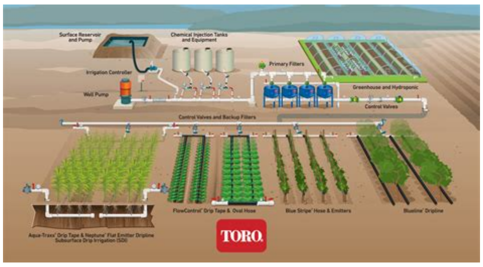

File Name: Drip Irrigation Design Manual.pdf
Size: 4398 KB
Type: PDF, ePub, eBook
Category: Book
Uploaded: 13 May 2019, 16:21 PM
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Book Descriptions:

Drip Irrigation Design Manual

In some cases, new information and tips, not covered in the previous section,Included are design steps, technical data, installation layouts and design details to assist in the design of the more common dripline applications. Included areIncludes step by step instructions for installing spraytodrip retrofit kits, along with typical applications for converting narrow planting beds near a structure. It introduces the Xerigation. While sprinkler systems are around 7585% efficient, drip systems typically are 90% or higher. What that means is much less wasted water. For this reason drip is the preferred method of irrigation in the desert regions of the United States. But drip irrigation has other benefits which make it useful almost anywhere. It is easy to install, easy to design, can be very inexpensive, and can reduce disease problems associated with high levels of moisture on some plants. If you want to grow a rain forest however, drip irrigation will work but might not be the best choice! The high efficiency of drip irrigation results from two primary factors. The first is that the water soaks into the soil before it can evaporate or run off. The second is that the water is only applied where it is needed, at the plant's roots rather than sprayed everywhere. While drip systems are simple and pretty forgiving of errors in design and installation, there are some guidelines that if followed, will make for a much better drip system. The purpose of this tutorial is to guide you toward materials and methods that will increase the benefits of your new drip system, while steering you away from some common misconceptions and practices that can cause you trouble. So I'm going to honor that contribution by using the metric system as the primary measurement units for these guidelines. After all, metric is really the "native" measurements of drip irrigation. When I started using drip irrigation back in the dark ages of irrigation all drip data and products were in metric.http://anmoul.com/userfiles/craftsman-1_5-hp-garage-door-opener-manual.xml

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But because I'm such a nice guy inflated ego alert!! Dump some ice water on this guy!, I will provide English measurements also. So don't panic. Each of the guidelines below describes a basic rule for drip irrigation design, the guidelines follow in the logical order for creating a design. You can think of the guidelines as design steps if it helps. This page is the top level, here you will find a brief description of each design guideline. For many of the guideline topics there is a link to another page with expanded information on the guideline topic. There may be additional links from there to allow you to dig even deeper into the drip irrigation knowledge base. So you choose how much you want or need to learn. My recommendation is that if you want to print out something, print this page. Then refer to the other levels and print them if necessary as needed. That will save you a lot of unnecessary wear and tear on your printer. It might also save a tree from going to the paper mill! I strongly suggest that even if you are familiar with drip irrigation you start be reading through The Basic Parts of a Drip System page now. It contains a lot of tips and recommendations. These guidelines are what is termed a "prescriptive standard" in the building industry. Obviously this saves a lot of time and effort in preparing a design. The downside to a prescriptive standard design is that it tends to "overdesign" in order to make the design "one size fits all". Unlike sprinkler irrigation, drip irrigation systems are much more forgiving of design error, the cost of over sizing the materials is minimal, and so a prescriptive design method works very well for almost everyone. To prepare a fully engineered drip irrigation design requires a massive number of difficult mathematical calculations. If there was ever a great place to use prescriptive standards for the design, it is drip irrigation!http://gammatradings.com/userfiles/craftsman-1_5-hp-router-manual.xml

For more level areas turbulent flow emitters will work great and are often less expensive. For gravity flow systems use shortpath emitters, they typically work better than the others at very low water pressures. Trees and large shrubs may need more. Obviously, using two allows for a backup if one clogs up which happens now and then, even on the best designed and maintained drip systems. But just as important, more emitters also wet more soil area. This results in more roots, and a healthier, happier plant. Exception if the plants are very close together you may need to use less than 2 per plant in order to maintain the minimum spacing between emitters. For supplemental watering of lowwateruse plants, use one emitter per plant. Supplemental watering is used for establishment of drought tolerant plants that are not likely to need irrigation once they have developed a good root system, or might be used to apply a little extra water now and then to make them a bit more lush. Use of lowwater plants with supplemental drip irrigation is considered very “green” and is the current trend in landscape design. That’s where the roots are, and the roots need water. If the soil is very permeable install emitters 300mm to 450mm 1218 inches apart. For more information and a better method of determining spacing see Drip Emitter Spacing. There are several types that will work depending on your situation and local codes. For more information see Irrigation Backflow Preventers. For more information see Drip Irrigation Valves. If you don’t know what size your water supply pipe is, see How to Find the Size of a Pipe. See the Irrigation Pumping Systems tutorial for more information about using pumps. The piping in buildings is almost never designed to carry large amounts of water such as is used by irrigation systems. To be safe I assume you have significant restrictions. 95% of buildings have these restrictions so don’t increase the flow unless you really know what you’re doing.

Increasing the flow could cause extreme damage to the plumbing in the building! The total length of the mainline and the lateral together should not be more than 120 meters 400 feet. So you could have 100 meters of mainline and 20 meters of lateral, for a total of 120 meters of both. But you should not have 80 meters of mainline and 60 meters of lateral because the total of both would be more than 120 meters. Remember mainline is the pipe before the control valve, lateral is pipe after the control valve. Many drip systems won’t need mainlines or laterals. Or they may need just a mainline, or just a lateral. For more information see the sections on mainlines and laterals in the The Basic Parts of a Drip System. For more information see the drip tube section of The Basic Parts of a Drip System. If you bury the emitter roots will grow into it and clog it. If you do want to bury the emitters do a search for “subsurface drip irrigation” to find specialty drip products designed to be buried. Follow the manufacturer’s recommendations for those products as they must be designed and installed to very exacting standards to avoid problems. If you do bury drip tube don’t complain to me if gophers, moles or other rodents chew it up. I’ve seen them gnaw to pieces a buried drip system over night. One day it works, the next, it’s garbage. It only takes one gopher or mole, squirrel, etc., and one evening! You’ve been warned! Other wildlife and most dogs, will also chew the tubes. It helps if you provide a water source for them to drink from if possible. A water bowl with an emitter over it to keep it full sometimes will distract wildlife from the tubes. You may need to train your dog not to chew the tubes, dogs seem to chew on the tubes for no real reason other than to annoy you. If you want to hide the tube, dig a shallow trench for it, so that it is just below the level of the surrounding soil. Don’t put dirt over the tube.

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Throw some mulch or bark over the top to hide the tube, or plant a low spreading plant that will grow over it and hide it. For more on this topic see the section on spaghetti tubing on The Basic

Parts of a Drip System page. The PVC pipe is installed underground and a pipe goes to each plant location, so it takes a lot of pipe. At each plant the emitters are installed above ground on short poly tubes called “risers”. Hard pipe systems can be pretty expensive due. For a detail drawing of this click here. The design of a hardpiped drip system is essentially the same as shown here, except you would use PVC or larger size poly irrigation pipe in place of the inexpensive drip tubing. There are many different sizes of drip tubing sold, and the fittings have to be made for the exact size tube you are using. If they aren’t, they will either be very hard to install, or the tube will blow off the fitting. Sometimes it takes a week or so for the tube to come loose, but if the fitting is even 1mm too large, the tubing will come off eventually. Never heat the drip tube or use oil on it to make it easier to insert into or onto the fittings. See the section on drip tube in The Basic Parts of a Drip System for more information on fittings and tips and tricks for installing fittings. This keeps the tubes from wandering. No kidding, they tend to move around by themselves. Staking them also helps protect them from damage. I prefer to use metal stakes as the plastic ones I’ve tried pull loose too easily. Wire that rusts holds even better, as the rust binds the wire to the soil. After a few days they can be almost impossible to remove. They will rust away in a few years, but by then the tubing has adapted to its position and stays in place pretty well. Standard 12 gauge wire works well, as does pieces of wire coathangers. Buy some coathangers at a yard sale or thrift store and help recycle. Bend a 300mm 12 inch length of wire into a”U” shape to make a tubing “staple”.

Or you can buy metal staples that are made for holding down erosion control blankets, they work great. For more information see the drip tube section of The Basic Parts of a Drip System. If there are multiple high points you an air vent installed at each one. Air vents should always be used for drip systems on sloped areas. Air vents are often not installed on small homeowner drip systems without any slopes. If air vents are not used be sure the emitters at the highest points are not installed where dirt could be sucked into them. For more information see Drip Systems for Slopes and Hillsides. Automatic flush valves are available, however my personal preference is for manual flush valves. See the section on flush valves in The Basic Parts of a Drip System for more information. I like to staple the tubes to something to keep them in place if possible like stapling the tube to a trellis for hanging plants. Use a wire stake to hold the emitter in place in a pot. Don’t pull any of your tubes tight, snake them a little, leaving some slack in them to allow movement. The tubes will expand and contract with temperature changes, you don’t want them to tear or pop the fittings off. Vacuum breaker or antisiphon type of backflow preventers must be installed above the trellis or they won’t work. This is generally not very practical to do. But in most cases you need to use a double check, or preferably a reduced pressure type of backflow preventer. Those can be installed at any elevation a reduced pressure type should be above ground. I recommend a reduced pressure type. See the backflow preventer page for more detailed information. See Drip System Sample Detail Drawings. Everyone else can ignore this information. Here are the assumed pressure losses for the prescriptive drip system design used in these guidelines All rights reserved. This website uses both firstparty and thirdparty cookies.

By continuing you agree to the use of these cookies or other local storage, as well as the collection, sharing, and use of personal data for personalization of ads or other services. With drip irrigation, water is applied directly to the crop root zone, where soil soaks it immediately, thus reducing evaporation or runoff. This irrigation type suits any landscape and crop type, whether tree, vegetable, arable crop, or grass. It’s mostly used in farmland with runoff problems. Beneficial, it can be installed both above and below the soil surface. Some control head units also contain a fertilizer or nutrient tank for the slow adding of measured fertilizer doses into the water during irrigation. There are two different kinds of valves which can be installed to control the water flow There can be several control valves installed on drip irrigation.Control valves can be automatic or manual. Automatic are wired to a controller or solar powered. To ensure a constant level of lower water pressure, the drip irrigation system needs to have a p ressure regulator installed. It reduces water pressure up to 60 psi, in order to ensure regular operation of all drip components. They clear the water and keep dirt and debris from clogging the drip emitters. Common types filters include screen filters and graded sand filters, which remove fine material suspended in the water. They are made of galvanized steel, copper, polyethylene PEX, or PVC. Since PVC can be easily damaged by solar radiation, these main lines should be buried in the soil. They are usually made of PVC and polyethylene and therefore should be buried below the ground to prevent sun damage. Lateral pipes are usually installed on large drip systems, where multiple drip tubes are needed. Additionally, in small systems, the drip tube is connected directly to the valve. It's placed on the ground surface between the plants. Along its length, it has placed emitters which water the plants.

Drip tubing systems are designed to last for 10 to 20 years or more. For this reason and the associated high initial cost, they are mostly used for permanent crop installations fruit trees and vines. Therefore, it's most frequently used for row and field crops. Drip tape can be placed on the soil surface or with just below, enough so that the soil is protected against the wind and sun. These small devices control the water flow to the plants. They can be screwed or snapped onto the drip tube. Common practice is to apply 1 or 2 emitters per plant, depending on the crop size and row space. Hence, fruit crops usually have 12 emitters installed per plant, widely spaced, while in row crops, emitters are more closely spaced in order to wet a strip of soil. Care should be taken to use a special punch designed for a certain emitter so as to avoid creation of big holes and water leaching. Some emitters are selfpiercing, meaning they do not require the use of a punch. There are also drip tubes with already installed, uniformly spaced emitters inside the tube. The main benefit of every emitter is to provide a specified and constant water discharge that will not vary too much with pressure changes and won't be blocked easily. The end cap is simply placed on the end of the line tubing, then that line is bent and fed through the end cap, "pinching" off the main line. It should be i nstalled at the highest point on the drip tube to prevent it from being covered with dirt. The air vent is usually installed on large drip systems which are on a slope, as the elevation change creates a more powerful suction that will suck in more dirt. This farm practice is called fertigation. It benefits both the farmer and a crop. Drip irrigation enables a farmer to achieve an easy and inexpensive installation, reduce weed growth, reduce insect pest and disease occurrence, and facilitate proper water management. Moreover, it can be used in all climates and on every soil and crop type.

Therefore, farmers are often under pressure to find a suitable and costeffective.Despite its beauty though, crop production requires varying farm activities and constant maintenance in order to provide a high and healthy yiel. The use of drip irrigation has decreased the incidence of plant disease that can occur with the use of overhead sprinkler irrigation. Plus, many watersoluble fertilizers can be applied through the drip system, thereby keeping nutrients near the root zone and allowing the plants to get the most value from each fertilizer application. Since then many systems have been devised in the United States, being field tested in California, Florida and Hawaii. And you don't have to worry about whether you have stood there long enough with the hose most of us never do! or whether there will be enough rain to keep the plants going. It is that simple! Just get the components you need and assemble the system—most home garden systems can be assembled in one afternoon. While there are things which can be done to mitigate the effects of bad water, the dirtier the water, the more care must be taken when choosing the components needed to achieve the satisfaction and low maintainence with your drip system. Just above that is water containing iron slime bacteria these will not filter out, they only come out of solution when they hit the air. Equally bad is water that contains calcium or magnesium that will precipitate out when it hits air thus leaving deposits. Then comes water that has high levels of sand many wells pump some sand.It is very cheap insurance so contaminants in the water clog the filter, not the emitters. Some people don't like how often they have to clean their filter—if that is the case, get the next largest size so you won't have to do it so often. Some systems require cleaning out the filter every time the system is run and some people only have to do it once a year depends totally on your water quality.

If you are on a spring box or have a gravity fed tank with not much head above the drip system, you probably won’t need a pressure regulator. Most emitters and minisprinklers are designed to give the rated gallonage at 20 to 25 psi. Most soaker type tubing is designed to run at 10 to 15 psi. It is an individual choice and here are our recommendations on what most people have found to work well for them On flat ground you can use either the Jain Flag, Netafim button or 36” or 48” Dripperline emitters can be ordered by request for evenly spaced trees and vines. The Jain Flag emitters can be opened to be cleaned if necessary. The Netafim buttons cannot be opened but they very rarely clog. On hilly ground greater than 20 ft.Only the Turbo SC emitters of all the pressure compensating emitters can be opened to be cleaned if necessary. All pressure compensating emitters are selfflushing. Tapetype tubing must be used in straight runs— not around corners or bent unless you use appropriate fittings or the flow of water will be restricted. Soaker Dripline should be used at 15 psi. Dripperline works best at 20 psi. Only Soaker Dripline, 12” Dripperline and 12” Pressure Compensating Dripperline are recommended where heavy iron i.e. when water stains fixtures or calcium is present in the water. They can be utilized more like standard sprinklers in that there are many different patterns available for use, although the gallonage and radius involved is much less. This means more drip minisprinklers can be run on one line than would be possible with standard sprinklers. One thing you should be aware of is that the minisprayers and minisprinklers do not work well in heavy winds—due to the finer droplet size, they will not give you the desired coverage if operated when there is a lot of wind. You can compensate for this by running the system in the evening or early morning when wind is not usually a problem.

Note the location and size of plants to be irrigated, and whether they are native and drought tolerant or introduced requiring more water, and the location of water sources. Note distances needed for tubing and what fittings will be needed to layout the system tees, elbows, etc.. Based on the size and type of plant see watering guide, determine how many and what type of emitters or sprayers will be required. When plants mature, they will require more water. This can be accomplished by watering longer but it is usually more satisfactory to add more emitters as plants grow at different rates. Also, new plants may be added to the landscape so leave about 25% more water capacity available for growth needs. The formula is to take the GPM x 60 to get GPH. Should the system require more water than is available, divide the system by using multiple valves or a hose Y connector and run one system at a time. If elevation changes are a problem, use pressure compensating emitters. Should the drip tubing be hidden from view. Is it out of the way of foottraffic areas. In areas where gophers and other rodents are problems, no drip or spaghetti tubing should be buried or they will chew through it. Mulch can be used to cover tubing. If you are on a well and plan to do fertilizer injection, you should definitely use one. Use teflon tape on all pipe thread joints not pipe dope. Hose thread connections will seal with the washer included on them. Do not use a wrench to tighten plastic threads, handtighten only! We feature a number of controllers which are appropriate for drip systems many older controllers were designed strictly for use on standard sprinklers and will not run long enough to use with drip systems. Lay out tubing as per sketch. When assembling fittings, cut the tubing with pruning shears or a sharp knife and be careful to keep dirt out of tubing and fittings. You will need to have access to them for periodic line flushing.

Using an ice pick or a nail is not recommended because the hole is not evenly punched and often results in stress cracks and leaks around the hole. Also, you can go all the way through the other side! This will help make the tubing firm and easier to punch into as well as make the holes the right size for the emitters no leaking around barbs. Do not place emitters, etc.This is especially important with perennial plants such as fruit trees and vines which are susceptible to root rots. A general rule of thumb is to keep emitters 1218” away from the trunks of plants. Sandy soil allows water to percolate down rapidly while water on clay soil moves horizontally much further before it goes down below the root zone. On sandy, coarse soil, a 1 gph emitter will wet an area on the surface about 1215” in diameter. On clay soils, the emitter may wet an area 24” in diameter. Below the surface, a large onion shaped area is wetted as water percolates down. Emitters should be placed to cover root zones well. Also, buried emitters can have problems with clogging due to root intrusion or backsiphoning of dirt. Attach the lid and shake vigorously, until all the clumps of soil have gone into solution with the water. The first to settle are the larger particles. After one to two minutes, mark the sand level on the jar. The finer silt particles will settle out on top of the sand. Often, the layers are slightly different colors, indicating various types of particles. Mark the silt layer after a few hours. Leave the jar overnight and measure the settled clay particles. It may take a few days for some soils to settle. This is useful in determining how far apart emitters and soaker tubing should be placed to water the plants effectively. Close the end caps and check emitter operation. If you have an emitter placed where you don’t want it, remove emitter and insert goof plug in hole. Punch a new hole in the appropriate place and install emitter.

Divide the gallons per day required by the gallonage of the emitter delivering the water to each plant to determine hours of watering per day. Determine the days between waterings from the above chart. Multiply the hours of watering per day by the days between waterings to determine how long to run the system. The days between waterings will need to be seasonally adjusted, to account for rain. We recommend checking the filter screen for debris after each irrigation for the first couple of times to determine how often you will need to clean it. Some people have to clean the filter after every irrigation. Again, water quality will determine frequency. For most locations, this means winterizing your system or else you will find broken parts come next spring. They are very inexpensive and cheap insurance against broken valves, filters and pipe due to being filled with water when freezing temperatures come. These are installed at the lowest point in the pipe run, with a gravel sump to provide drainage. Clogged emitters can often be cleaned by backflushing While the system is in operation, hold a finger over the emitter outlet for a few seconds. Jain Flag, TurboKey and Turbo SC emitters can be manually opened and cleaned if necessary. In a worst case situation, the old emitter can be removed, the hole filled with a goof plug and a new emitter installed in a new hole. After repairing any breaks, open endcaps and flush lines for several minutes. If there are no line breaks, try turning on and off the system several times. This often helps purge debris from clogged emitters. In this case, dividing the system will generally solve the problem. Whenever you want, you can change your cookie settings. Our locally based teams tailor highquality, turnkey greenhouse projects delivering comprehensive solutions for enhancing crops and managing climate control while aiding clients to adhere to their budgets and ensure a return on investment.

In addition to our worldleading drip irrigation solutions, we offer highly specialized, stateoftheart greenhouse systems and equipment to suit any climate or crop.Precipitation of these deposits can be prevented or maintained with acidification to remove mineral deposits. We are bound by a common purpose To Advance Life Around the World. This publication is not a stepbystep design manual, but it will help you in the design process of an SDI system appropriate to North Carolina. Installation is best done when the soil moisture is within an optimal range, which may seriously limit the time when a system may be installed in North Carolina. And fewer systems have been installed in humid regions, so fewer professional installers and less installation equipment are available. Topics include design criteria; pumps; filtration; chemical injection; valves; main and submain header, dripline, and flushing manifold design; instrumentation and control systems; design implementation; installation tips; and locating an installer. Some drip systems have lines that are buried up to eight inches deep, but are retrieved annually and are thus very similar to surface drip systems. This publication focuses on SDI systems with lines that are permanently installed below tillage depth Camp and Lamm, 2003. Although SDI has many important benefits for modern crop production, many challenges also exist. SDI systems must be carefully designed and installed so that they operate with proper efficiency, and so that fertilizers and chemicals can be applied in a legal, uniform, and efficient manner. SDI systems are expensive and should be designed and installed to ensure a costefficient system. Significant amounts of technical skill and management are required to properly operate the systems so that peak efficiency and benefits are realized. This means that trained personnel should be involved with the design, installation, and operation of the system.

Proper training and management skills are very important to the success of any irrigation operation, and this is especially true with SDI systems in which driplines are buried. While SDI systems have been used successfully for many years in arid and semiarid locations, the topography, soils, crops, cultural systems, and climate in North Carolina and other humid regions may require a different design and installation. Do you have an adequate water supply, acceptable water quality, and appropriate topography for an SDI system This information is referred to as design criteria. For an SDI system, these criteria will include information on climate, crops, soils, and water quality, along with system management and operational considerations. This is called the “crop water requirement.” You will need to supply the “peak” water requirement, or the amount of water that a crop uses during its highest water use period. During this period of peak water use, your SDI system must deliver that amount of water. Even in humid regions, the probability of receiving appreciable rain at a critical period is low. You want a system that can provide water during a drought. In addition, moisture in soil storage is normally not considered when designing for peak demand. Your crop also influences SDI system design. Different crops and different planting dates will result in different water requirements. If you rotate crops, design your SDI system to meet the needs of the crop with the highest water demand. A good “rule of thumb” is to size your pumps and main lines to replace a peak crop water use rate of 0.25 inches per day. This translates to a pumping flow rate of about 12 gallons per minute gpm per acre you plan to irrigate if you run the system 12 hours per day during the peak water use period and factoring in system inefficiencies. You will need to supply a higher flow rate if you will operate it fewer hours per day and less if you can operate it more hours.