Texas Cooperative EXTENSION
The Texas A&M University System

CONSERVING WATER THROUGH BETTER IRRIGATION MANAGEMENT

John Cooper
Denton County Extension Horticulturist
jn-cooper@tamu.edu

Increasing Demand for Water

People in the water business say we never know the value of water until the pump runs dry. Thanks to the drought of 1998-2000 most people across North Texas can now give you a pretty close estimate.

Between water rationing and watering bans, coping skills of people were taxed to the max. People make tremendous investments in their landscapes and from all indications will spend a fortune on water to save them, if they can buy it at any price.

We use water for everything from cooking and cleaning to drinking and bathing but during the summer we use it mostly for irrigating the landscape. Normally, half the municipal water supply is used on landscape irrigation during the summer months but during the big drought it was closer to two-thirds.

People water their landscapes for one reason, to keep their plants alive and healthy. Knowledge and skill in watering is required to get the most from the water your buy. Saving a dollar on water is like putting a dollar in your pocket so making every gallon count makes cents.

The long-term economic forecast for North Texas calls for continued strong growth. We can expand our water delivery systems to make wider use of existing water but future increases in water supplies are virtually unavailable due to ground water depletion and unavailability of dam sites for development of new surface water resources. Water for sustaining economic development in North Texas will, of necessity, come through conserving what we already capture in existing reservoirs. Only minimal increases can be expected from constructing additional East Texas reservoirs and piping the water back to the metroplex.

Evapo-Transpiration and Water Banking

Watering is one of those mysterious things we do without really understanding it. Watering is as much an art as it is a science. It is a science because you cannot fool mother nature. It is an art because mother nature can sometimes fool you. Understanding the fundamentals however will give you an even chance of getting it right.

Following an irrigation application water leaves the soil in only one of three ways. The first two ways are evaporation from the soil surface, and transpiration through the plant, which combined represent the evapo-transpiration (ET) rate. The third way is seepage into groundwater which only occurs under saturated ground conditions when people are not

watering anyway.

Think of your soil as a water bank. If you apply water and it soaks into the soil without running off, it is locked in for your plant's benefit and use. The only way you lose by banking water is if the soil is saturated from an irrigation and you get rainfall that won't soak into the soil a blessing you will just have to learn to accept.

Watering turns critical during the summer for one simple reason, the subsoil moisture disappears. Whatever your plants get comes from you. Consequently, when you water, you need to water through the bottom of the root. Functional roots only grow to the depth you water. If your watering is too shallow, extend the depth of your roots by watering deeper. The only way to water deeper is to use more water at each application.

Check Soil Infiltration Rates and Watering Depths

Many people water too often. A good rule of thumb is to apply one inch of water once a week on warm season turf during the summer months in the absence of rain. One inch of water is enough to supply a week's worth of water and this amount goes deep enough into the soil to allow full rooting depth of turf. If you deliver one inch of water once per week all your woody plants in the landscape will do well. You may be able to save water however if you use plants other than turf and zone your irrigation to meet the specific needs of your different plant communities.

Trees benefit from deeper watering. Established native and adapted trees under mulch will survive on two inches of water applied every three weeks. Established native and adapted shrubs, vines and ground covers under mulch will survive one and one-half inches every two weeks. During the first two to three years of establishment, woody plants need the full one inch of water on a weekly interval in the absence of rain during the growing period from April through September. For trees growing in turf, apply two inches every third or fourth time you irrigate in addition to the one inch per week.

The suggested irrigation rates are based on the absence of rainfall. Even if it does rain though, you cannot automatically assume the full amount entered the soil. Coarser sands absorb up to two inches of rain in one hour. Finer clays absorb as little as two-tenths of an inch in one hour. Obviously if the rain falls at a rate in excess of the infiltration rate of your soil, some will run off the site and cannot be counted.

Check the infiltration rate of your soil by cutting both ends from a coffee can, inserting it into the ground, pouring one inch of water into the inserted can and timing how long it takes for the water to soak into the ground. Deep rooting of healthy dense turf will increase infiltration rates in even the heaviest clay soils to surpass that of bare sandy soils.

Probe the soil periodically through the growing season to check soil moisture. This gives you one more "look" at your soil moisture conditions and helps you tell if your irrigation water or rainfall is really getting deep enough into the ground.

You can use a screw driver to check turf because you only need to go down 6-8 inches. Buy a longer probe at the hardware store to check 8-12 inches deep for broadleaf evergreen groundcovers, 12-18 inches for shrubs and 18-24 inches for trees. You don't need to saturate the soil to these depths at every watering because the surface soil dries out first, but the soil should be moist enough to be probed to these depths. You may want to dig a hole and actually feel the moisture to the desired depth from time to time or soil to soil to make sure your probe is giving you an accurate reading.

Watering rods help replace deeper moisture for trees growing in hard-to-wet soils, especially heavy clays on steep

slopes. Surface applications provide more uniform distribution of water over the entire root system which extend as far from the trunk as the tree is tall. If necessary, insert the tip of watering rods 8-10 inches deep and run it on slow. This depth will allow wetting to the surface. High pressure applications can create worthless soil cavities. If, after the application, the probe will not easily insert to the 24 inch depth push the probe deeper as possible and resume the application. Water on a grid density of one probe per square yard. Water the drip line first. If you want to apply more water, water a row one yard inside the drip line then one yard outside the drip line alternating rows until you have either applied all you want or have covered the entire root system. Obviously watering rods are time consuming and should be used only when necessary to irrigate deeper in hard-to wet soils. They are especially good though for deep root feeding especially with phosphorus and potassium which move very slowly through the soil profile from surface applications.

Check Irrigation Delivery Rates

The amount of water you apply depends on the length of time you run your sprinklers. Every system delivers water at a different rate. Every zone in a system delivers a different rate. If you drag hose, every hose/sprinkler head combination delivers a different rate.

To determine how long to run your irrigation system to deliver one inch of water, place five coffee cans distributed through out the wetting pattern of your sprinkler head or sprinkler zone. Turn your system on and record the time it takes to fill the coffee cans one inch deep with water. Check delivery rates for each sprinkler zone or hose/head combination.

If your soil will not absorb one inch of water before it runs off, shut the water off, and resume watering after the initial application has had time to soak in. If you have an automatic sprinkler system you can run through your cycles several times to deliver the full amount. On hard-to-wet areas, especially heavy clays on steep slopes, dry spots can develop where the turf become chronically dry and weak. To remedy this condition you may need to set a soaker hose at the top of the slope and run it very slowly, at least occasionally, to re-wet these dry spots down deeper.

If you have been practicing shallow frequent watering, you may not be able to extend your watering interval to a full week all at once. If you see significant wilting before the week is up, go ahead and put a full week's application out to maintain your full wetting depth. By adding a day or two to your interval each time you irrigate, you can gradually stretch your interval to a full week in all but the coarsest sands.

Permanent Wilting Point and Water Stress

All plants wilt in response to a soil water deficit. When the soil is wet again, plants regain their turgidity. If turgor pressure drops too low, plants will not recover following re-hydration of the soil. This is called the “permanent wilting point”. It is a very specific point measured as vapor pressure in the transpiration stream. It is different for every plant species and is somewhat modified by physiological state but every plant has one.

Dead spots in the lawn or dead shrubs in a hedgerow occur when individual plants reach the permanent wilting point in a single hour of a single day. When the water comes back on, it comes too late for some and just in time for others. Dead plants adjacent to perfectly healthy plants indicate some reached the permanent wilting point while others did not.

Watering at the first sign of wilting is the most accurate way to time your irrigation application. This works fine on

turf but woody plants don't show wilt signs until they begin to scorch and lose leaf tissue. This is why checking soil moisture with a probe or shovel, at least occasionally to re-calibrate your watering, is so important.

Waiting until turf wilts is a good way to extend your watering interval and use less water. When you walk across the lawn in the morning hours you leave foot prints, the grass has reached the wilting phase. If you have an automatic sprinkler system and you can water instantly by flipping a switch then this method of timing your application works very well for turf. If you do not have an automatic sprinkler system and have to wait more than a day after your grass begins to show morning wilt your lawn may reach the permanent wilting point before you get it watered. In this case, you will need to stick with a more regular weekly watering schedule.

Water at the Right Time

The best time to water is when temperatures, solar radiation, and wind speeds are down, and relative humidity is up. This results in the lowest possible evaporation losses during the irrigation application. These conditions usually occur during the late-evening through early-morning, pre-sunrise hours. Due to higher evaporation losses, watering in the middle of the day at the height of summer requires 20 to 30 percent more water than watering at night.

One of the problems with automatic systems that run at night or in the wee hours of the morning is that the operator never sees the system run unless they make a conscious decision to check the system out. Many times the only indication that the system is not operating correctly is that the lawn or other plants begin dying in areas that have gotten too dry.

Sprinkler heads break or go out of adjustment for a variety of reasons including normal wear, mowers, vehicular traffic, clogging, or even people just stepping on one wrong by accident. Valves get stuck, wires corrode, and fittings leak. Whatever it is, if you check the system only once a month, and it breaks the day after you check it, the system could operate an entire month before you catch it. Check your system often. It may be automatic but it isn't automatic maintenance.

Irrigating at night or in the early morning hours before sunrise without an automatic sprinkling system is impractical. Even if you don't have an automatic system though, there are some things you can do to cut your evaporation losses, conserve water, and save money.

If you have to water during the day, water in the early morning or late evening hours. Although this increases leaf wetness, you will only incite fungal diseases if you water more often than every four days which is not recommended anyway for agronomic reasons.

If you have to water during the middle of the day, water in the shade whenever possible. You can follow the shade patterns across your yard if you plan ahead. Temperatures in the shade are 10 to 20 degrees cooler, humidity is higher, especially if wind speeds are low, and drying from solar radiation is significantly reduced in the shade.

Use Drip on Everything but Turf

Use sprinklers that produce large water droplets with a low trajectory. The finer the droplet, and the longer it stays in the air, the greater the loss to evaporation. Avoid sprinklers that atomize the droplets or spray a fine mist. These type heads not only evaporate more water but the water they apply more easily blows off course resulting in dry spots.

Ground covers, trees, flowers, vegetables, and shrubbery borders, virtually everything except turf, can be irrigated

with drip irrigation. Evaporation losses in areas irrigated with drip are reduced to virtually zero no matter what time of day or night you water. Drip irrigation is especially helpful in using water high in salts.

If you are lucky enough to live in an area with expansive clay soils, watering around your foundation is of the upmost importance. If your soil cracks when it gets dry, your soil is expansive, i.e., the soil expands when it is wet and shrinks when it gets dry.

If you allow an expansive clay to dry and crack, the foundation of your house will crack as the soil shrinks. Foundation soils dry from the outside perimeter. Watering the vegetation around your home will naturally hydrate the soil around your foundation and keep it stable.

A soaker hose or drip irrigation system is the best way to water foundation plants as well as the foundation itself. It should not be operated continuously but simply used to meet the demands of your foundation plants. If you see the soil pulling away from your foundation, turn the system on and run it until the soil closes up. In heavy, hard-to-wet clays this may take several hours.

Zone Irrigation Systems for Greater Efficiencies

One of the most effective ways to improve irrigation efficiencies is to establish irrigation zones based on plant requirements. It is impractical to water each plant in the landscape separately but grouping plants in zones according to how often they are watered is both practical and effective.

The "frequent" watering zone would include color beds of flowering annuals along with container plantings and hanging baskets. This zone will typically be watered several times a week to keep the plants fresh.

The "regular" watering zone would include the lawn areas. During the summer months turfgrasses should generally be watered on the order of once a week in the absence of rain.

The "occasional" water zone would include perennial flowers and tender woody shrubs, vines, and groundcovers. These plants would be watered on the order of once every few weeks in the absence of rain.

The "natural" watering zone would include drought-tolerant trees, shrubs, vines, and groundcovers. These would not be irrigated but would rely solely on natural rainfall. It should be noted that during exceptionally dry years, even the "natural" zone might need the benefit of an occasional deep watering.

Long-Term Landscape Drought-Proofing Depends on Plant Selection

In 1981, Denver water authorities responded to a prolonged drought which had resulted in millions of dollars of plant losses by promulgating the seven principles of xeriscaping. During the 1980's and 1990's xeriscaping became a national movement to conserve water in the irrigated landscape. In 1993, the Texas State Legislature enacted a law requiring the seven principles of xeriscaping be applied to the landscapes of all state buildings.

The seven principles of xeriscaping include thoughtful design, limited turf, efficient irrigation, soil improvements, use of mulches, native and adapted plants, and proper maintenance. Thorough application of these principles have been demonstrated to reduce water use by up to 80 percent over conventional landscaping. Of the seven, none of the principles is more strategic than the use of native and adapted plants.

Plants all over North Texas were seriously injured by the of 1998-2000 drought. Although soil preparation, maintenance or the lack thereof and poor irrigation practice played a part in these losses no factor was more important than plant selection.

The plants used in the landscape determine in large measure how much water your landscape requires. Careful plant selection is an essential long-term approach to drought-proofing your landscape. As landscapes are replanted a few considerations on plant selection will be helpful.

Plants may be generally classified as native or non-native. Native plants are naturally drought hardy. Just because a plant isn't native doesn't mean it isn't drought hardy. There are plenty of places around the world with even hotter and drier climates than Texas from which plants may be and have been introduced, crape myrtles from Asia, for instance, but the presumption of drought-hardiness should favor natives in the absence of reliable information on introduced species.

Another useful plant classification is woody versus non-woody. Woody types include trees, shrubs, woody vines, and most ground covers. Non-woody plants include turfgrasses, ornamental grasses, herbaceous perennials, and flowering annuals including many vines.

Generally, the more woody plants you have and the fewer the non-woody plants, the more drought hardy your landscape will be. Although by definition all native plants are completely drought hardy, even native woody plants are more persistent through a drought than native non-woody types.

Because most of the trees used in our area are native, these large woody plants are considered to be the most drought hardy of all plant types in the landscape but they also reduce irrigation requirements by shading the plants beneath. Lower light intensities and cooler temperatures under trees make plants respire at lower rates and so use less and lose less water. Cooler soil temperatures in shade also translate into lower soil evaporation rates. Choosing trees to dominate the plant community is among the most strategic decisions you can take to drought-proof your landscape.

Annual flowers use more water than any other plant type. Because of their high initial planting cost most people are not willing let them die from drought. Flowering annuals should be used selectively to achieve the maximum effect with the least cost in time, money, and water. Flowering annuals are used to best effect at natural focal points such as by the front door or garden gate.

After flowers, lawns typically use more water than any other part of the landscape. Not all turfgrasses look or act the same and personal preferences play a strong role in the selection process, but in the end, tall fescue uses more water than any other turfgrass, and buffalograss is the only turfgrass we can use without having to irrigate whatsoever.

Reducing the area dedicated to turf and replacing it with ground covers is another strategic decision you can make in plant selection to drought-proof your landscape. Unfortunately, any time you use a plant less than four feet tall in the sun your weed problems will be merciless. This problem is overcome by planting more trees and creating more shade. Turf remains the best ground treatment in the sun however and buffalograss is the most drought-tolerant species we can use.

Extension programs serve people of all ages regardless of socioeconomic level, race, color, sex, religion, handicap, or national origin.

The Texas A&M System, U.S. Department of Agriculture, and the County Commissioners Courts of Texas cooperating.