over watered with longer irrigation.

Remember water must be delivered to the roots of the plant, not the base of the trunk. As the plant grows, the feeder roots should grow out from the trunk. Move emitters away from the plant gradually at first, maybe two to four inches per month, and keep moving emitters to the drip line over time.

Now for the planning part, and a little about soils and water. Do you remember the conversation at the top of the article? I hear it all the time. Drip systems are not magic. Most people not using DI over water all their plants. We get away with it because our soils tend to drain rapidly. With DI water is doled out sparingly, and we have to get it right.

How much to water a potted cactus that is bone dry? Soak the entire root ball, of course. But no reason to give more water than needed to soak the root ball. DI is approached like that. We want to soak the entire root zone of the plant, and then let it almost dry before soaking again.

Most plants should grow roots out sideways from the stem in all directions and down into the soil. Water soaks down into the soil and does not spread sideways very far. Water does not travel rapidly through the soil. Therefore, it seems obvious that one emitter will not be adequate for soaking the entire root ball of anything larger than a petunia unless the plant is in a non-draining well. It should also be obvious that DI requires very long run times to get water down to the entire root ball. How often do you see one little tiny wet spot right next to the trunk of a large, stressed shrub?

Plants on just one emitter grow roots in the direction of the water but still looks stressed. The operator adjusts the system to deliver 5 minutes of water 3 times a day all year. The plant remains shallow-rooted because the roots only grow where there is water. Mid-July comes.

This is the usual scenario, even with "professionals." The plant grows all its roots toward the emitter. When a storm comes, it goes over. For an excellent example of this in practice, visit Marshall Way in downtown Scottsdale after any monsoon storm. All the mesquites are blown over every summer. The city buys 15-gallon mesquites as if they were consultant's reports. The "landscape designers" built something that could not work. They must have been idiots, and I say that publicly. Nobody with an ounce of plant sense would put Chilean mesquites into raised containers like that and water shallowly.

Now you know all your shrubs and trees will require multiple emitters spaced evenly around the stem, and long run times.

Trees and shrubs are supposed to grow. The feeder roots capable of absorbing water are usually located at least as far from the main stem as the outermost leaves, at what is known as the drip line. Going down, they tend to be even deeper than this. As the plant grows, it will need more water. Not only do you need multiple emitters per plant, but they will need to be moved out from the plant as it grows, and you will be placing more emitters around the plant as it grows.

This means you must plan your DI system not on what your plants need today, but what they will need when mature. Unless installing DI into existing mature landscaping, you must plan for increased water delivery.

How much water does it take to soak the root ball? This depends on the size of the root ball and the consistency of soil. In general, an inch of rain will penetrate about 4 to 6 inches deep into the soil if delivered slowly enough to soak in and not run off. When properly watered, annuals' roots are shallow, maybe 2-4 inches deep. Small shrubs go deeper, maybe 6-9 inches. Medium shrubs maybe 1-2 feet. Mature citrus and other trees, 3-4 feet. You need to deliver enough water to soak a cylinder of soil extending from the trunk to the drip line, and down to the proper depth