Efficient Use of Water in the Garden and Landscape

Information from the Extension Horticulture Information Resource [website]
The Agricultural Program of the Texas A&M University System

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During 1984, an estimated 1.25 million acre feet of water were used by Texans in the care and maintenance and residential landscapes. Texas is expected to soon become the second most popular state in the U.S. with two-thirds of the population located in urban/suburban areas. With this growth, conservative estimates indicate water needs will increase 75 percent by the year 2000. Thus, conservation, reclamation and efficient use of water resources will become increasingly important.

Essentially all water used in Texas is derived from precipitation. Part of the precipitation flows into streams, ponds, lakes and reservoirs, and some of this eventually reaches the Gulf; another portion infiltrates the soil to the rooting zone of plants; a third portion percolates below the rooting zone and becomes groundwater.

Surface water sources are recharged rapidly, but groundwater reservoirs such as the Ogallala Aquifer, are recharged very slowly. The Ogallala Aquifer is slowly being exhausted in some areas of heavy pumping. The proportion of precipitation received in Texas that is returned to the atmosphere as water vapor is estimated to be 70 percent from non-irrigated land areas and 2 percent from irrigated areas. Most of this loss represents evaporation or transpiration from plant surfaces.

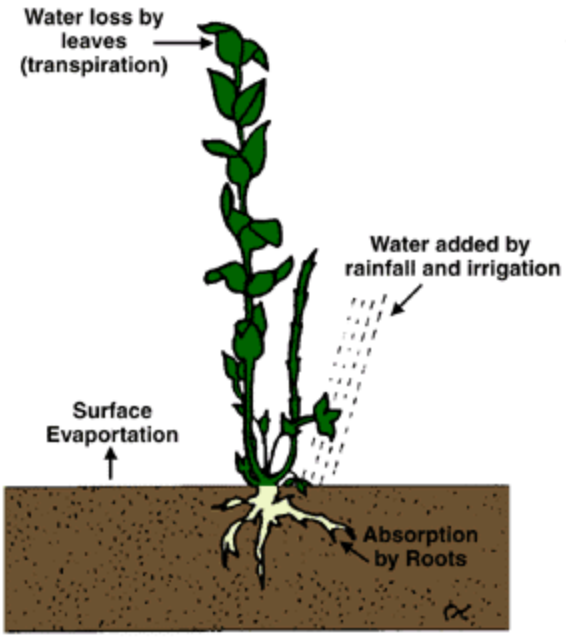

Fig. 1. The plant/soil/water cycle.

Efficient, Responsible Water Use

The danger of exhausting valuable aquifers by excessive pumping is paralleled by the threat of polluting the groundwater with industrial, agricultural and home landscape contaminants. Nitrates from excessive and untimely fertilization are especially threatening.

Plants, Soils and Water

When water is applied to the soil it seeps down through the root zone very gradually. Each layer of soil must be filled to "field capacity" before water descends to the next layer. This water movement is referred to as the wetting front. Water moves downward through a sandy coarse soil much faster then through a fine-textured soil such as clay or silt.

If only one-half the amount of water required for healthy growth of your garden or landscape is applied at a given time, it only penetrates the top half of the root zone; the area below the point where the wetting front stops remains dry as if no irrigation has been applied at all.

Once enough water is applied to move the wetting front into the root zone, moisture is absorbed by plant roots and moves up through the stem to the leaves and fruits. Leaves have thousands of microscopic openings, called stomates, through which water vapor is lost from the plant. This continual loss of water called transpiration, causes the plant to wilt unless a constant supply of soil water is provided by absorption through the roots.

The total water requirement is the amount of water lost from the plant plus the amount evaporated from the soil. These two processes are called evapotranspiration. Evapotranspiration rates vary and are influenced by day length, temperature, cloud cover, wind, relative humidity, mulching, and the type, size and number of plants growing in a given area.

Water is required for the normal physiological processes of all plants. It is the primary medium for chemical reactions and movement of substances through the various plant parts. Water is an essential component in photosynthesis and plant metabolism, including cell division and enlargement. It is important also in cooling the surfaces of land plants by transpiration.

Water is a primary yield-determining factor in crop production. Plants with insufficient water respond by closing the stomata, leaf rolling, changing leaf orientation and reducing leaf and stem growth and fruit yield.

WATERING TECHNIQUES

Proper watering methods are seldom practiced by most gardeners. They either under- or over water when irrigating. The person who under-waters usually doesn't realize the time needed to adequately water an area; instead he applies light, daily sprinklings. It is actually harmful to lightly sprinkle plants every day. Frequent light applications wet the soil to a depth of less than 1 inch. Most plant roots go much deeper. Light sprinkling only settles the dust and does little to alleviate drought stress of plants growing in hot, dry soil. Instead of light daily waterings, give plants a weekly soaking. When watering, allow the soil to become wet to a depth of 5 to 6 inches.

This type of watering allows moisture to penetrate into the soil area where roots can readily absorb it. A soil watered deeply retains moisture for several days, while one wet only an inch or so is dry within a day.

In contrast, there are those who water so often and heavily that they drown plants. Symptoms of too much water are the same as for too little. Leaves turn brown at the tips and edges, then brown all over and drop from the plant. These symptoms should be the same, since they result from insufficient water in the plant tissue.

Too much water in a soil causes oxygen deficiency, resulting in damage to the root system. Plant roots need oxygen to live. When a soil remains soggy little oxygen is present in the soil. When this condition exists roots die and no longer absorb water. Then leaves begin to show signs of insufficient water. Often gardeners think these signs signal lack of water, so they add more. This further aggravates the situation and the plant usually dies quickly.

Thoroughly moisten the soil at each watering, and then allow plants to extract most of the available water from the soil before watering again.

Fig 2. Mulching around plants is an excellent way to conserve soil moisture and encourage vigorous plant growth

MULCHING

A mulch is a layer of material covering the soil surface around plants. This covering befriends plants in a number of ways. It moderates soil temperature, thus promoting greater root development. Roots prefer to be cool in summer and warm in winter. This is possible under a year-round blanket of mulch.

Mulch conserves moisture by reducing evaporation of water vapor from the soil surface. This reduces water requirements. Mulching prevents compaction by reducing soil crusting during natural rainfall or irrigation. Falling drops of water can pound the upper 1/4 inch of soil, especially a clay soil, into a tight, brick-like mass that retards necessary air and water movement to the root zone.

Mulching also reduces disease problems. Certain types of diseases live in the soil and spread when water splashes bits of infested soil onto a plant's lower leaves. Mulching and careful watering reduce the spread of these diseases. Mulching also keeps fruit clean while reducing rot disease by preventing soil-fruit contact.

Most weed seeds require light to germinate so thick mulch layer shades them and reduces weed problems by 90 percent or more.

Any plant material that is free of weed seed and not diseased is suitable for mulch. Weed-free hay or straw, leaves, grass clippings, compost, etc., are all great. Fresh grass clippings are fine for use around well-established plants, but cure them for a week or so before placing them around young seedlings.

Mulch vegetable and flower gardens the same way. First get plants established, then mulch the entire bed with a layer 3 to 4 inches thick. Work the mulch material up around plant stems.
Organic mulches decompose or sometimes wash away, so check the depth of mulches frequently and replace when necessary.

Recent research indicates that mulching does more to help newly planted trees and shrubs become established than any other factor except regular watering. Grasses and weeds, especially bermuda grass, which grow around new plants rob them of moisture and nutrients. Mulch the entire shrub bed and mulch new trees in a 4-foot circle.

USING WATER AROUND HOME TREES AND SHRUBS

Grass and/or weeds growing under and around trees and shrubs compete for the same nutrients and water. When summer rainfall is low and less than adequate watering occurs, competition for water and nutrients imposed by weeds or grass substantially reduced tree growth, bud development and fruit size. When competition from grass is eliminated, roots are more evenly distributed, root numbers increase and they utilize a larger volume of soil. Effective soil utilization by a large root system means that fertilizer and moisture will be used more efficiently.

Remove grass and/or weeds from beneath newly planted trees and shrubs as soon as possible. The longer turfgrass grows under trees and shrubs, the greater the reduction of new growth. There is also a cumulative effect which may decrease tree growth for several years. For instance, if the growth of a tree is reduced by 20 percent for one year because of grass competition, the growth automatically is 20 percent less during the second year's growth. Grass competition reduces growth by as much as 50 percent.

If trees and shrubs are surrounded closely by tenacious grasses such as bermuda, remove or kill the turf. The safest grass killer for use near young trees and shrubs is glyphosate, which is sold as Roundup, Kleenup, Doomsday or Weed and Grass Killer.

This herbicide totally eliminates grasses and roots, yet is inactivated upon soil contact. Use a piece of wood, cardboard, etc, as a shield to prevent spray droplets from touching trunks or foliage of desirable plants. Use only the amount of glyphosate suggested on the product label.

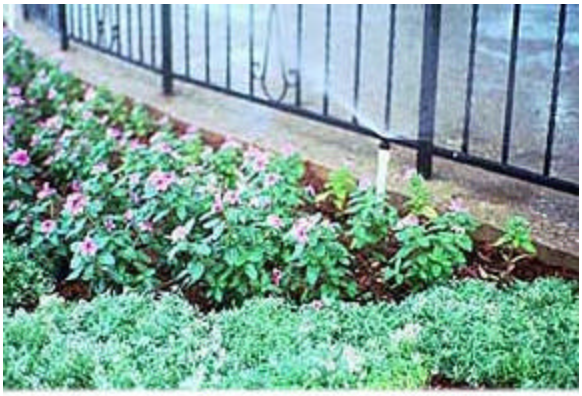

Fig. 4. A tremendous quantity of water may be used in the care and maintenance of the landscape.

Liberal watering offsets the retarding effect of grass. If the competition of grass for water can be overcome by extra watering, plants will grow much better.

Trees need a deep, thorough soaking once a week in the growing season, either from natural rainfall or supplemental irrigation. When irrigating, be thorough and allow the water to penetrate deeply. To water large trees let water flow slowly onto an area under the dripline of the tree for several hours.
Professionals indicate that large trees require more deep watering than homeowners can imagine. Remember that watering which is adequate for lawn grasses growing under trees is not adequate for actively growing trees.

Young and mature pecans, which are popular lawn trees in many areas, respond positively to irrigation. Irrigation can be very beneficial if not necessary, in June, July, and August. Irrigation often means the difference between a marketable and unmarketable product. A dry June and July may cause many or all nutlets to drop. Drought during July and early August can decrease nut size. Pecans fill during August and September. Drought during three months may cause nuts that are poorly filled. A dry September and October may prevent shuck opening and cause a high proportion of "sticktights". Drought-induced sticktights can be a serious problem.

Growth of young, nonbearing pecan trees depends on a regular supply of water from April bud break to mid-August. The frequency of irrigation varies with the system used. However, avoid applying too much water. An understanding of internal soil drainage prevents overwatering. When too much water is supplied, oxygen is forced out of the root zone and many serious problems result, including the following:

Fig 5. Pecans are popular in Texas landscapes and require adequate water if they are to be productive

- Growth stops.
- Minerals are not absorbed.
- Leaves turn yellow and remain small.
- Roots begin to die.

A guide for young tree irrigation is shown in Table 2. If soil drainage is poor, apply 50 percent of this volume.

All bearing pecan trees respond positively to irrigation. In general, pecans in good soil bear with only 32 inches of rainfall from August to October. However, more water increases tree health and regular production.

Table 2. Average weekly water requirements in gallons per tree.

Age	April	May	June	July	August
1-year old trees	7	7	14	28	28
2-year-old trees	14	14	28	54	54
3-year-old trees	28	28	54	112	112
4- to 7- year-old trees	56	56	112	224	224

Pecans require 1 inch of water each week from April to October; the optimum amount is 2 inches per week.

A bearing pecan tree has its greatest water needs during the following periods:

- March, immediately before growth begins.
- June, when nuts begin to size
- Late July, when kernels begin to fall.

Severe drought during one of these four periods can cause complete crop failure or serious loss. If these occur during the last period, a poor crop results the following year.
Pecan roots can dry out and die if no rain occurs from September to April. Therefore, consider a mid-winter irrigation to ensure good tree health and regular production.

LAWNS

Water needs vary considerably among the turfgrasses. Consider this when establishing a lawn, for it may significantly reduce irrigation needs during the summer. Of the common turfgrasses tall fescue requires the most water and buffalo-grass the least. St. Augustine, hybrid bermuda grass and common bermuda grass have intermediate water needs.

Lightly water newly seeded or sprigged lawns at frequent intervals. Keep the seed or sprigs moist but not saturated during this initial growth period. This may require watering four or five times on hot, windy days.

The first 10 days to 2 weeks are especially critical. If young plants dry out, they may die. After a couple of weeks root system development should be well under way and the watering frequency can be slowly reduced. At about 1 month after seedling or sprigging the lawn it should be treated as an established lawn. Purple or red colored bermuda grass may indicate seedlings are overwatered. If this occurs, reduce watering and plants usually recover.

Water newly sodded lawns much like established lawns except more frequently. After the sod is applied, soak it with enough water so that the soil under the sod is wet to a depth of 2 to 3 inches. Each time the sod begins to dry out, resoak it. Roots develop fairly rapidly and within 2 weeks or so the sod can be treated like an established lawn.

Ideally, a lawn should be watered just before it begins to wilt. Most grasses take on a dull purplish cast and leaf blades begin to fold or roll. Grass under drought stress also shows evidence of tracks after someone walks across the lawn. These are the first signs of wilt. With careful observation and experience, one can determine the correct number of days between waterings. Common bermuda grass lawns can go 5 to 7 days or longer between waterings without loss of quality.

- Early morning is considered the best time to water. The wind is usually calm and the temperature is low so less water is lost to evaporation. The worst time to water is late evening because the lawn stays wet all night, making it more susceptible to disease.

- When watering a lawn, wet the soil to a depth of 4 to 6 inches. Soil type affects the amount of water needed to wet soil to the desired depth.

- It takes about 1/2 inch of water to achieve the desired wetting depth if the soil is high in sand, and about 3/4 inch of water if the soil is a loam. For soils high in clay, an inch of water is usually necessary to wet the soil to the desired depth.

- If waterings are too light or too frequent the lawn may become weak and shallow-rooted, which in turn makes it more susceptible to stress injury.

Use the following steps to determine the amount of water your sprinkler or sprinkler system puts out and check its distribution pattern at the same time.

- Determine the rate at which your sprinkler applies water to the lawn.
    - Set out three to five empty cans in a straight line going away from the sprinkler. Set the last can near the edge of the sprinkler's coverage.
    - Run the sprinkler for a set time such as 1/2 hour.
    - Measure the amount of water in each can.
    - Each can will contain a different amount of water. Usually, the can closest to the sprinkle will have the most water. The sprinkler pattern must overlap to get an even wetness of the soil. Use this information to find out how long it takes your sprinkler to apply 1 inch of water. For example, if you find that most cans contain about 1/4 inch of water after the sprinkler runs 1/2 hour, it would take 4 x 1/2 or 2 hours to apply 1 inch.

- Run the sprinkler or sprinkler system long enough to apply at least 1 inch of water or until runoff occurs. If runoff occurs first:
    - Stop sprinkler and note running time.
    - Allow water to soak in for 1/2 hour.
    - Start sprinkler.
    - If runoff occurs, repeat above steps until at least 1 inch of water has been applied and allowed to soak into the soil.

- Do not water again until the lawn has completely dried out. (This usually takes 5 or 6 days.)
    - Apply enough water to wet the soil to a depth of 4 to 6 inches.
    - Avoid frequent light applications of water.
    - Water in early daylight hours.
    - Select a turfgrass with a low water requirement.
    - Avoid using soluble nitrogen fertilizers. (They promote high growth rates which, in turn, increase water requirements of the plant.)

Many soils will not take an inch of water before runoff occurs. If this is a problem with your lawn, try using a wetting agent, also called a surfactant, which reduces the surface tension of water making it "wetter." This "wetter" water runs into the soil at a faster rate and goes deeper than water in a non-treated soil.

There are a number of wetting agents available; apply them according to directions on their labels. If this does not solve to runoff problem, it may be necessary to apply 1/2 inch one day and 1/2 inch the next day.

VEGETABLE GARDENS

Generally speaking, if you keep your tomatoes happy, the rest of the vegetables will receive enough water. Obviously, irrigating a garden containing many kinds of vegetables is not simple. Early in the season when plants are young and have small root systems, they remove water from the soil near the center of the row. As the plants grow larger, roots penetrate into more soil volume and withdraw greater quantities of water faster.

In sandy loam soils, broccoli, cabbage, celery, sweet corn, lettuce, potatoes and radishes have most of their roots in the top 6 to 12 inches of soil (even though some roots go down 2 feet) and require frequent irrigation of about 3/4 to 1 inch of water. Vegetables which have most of their root systems in the top 18 inches of soil including beans, beets, carrots, cucumbers, muskmelons, peppers and summer squash. These vegetables withdraw water from the top foot of soil as they approach maturity and can profit from 1 to 2 inches of water per irrigation.

A few vegetables, including the tomato, cantaloupe, watermelon and okra, root deeper. As these plants grow they profit from irrigations of up to 2 inches of water.

For fruiting crops, the most critical growth stage regarding water deficit is at flowering and fruit set. Moisture shortage at this stage may cause abscission of flowers or young fruits, resulting in insufficient fruit for maximum yield.

The longer the flowering period, the less sensitive a species is to moisture deficits. For example, the relative drought resistance of beans during flowering and early pod formation is the result of the lengthy flowering period --30 to 35 days with most varieties. Slight deficits during part of this period can be partially compensated for by subsequent fruit set when the water supply is adequate. More determinate crops such as corn or processing tomatoes are highly sensitive to drought during the flowering period.
In terms of food production, the period of yield formation or enlargement of the edible product (fruit, head, root, tuber, etc.) is critical for all vegetables and is the most critical for non-fruiting crops. Moisture deficits at the enlargement stage normally result in a smaller edible portion because nutrient uptake and photosynthesis are impaired.

Irrigation, especially over irrigation during the ripening period may reduce fruit quality. Ample water during fruit ripening reduces the sugar content and adversely affects the flavor of such crops as tomatoes, sweet corn and melons. Moisture deficits at ripening do not significantly reduce yield of most fruit crops, irrigate at this time with extreme caution.

WATER RESPONSIBILITY
Water is a limited and fragile resource. Each gardener utilizes a small part of the total water consumed, but the total use by all gardeners is significant. Irrigating home gardens and landscapes is considered a luxury use of water by many people. Non-essential use of water implies a special responsibility on the part of gardeners to efficiently use the resource and to protect its quality.

This responsibility is fulfilled by following the recommendations in this bulletin concerning water conservation and to further avoid practices that contribute to surface and groundwater contamination. Among the threats to pure water are improper use of fertilizers, pesticides and soil erosion. Label instructions on all pesticides and fertilizers must be followed faithfully and water run-off due to excess irrigation should be minimized.