EXTENSION
College of Agriculture,
Biotechnology & Natural Resources

IP-22-02

Watering Trees in Hot, Dry Home Landscapes

By Heidi A. Kratsch, Sustainable Horticulture Specialist,
University of Nevada, Reno Extension

Droughts in the western U.S. are becoming more frequent and severe. They are particularly hard on our trees. Learning how to properly water your landscape trees can lower your monthly water bill and keep your home and landscape cool and livable.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

Chapter 1. The Role of Trees in Your Landscape……………….4

Chapter 2. How Trees Take Up Water……………………………7

Chapter 3. How Much Water Do Trees Need?………………...13

Chapter 4. Effective Strategies for Irrigating Trees……………19

Chapter 5. Other Ways to Care for Landscape Trees………...25

Chapter 6. How to Do a Turf Conversion………………………27

Chapter 7. Selecting Trees That Require Less Water………...32

Top-10 Drought-Tolerant Trees for Northern Nevada..................... 33

Top-10 Drought-Tolerant Trees for Southern Nevada……………....38


Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

CHAPTER 1
The Role of Trees in Your Landscape

A tree is the most valuable resource in your landscape.

Trees...

- ⇒ Provide privacy or block unwanted views.
- ⇒ Shade our homes and cool our cities.
- ⇒ Reduce water evaporation from neighboring plants.
- ⇒ Decrease runoff of water into our sewer systems.
- ⇒ Block wind and reduce dust.
- ⇒ Buffer noise.
- ⇒ Help us use less water because they use water efficiently.
- ⇒ Help us use less energy by cooling our homes in the summer. Evergreen trees protect our homes from cold winds in winter, and deciduous trees lose leaves to provide passive solar heating.
- ⇒ Beautify our landscapes and increase the value of our homes.
- ⇒ Are an investment in the future … let's learn how to care for them!

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

We Are Losing Our Urban Trees

In Nevada, the trend has been to remove the lawn to conserve water and save on the water bill. This has led to the decline of trees in Las Vegas, Reno and other urban areas in U.S. western states. Although at first glance it doesn't look like this tree is struggling, can you pick out the subtle clue that this tree is under stress?

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

The heavy cone production seen at the top of this blue spruce is a sign that the tree is under stress and is preparing to pass on its genes to the next generation before it dies.

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

This blue spruce suffered for years without irrigation before it entered a death spiral. Nothing can be done to save this tree, but new trees planted in this landscape must be provided an irrigation system designed for the unique water needs of trees.

Trees often struggle for years without obvious signs of stress, until they finally fail. This was a blue spruce. The lawn and irrigation were removed to save water, but the owner did not install an irrigation system to the tree. It is a good idea to remove water-hungry lawns to conserve water, but the trees left behind must be managed properly to keep them alive and functional.

Trees Use Water More Efficiently Than Do Lawns

This landscape uses **72,875 gallons** of water annually.

- ⇒ 4,850 square feet
- ⇒ 15% hardscape
- ⇒ **45% turfgrass**
- ⇒ 15% shrub beds
- ⇒ 21% perennial beds
- ⇒ 5% groundcover plants
- ⇒ 12 trees
- ⇒ Watered using pop-up sprinklers

This landscape uses only **22,610 gallons** of water annually.

- ⇒ 4,870 square feet
- ⇒ 20% hardscape
- ⇒ **0% turfgrass**
- ⇒ 60% shrub beds
- ⇒ 20% perennial beds
- ⇒ 0% groundcover plants
- ⇒ 18 trees
- ⇒ Watered using a drip irrigation system

Source: Rosenberg et al. 2010. Value Landscape Engineering: Identifying costs, water use, labor and impacts to support landscape choice. Journal of the American Water Resources Association.

CHAPTER 2
How Trees Take Up Water

Although trees take up water through their roots, the uptake process begins at the tree's leaf surfaces. As water evaporates from the surface of leaves, capillary action pulls water molecules from below. This suction process continues in a near continuous stream within the water-conducting tubes inside the branches and the trunk, until it reaches the roots. Water uptake will continue as long as moisture is present in the soil around the tree's root zone. Trees lose water faster when the air is hot and dry and on windy days, when the wind blows across leaf surfaces. So, water evaporation from leaves stimulates water uptake by the roots. This process is called transpiration. **Evapotranspiration** refers to the combined processes of water evaporation from the earth's surface and of transpiration from plants into the atmosphere. Evapotranspiration will be discussed more on Page 12.

Trees Lose Water Through Tiny Mouth-Shaped Pores Called Stomata on the Underside of Their Leaves

Photo credit: Larry Korhnak, University of Florida

What our eyes can see

Lauren Holden, Wellcome Collection CC BY 4.0

What our eyes cannot see

Transpiration, or water movement through plants, begins at the leaf surface. Water loss from leaves stimulates water uptake from the soil by the tree's roots. Dry, hot air moving across leaf surfaces increases the rate of water loss from leaves. Some trees are able to slow water loss from their leaves as a result of genetic adaptations to dry, hot climates. Some examples include:

- ⇒ Leaf size: Smaller leaves lose less water.
- ⇒ Leaf color: Blue leaves deflect heat and lose less water.
- ⇒ Leaf orientation: Vertically oriented leaves (leaves pointing downward) are protected from the hot sun and wind.
- ⇒ Extensive root system: Deep, extensive root systems give trees access to a larger water supply.

Examples of plants with these characteristics are on Page 9.

The reduced size of **Rocky Mountain juniper** (*Juniperus scopulorum*) leaves lowers the leaf surface area to reduce water loss. This tree is native to the western U.S. and is very drought-tolerant. It does well in cultivated landscapes, but it can be a wildfire hazard if planted too close to homes.

The blue-green leaves of **Fremont barberry** (*Mahonia fremontii*) reflect high-energy solar radiation in the blue wavelength. This lowers leaf temperatures and reduces water loss. Native to the southwestern U.S., this drought-tolerant shrub can survive without irrigation once established.

Common hackberry (*Celtis occidentalis)* is highly recommended for low-water landscapes in the West. Its leaves are oriented vertically, so that exposure to direct sunlight is minimized. This strategy protects trees from losing too much water in hot environments.

Gambel oak (*Quercus gambelii)* is native to the western U.S. Its relatively deep roots provide access to a larger water supply, which protects trees from drought-related dieback. This multi-trunked tree is best for use on tough, dry sites, where its glossy green leaves turn reddish in fall, providing a handsome background to the landscape.

Photo credits: Roger Kjelgren, University of Florida IFAS

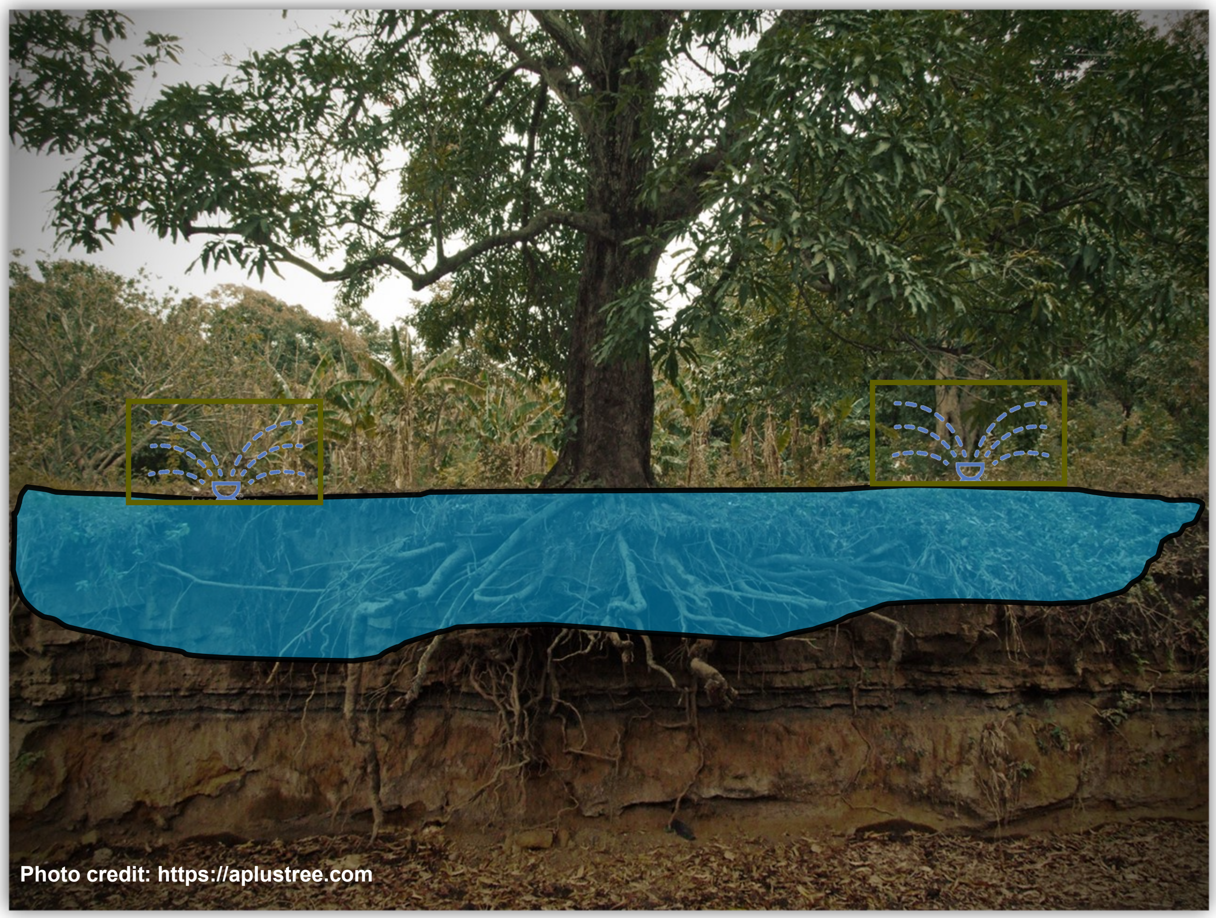
Branch dieback can occur when the tree root zone dries out before enough water has reached the tops of the branches and roots die. The branches begin to die from the tips down, leaving bare leafless areas that are unable to process the sun's energy for growth. These trees become less effective at providing shade and cooling your home. They also become more susceptible to insects, such as bark beetles and borers, which attack weakened trees, causing premature leaf drop and eventual death of the tree.

Early symptoms of drought stress are visible on the leaves: wilting, yellowing, early fall color, scorch (browned or burned appearance) and early leaf drop. Bark cracking can also occur in thin-barked trees, such as maple.

Long-term symptoms include: dead or dying branches, thinning foliage, smaller than normal leaves, slowed growth rate, increased susceptibility to bark beetles and borers, and inability to recover from wounds (such as pruning cuts or storm damage).

- ⇒ Branch dieback is often caused by too little moisture in the root zone for the tree to maintain all of its branches.
- ⇒ The stressed tree becomes less effective at shading and cooling your home and landscape.
- ⇒ Trees weakened by drought stress become susceptible to bark beetles and borers.
- ⇒ Drought-stressed trees may not show symptoms for several years.

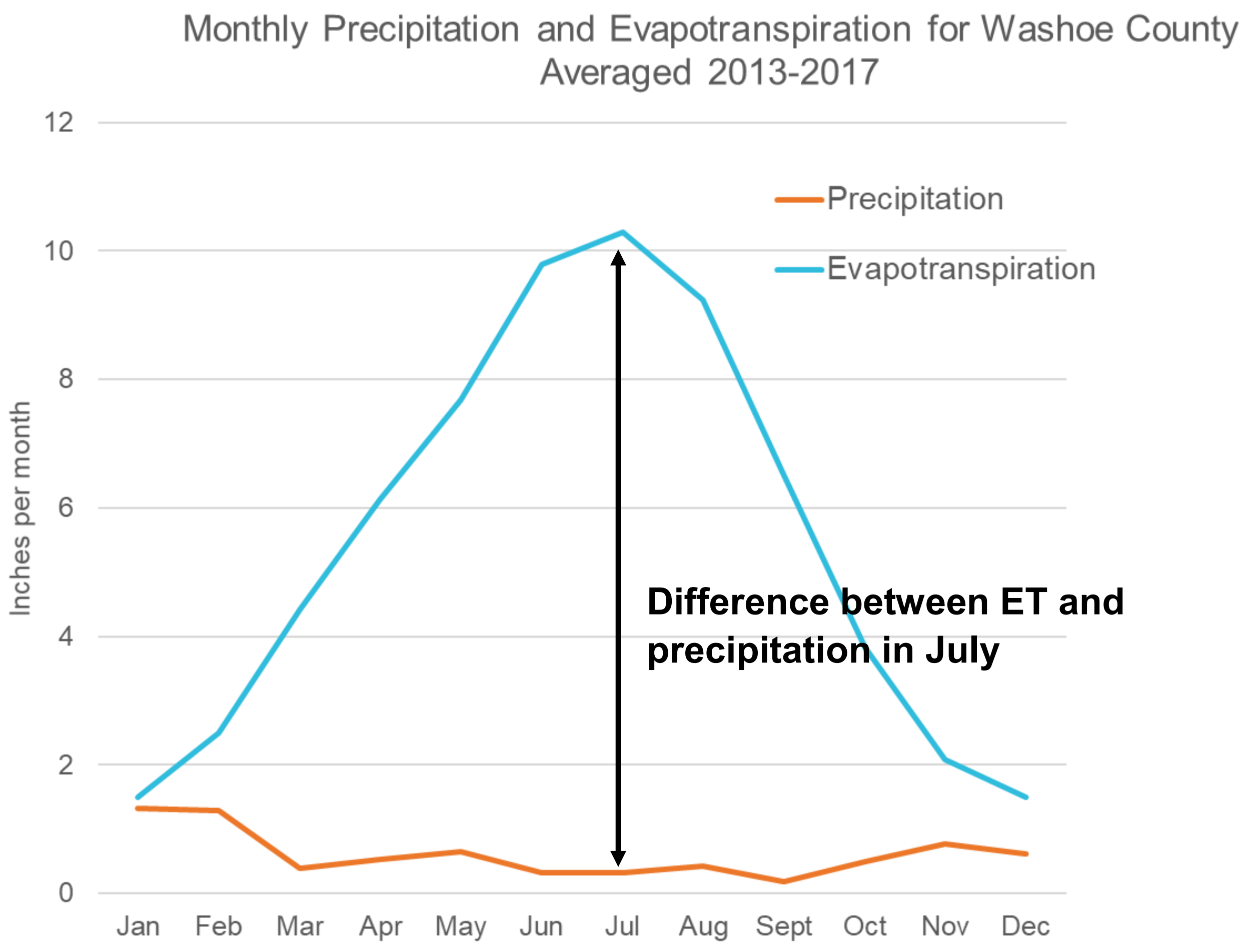

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension



Helping your landscape trees thrive begins with knowing where the water-absorbing roots are, so the water you provide is effective in meeting the tree's water needs. The water-absorbing roots are concentrated in the top 2 feet of soil. These roots extend out to the edge of the tree's leafy canopy and will grow laterally beyond the leafy canopy unless physically obstructed. There are few water-absorbing roots within 6 inches of the trunk. When you irrigate, you need to wet 60% to 75% of the area of the root zone. This is especially true in a state such as Nevada, where little to no precipitation falls during the growing season. Most of Nevada receives less than 10 inches of precipitation per year, and in western Nevada, most of that falls as snow during the winter. We get little to no precipitation during the heat of summer, when trees most need water. In southern Nevada, the monsoon season lasts from June 15 to Sept. 30, but rain falls so quickly during a monsoon that the dry soil cannot absorb the water, and most of it runs off, causing flash floods.

The Difference Between Evapotranspiration and Precipitation Defines How Much Water is Needed

Evapotranspiration (ET) is the loss of water from plants and from other surfaces due to weather conditions. It is increased by light, heat, low humidity and wind. **Precipitation** falls as rain or snow. ET and precipitation are measured in inches. The graph below shows the great disparity between ET and precipitation during the time when trees need water the most.



The difference between ET and precipitation varies in Nevada from county to county and from year to year. It's not important to know exactly how much they differ. The point is: **Landscape trees in our state that are not properly irrigated will fail!**

CHAPTER 3
How Much Water Do Trees Need?

Proper irrigation of trees requires you to know two things:

⇒ **Duration**: **How long** to run your irrigation system.

This means how many minutes or hours to run your irrigation system. It is determined by how deep into the soil you want the water to go. Mature trees have water-absorbing roots as deep as 18 inches to 24 inches.

⇒ **Frequency**: **How often** to run your irrigation system.

This means how many times a week or month to run your irrigation system and is determined by the air temperature. Warmer air temperatures require irrigating more often to prevent the soil in the root zone from drying out.

Recommended Watering Depth and Frequency

Plant Type	Watering Depth	Watering Frequency
Mature trees	18 to 24 inches	Every 1 to 2 weeks
Shrubs & perennials	12 to 18 inches	2 to 3 days per week
Annuals	8 to 12 inches	3 days per week
Turfgrass lawns	6 to 8 inches	3 days per week

Watering frequency depends on air temperature. The listed frequency covers much of the growing season. Watering frequency should be increased during exceptional heat and decreased during cooler times of the year (late fall and early spring).

This information is valid for most of Nevada but may need to be adjusted for the southern part of the state.

Tip: You should <u>not</u> irrigate your trees the same way you irrigate your turfgrass lawn!

Other Factors That Affect Tree Water Needs: Microclimates

Tree water needs depend primarily on the evapotranspiration rate of a given region—that is, how much water evaporates from the soil and transpires through the plants in a given region. Although knowing this regional ET rate can be helpful in calculating the needs of individual trees or groups of trees in a landscape, the rate can also be affected at a smaller scale by many localized climate factors. The localized climate in a smaller area that differs from the overall climate of a region is called a **microclimate**.

Microclimate effects on trees can be substantial and can account for trees in one part of a landscape doing worse than trees in another part of the same landscape. Microclimates can be caused by:

⇒ **Directional exposure to sunlight**—a southern or western exposure to sunlight is more intense than a northern or eastern exposure.

⇒ **Exposed hardscaping or rock mulch**—causing increased loss of water from plants due to reflected heat and/or light.

⇒ **Protection provided by buildings or neighboring plants**—lowering the rate of evapotranspiration by blocking the sun or the wind.

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

Trees planted in areas with exposed hardscapes or rock mulch should be irrigated more frequently. Trees planted in shady areas should be irrigated less frequently.

Calculating Tree Water Needs for Northern Nevada

The U.S. Environmental Protection Agency (EPA) provides peak month ET data for each zip code in the U.S. The data below is based on EPA data collected 1961-1990.

As of 2022, Reno and Las Vegas were two of the fastest warming cities in the U.S, so we used the highest peak month ET provided by the EPA for the zip codes in each region.

Tree water needs in gallons per week =

Weekly evapotranspiration (ET) x water-use factor (WF) x root-zone area x 0.623, where:

⇒ ET is in inches.

⇒ Water-use factor (WF) is shown as a decimal fraction of ET.

⇒ Root-zone area is in square feet (see Page 18).

⇒ 0.623 is a conversion factor: gallons of water applied when you irrigate 1 square foot of ground with 1 inch of water.

Gallons of Water Per Week (N. Nevada)						
	Diameter of Root-zone Area in Feet					
Water-use Factor (WF)	**8**	**10**	**15**	**20**	**25**	**30**
High-water-use (WF 0.8)	54	85	191	340	531	764
Low-water-use (WF 0.5)	34	53	119	212	332	478

Based on peak month ET of 9.32 inches. Divide peak month ET by 4.3 to get weekly ET of 2.17 inches. Visit www.epa.gov/watersense/water-budget-data-finder to find peak month ET for your zip code.

Calculating Tree Water Needs for Southern Nevada

The U.S. Environmental Protection Agency (EPA) provides peak month ET data for each zip code in the U.S. The data below is based on EPA data collected 1961-1990.

As of 2022, Reno and Las Vegas were two of the fastest warming cities in the U.S, so we used the highest peak month ET provided by the EPA for the zip codes in each region.

<u>Tree water needs in gallons per week</u> =

Weekly evapotranspiration (ET) x water-use factor (WF) x root-zone area x 0.623, where:

⇒ ET is in inches.

⇒ Water-use factor (WF) is shown as a decimal fraction of ET.

⇒ Root-zone area is in square feet (see Page 18).

⇒ 0.623 is a conversion factor: gallons of water applied when you irrigate 1 square foot of ground with 1 inch of water.

Gallons of Water Per Week (S. Nevada)						
	Diameter of Root-zone Area in Feet					
Water-use Factor (WF)	8	10	15	20	25	30
High-water-use (WF 0.8)	83	130	292	520	812	1,170
Low-water-use (WF 0.5)	52	81	183	325	508	731

Based on peak month ET of 14.27 inches. Divide peak month ET by 4.3 to get weekly ET of 3.32 inches. Visit www.epa.gov/watersense/water-budget-data-finder to find peak month ET for your zip code.

On first glance, it seems that trees use a lot of water. But, trees are more efficient water users than are turfgrasses. When you compare the water requirements of a tree with the water requirements of a turfgrass lawn with an equivalent root-zone area, you quickly see why replacing lawns with trees can help you conserve landscape water and save money on your monthly water bill:

Monthly Tree Water Requirement (WF 0.5)	Monthly Lawn Water Requirement (WF 0.8)
2,903 gallons per month	4,645 gallons per month
Based on planting a drought-tolerant tree (WF 0.5), a peak month ET of 9.32 inches and 1,000 square feet of root-zone area.	

It is pretty easy to understand the concept of lawn root-zone area, but how do you calculate the root-zone area of a tree? It helps to know where the roots of your trees are. Most tree roots are in the top 2 feet of soil, but they can spread out to more than twice the diameter of the tree's crown.

If you have a tree or trees planted in your lawn, it is likely that the tree roots are intermingled with the lawn roots, and the tree is benefitting from your lawn irrigation. But even if your tree is in a lawn, most of the water-absorbing roots are in the ground beneath the canopy of the tree's crown. So, when calculating the water needs of a tree, the following equation is used:

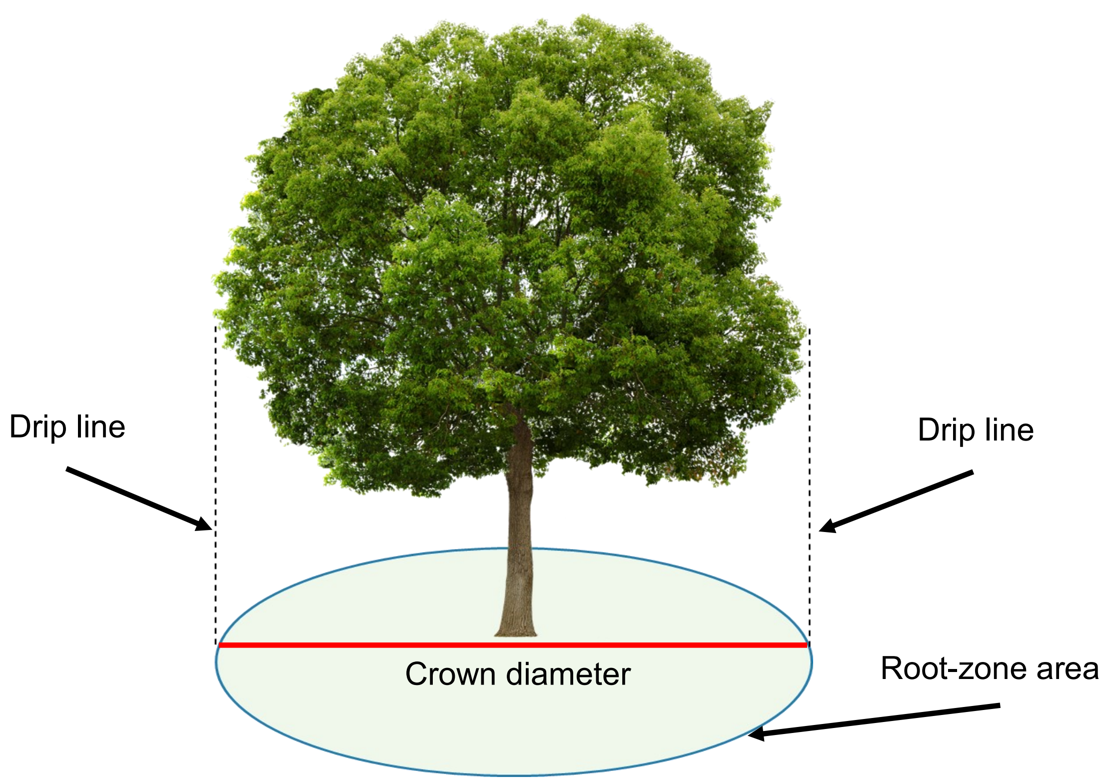
Crown diameter^2 x 0.7854 = Tree root-zone area

Let's look at an example:

Crown diameter = 10 feet, so…

10^2 (10 x 10) x 0.7854 = 78.54 square feet

This tree's root-zone area is 78.54 square feet.



Although trees in a lawn can thrive, it is not ideal. First, the tree's roots have to compete with the lawn roots for water, and trees almost always lose that battle. Second, trees need deep watering, and lawns are irrigated shallowly because of their shallow roots, so irrigation of trees in a lawn is less efficient. The lawn within the root zone of trees should be removed and that area mulched with organic matter to foster fine, water-absorbing root development.

CHAPTER 4
Effective Strategies for Irrigating Trees

Drip Irrigation

We recommend drip irrigation for trees, because it supplies water directly to the root zone slowly enough that the roots can use the water before it leaches beyond the rooting zone. This is important in sandy soils. But, it can be equally important in heavy, clay soils to minimize potential runoff.

Drip Irrigation Benefits:

⇒ Slow application rate for greater root uptake.

⇒ Measured in gallons per hour (gph) instead of gallons per minute (gpm) to reduce runoff onto paved surfaces.

⇒ Delivered at low pressures (10-30 psi), so you must use a pressure regulator.

⇒ Reduced loss of moisture to evaporation.

⇒ Reduced leaching below the root system.

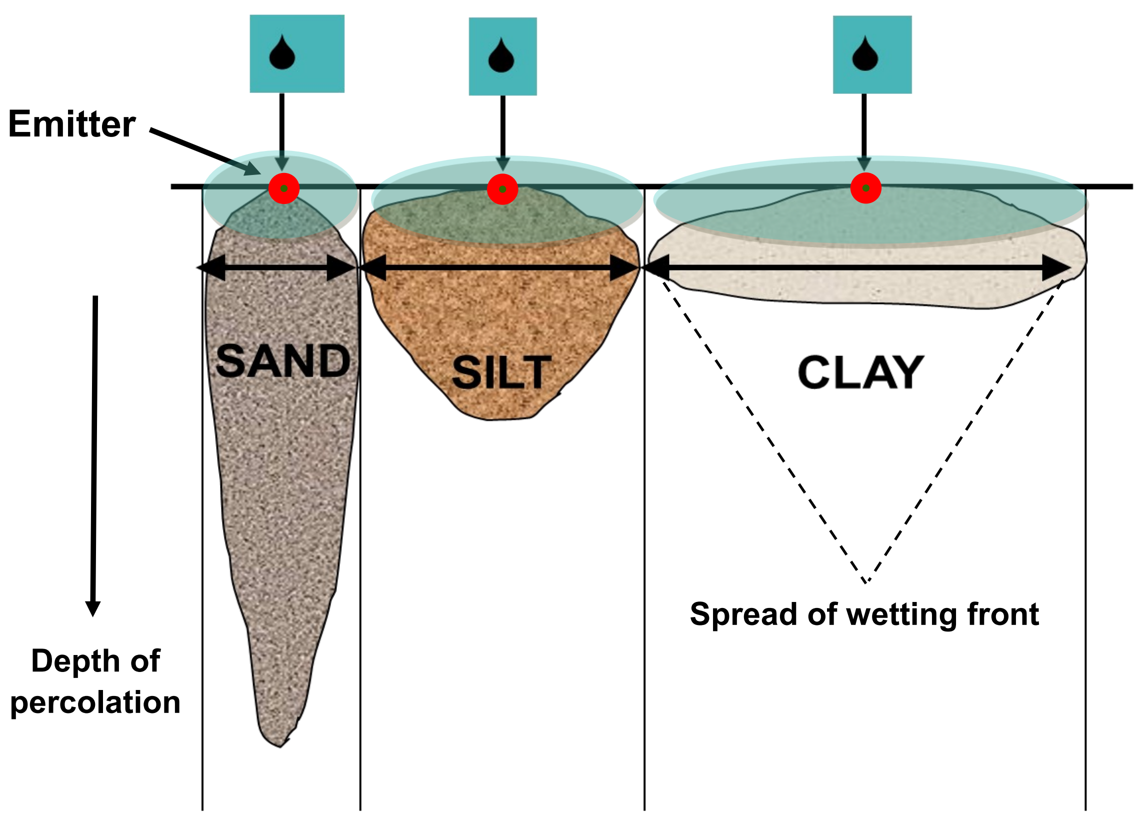
⇒ Irrigation system efficiency of 80% to 90% (sprinkler systems are less than 75% efficient).

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

How Many Drip Emitters Should I Use?

How many emitters you use and how long you irrigate will depend on the texture of your soil. The line drawing below shows how water moves through soils of different textures. Water moves quickly through a sandy soil, but the wetting front doesn't cover much surface area. Sandy soils are prone to leaching. Water moves slowly through a clay soil, but the wetting front is wider. Clay soils are prone to runoff.

- ⇒ **Sandy soils need more emitters spaced closer together to cover a tree's root system.**
- ⇒ **Clay soils need fewer emitters spaced farther apart to provide equivalent coverage of the root system.**
- ⇒ **Use higher output emitters and shorter runtimes for sandy soils.**
- ⇒ **Use lower output emitters and longer run times for clay soils.**



How Long Should I Run the Irrigation System?

The charts below show suggested length of tubing and run times for individual trees of different sizes. It is assumed that your **trees are low-water-use (WF 0.5)**. These run times are calculated for the hottest time of the year. *Irrigate less often during cooler times of the year*. Test the depth of water penetration in the soil using a soil probe or long screwdriver, and adjust irrigation run times accordingly.

Weekly Irrigation Run Times for Northern Nevada

Size of Tree	**Clayey Soil .6 gph emitters 18 in. apart**	**Sandy Soil .9 gph emitters 12 in. apart**
Large tree	133 emitters for 5 hrs.	200 emitters for 2.25 hrs.
Medium tree	66 emitters for 4.2 hrs.	100 emitters for 1.8 hrs.
Small tree	33 emitters for 2.25 hrs.	50 emitters for 1 hr.

Weekly Irrigation Run Times for Southern Nevada

Size of Tree	**Clayey Soil .6 gph emitters 18 in. apart**	**Sandy Soil .9 gph emitters 12 in. apart**
Large tree	133 emitters for 7.75 hrs.	200 emitters for 3.45 hrs.
Medium tree	66 emitters for 6.4 hrs.	100 emitters for 2.8 hrs.
Small tree	33 emitters for 3.4 hrs.	50 emitters for 1.5 hrs.

- ◊ Emitter flow rate (gph) x number of emitters x number of hours = Gallons per tree
- ◊ Use 1/2-inch drip tubing with inline pressure-compensating emitters.
- ◊ Wrap drip tubing in concentric circles around the drip line of the tree.

Number of Emitters in Drip Tubing With Different Emitter Spacing

1/2-inch Inline Tubing Length	18-inch Emitter Spacing	12-inch Emitter Spacing
200 feet	133 emitters	200 emitters
100 feet	66 emitters	100 emitters
50 feet	33 emitters	50 emitters

- ◊ Emitter flow rate (gph) x number of emitters x number of hours = Gallons per tree
- ◊ Use 1/2-inch drip tubing with inline pressure-compensating emitters.
- ◊ Wrap drip tubing in concentric circles around the drip line of the tree.

Proper irrigation of at least 60% to 75% of the tree's root zone out to the drip line minimizes branch dieback, prevents tree stress and reduces the risk of disease and secondary pest infestations, such as spider mites and wood-boring insects.

Trees in a grove are more resilient during drought, because they can share water through their root systems, and they can shade one another from excess light and heat. Organic mulch helps by fostering symbiotic associations in the root zone.

For trees planted within a grove or oriented in a row, measure the total area of rooting space within the grove, and calculate water needs for roots covering the entire area:

<u>Water needs for tree roots in a grove or in a row</u> =

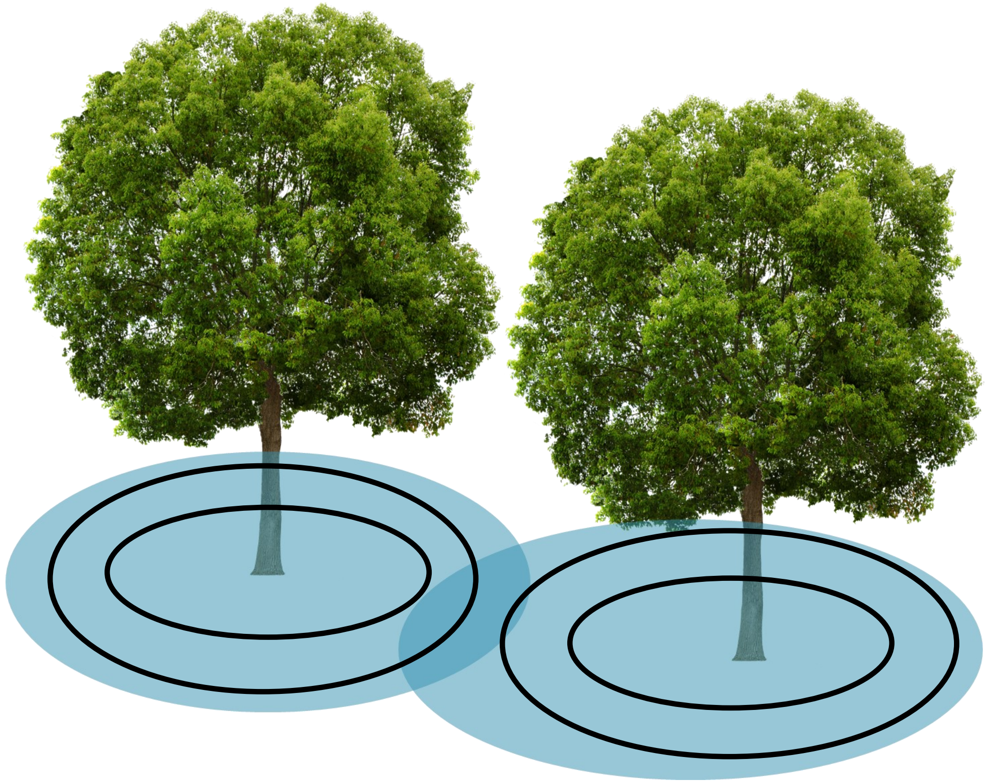
Weekly evapotranspiration (ET) x water-use factor (WF) x root-zone area (within grove or row) x 0.623

⇒ ET is in inches.

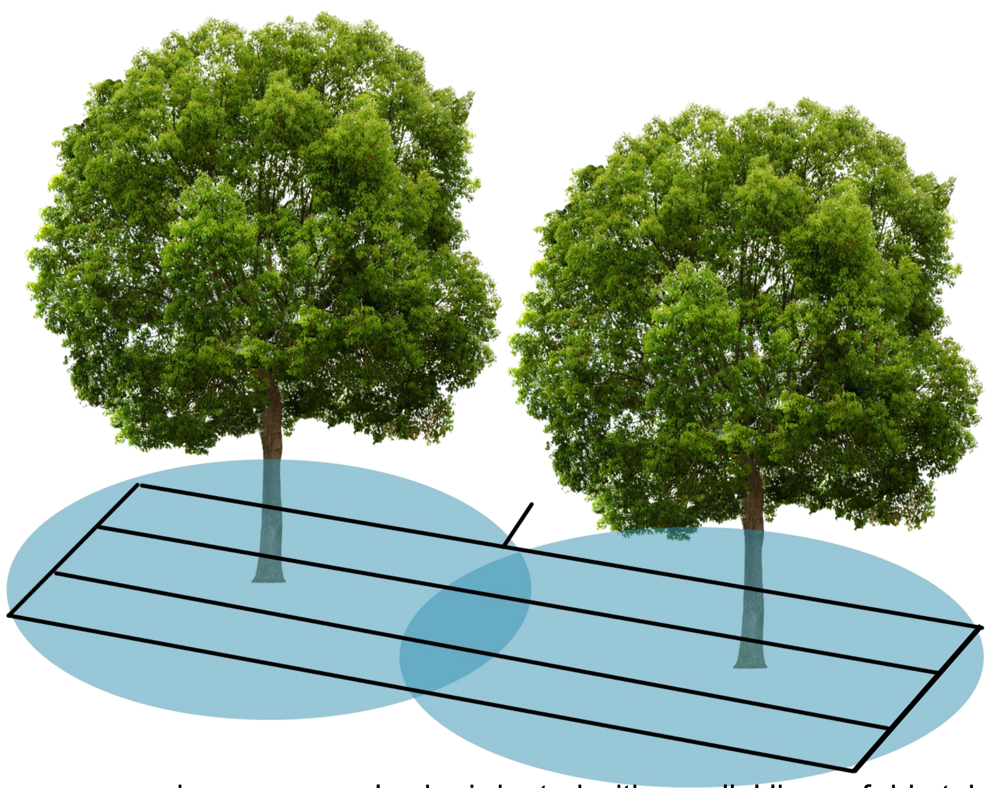
⇒ Water-use factor (WF) is shown as a decimal fraction of ET.

⇒ Root-zone area is in square feet (length in feet x width in feet) (see Page 18).

⇒ 0.623 is a conversion factor: gallons of water applied when you irrigate 1 square foot of ground with 1 inch of water.



Trees planted in a grove or in a row can be irrigated individually by placing drip tubing in concentric circles around each tree. The most critical area to irrigate is the root-zone area just inside and just beyond the trees' canopies.



Trees in a grove or in a row can also be irrigated with parallel lines of drip tubing, oriented in a closed loop and connected to the main irrigation line.

CHAPTER 5
Other Ways to Care for Landscape Trees

⇒ **Do not fertilize trees during hot, dry conditions or drought.**

Providing fertilizer when root-zone water is limited stresses the tree. Without adequate water, the roots cannot take up the fertilizer, so it remains in the soil. This increases the solute concentration around the tree roots, creating a “chemical drought” that pulls water away from the roots.

⇒ **Limit pruning to removal of dead wood or crossing branches during the heat of summer**.

If you must prune during the hot, dry season, limit it to removal of dead wood or crossing branches that can cause branches to rub against one another, damaging the bark and underlying tissues.

Removing live wood from a tree stimulates growth. Trees with inadequate water will not be able to support the new growth and will suffer even greater damage from water stress.

⇒ **Mulch around your trees at least out to the drip line**.

Organic mulches are best, because they hold water in the soil better than inorganic mulches. Organic mulches also keep the soil cooler than inorganic mulches. Organic mulches condition the soil as they decompose, increasing the water-holding capacity and providing nutrient sources for beneficial soil organisms. Inorganic mulches, such as rock or decomposed granite, are fine for trees that are drought-tolerant and adapted to low soil organic matter.

Organic mulches attract and support symbiotic associations between trees and soil micro-organisms. Tree root associations with **mycorrhizal fungi** allow root access to a wider area within the soil profile, which increases uptake of water and nutrients. Root associations with **symbiotic soil bacteria** allow trees to benefit from the capacity of these bacteria to fix atmospheric nitrogen and transport it to the tree.

Mulch Options for Trees

INORGANIC MULCHES
(2-3 inches deep)

Decomposed granite

Gravel or rock mulch

Wood chips

Shredded bark

ORGANIC MULCHES
(3-5 inches deep)

CHAPTER 6
How to Do a Turf Conversion

Turf reductions and conversions are becoming popular nationwide, as people become more aware of what a limited resource water is and how much more sustainable a landscape is when you provide greater diversity in your planted areas.

What a turf conversion IS:

A turf conversion (or reduction) is replacement of some or all of your turfgrass lawn with trees, shrubs and perennials to:

⇒ Reduce water consumption and waste.

⇒ Protect water quality by reducing use of lawn chemicals.

⇒ Enhance the health of your soils by amending and mulching your soils with organic materials.

⇒ Protect pollinators and other wildlife by using a diversity of flowering landscape plants.

What a turf conversion IS NOT:

A turf conversion is not replacing your turfgrass lawn with hardscaping or inorganic mulch. Hardscaping and some inorganic mulches, especially used beneath tree canopies, reflect a lot of heat and light from the sun. Even when not used around trees, hardscaping can heat up your landscape and increase home cooling costs and energy use. We consider artificial turf a form of inorganic mulch because artificial turf does not decompose nor add to the organic component of soils, and it gets extremely hot when exposed to sunlight. Temperatures of 120 F to 180 F have been recorded. This can be disastrous to trees in the vicinity.

Tree planted near artificial turf

How to Do a Turf Conversion

So, you have decided to do a turf reduction or conversion. Congratulations! You have taken the first step in making your home landscape more sustainable. Now let's take a look at how to do this in a way that preserves the life in your soil and protects the health of your existing landscape plants.

Step 1: Deeply irrigate your landscape trees BEFORE beginning this process.

Step 2: Identify where the roots are for your existing trees.

Step 3: Consider the method(s) you will use to remove turfgrass. Common methods include:

- ⇒ *Sheet mulching*—Can be used in any area of your landscape. Should be used cautiously around tree roots. An alternative to sheet mulching within a tree's drip line is applying a 5-inch layer of organic mulch within the tree's drip line to block the sun and starve your turfgrass.
- ⇒ *Selective herbicide plus "scalp" mowing*—Selective herbicides are weed (plant) killers that are selective for certain kinds of plants. Choose an herbicide that is selective for killing grass plants. This is especially important if you are trying to kill the turfgrass within a tree's root zone. "Scalp" mowing is setting your mower to it lowest height to remove as much of the grass blade as possible.
- ⇒ *Airspade removal*—Avoid using this method within the tree's canopy drip line, because it could damage tree surface roots.
- ⇒ *Mechanically with a sod cutter or skid steer*—Avoid using this method within the tree's canopy drip line, because it could damage tree surface roots.

Step 4: Create a protection zone around the drip line of existing trees to protect the roots within the drip line that are critical to tree survival.

Step 5: Plan for effective irrigation of your existing trees.

How to Perform the Sheet Mulching Method Around Trees

Step 1: Remove weeds.

Step 2: Mow the lawn and leave the clippings in place.

Step 3: Water the area thoroughly.

Step 4: Lay down 2-3 inches of compost or compost mixed with native soil to cover the area of turf to be removed.

Step 5: Lay cardboard over the area, overlapping the edges by 6 to 8 inches to completely block the light.

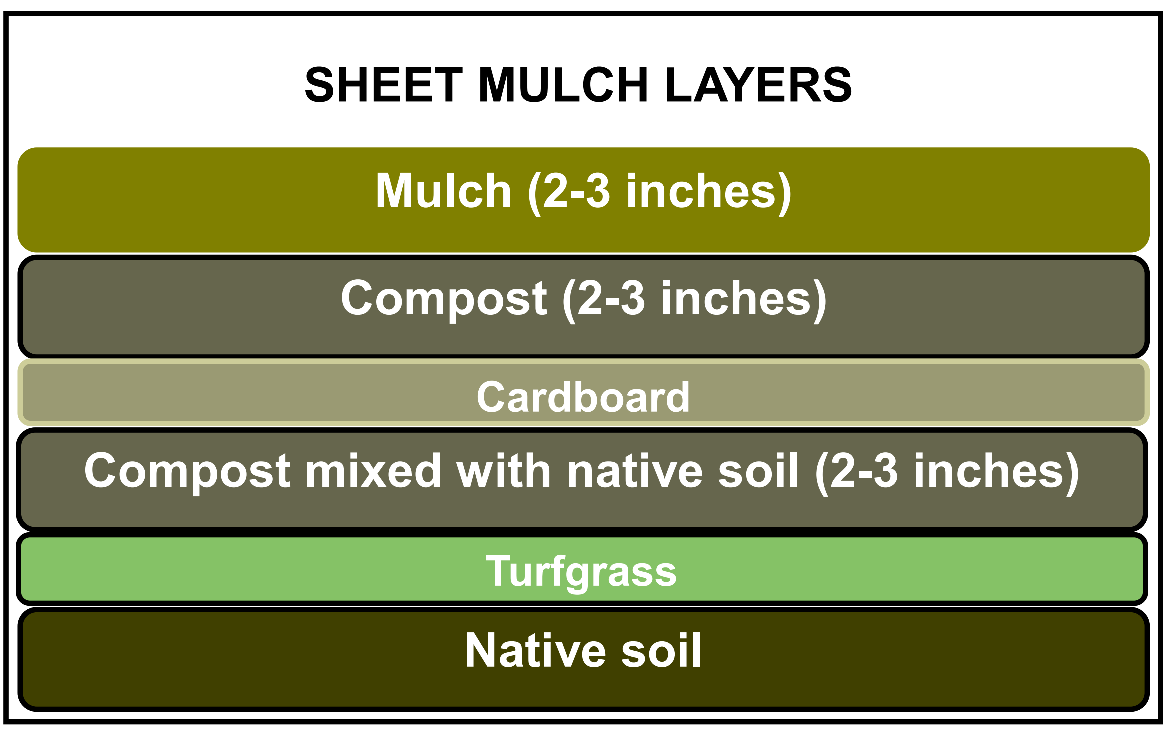
Step 6: Thoroughly wet the cardboard to keep it in place and to kickstart the composting process.

Step 7: Add another 2-3 inches of compost over the cardboard.

Step 8: Cover the second layer of compost with organic mulch (3 inches of wood chips or 2 inches of shredded bark).

Step 9: Water thoroughly after each layer is applied.

Step 10: Keep sheet mulch layers a few inches away from the tree trunk to prevent damage to the trunk.



Sheet mulching to remove turfgrass from within the drip line of a tree. A cutaway view is shown to illustrate sheet mulch layers and their depth. Note that sheet mulch materials are kept 2 inches to 3 inches away from the trunk.

How to Calculate How Much Sheet Mulch Material is Needed

Area in square feet x depth in feet = Volume in cubic feet

Volume in cubic feet ÷ 27 = Volume in cubic yards

Here is an example:

How many yards of compost are needed to cover an 80 square-foot area with 4 inches of compost? [Number of inches ÷ 12 = Number of feet]

80 square feet x (4 ÷ 12) = 26.67 cubic feet

26.67 cubic feet ÷ 27 = .99 cubic yard (or ~1 cubic yard)

Tip: When calculating how much compost you will need for sheet mulching, make sure to include the amount for both compost layers.

A simple alternative to sheet mulching is to mulch over the grass within the drip line of your tree (beneath the tree canopy). Spread organic mulch to a depth of 5 inches. Hand-pull grass and weeds that may grow up through the mulch. Pull mulch a few inches away from the trunk to prevent crown rot. Warm-season grasses, such as Bermudagrass and St Augustine, tend to come back aggressively and will require additional intervention over time.

How to Calculate How Much Mulch is Needed

Area in square feet x depth in feet = Volume in cubic feet

Volume in cubic feet ÷ 27 = Volume in cubic yards

Here is an example:

How many yards of mulch are needed to cover a 1,000 square-foot area with 5 inches of mulch? [Number of inches ÷ 12 = Number of feet]

1,000 square feet x (5 ÷ 12) = 417 cubic feet

417 cubic feet ÷ 27 = 15.44 cubic yards

CHAPTER 7
Selecting Trees That Require Less Water

Trees provide so many ecological and environmental services in our landscapes. But, trees can only be effective if they are healthy and free from stress. Appropriate tree selection is an important part of keeping trees stress-free without the need for excessive water or maintenance. Tree selection is also critical for retaining a healthy urban tree canopy and for keeping our urban areas resilient to predicted long-term changes in our climate.

We surveyed arborists in the Intermountain West region of the U.S. to find out which trees are their favorites for drought-prone areas in USDA hardiness zones 4-7 (**northern Nevada**). Drought tolerance is relative, depending on the regional climate. So, careful observation of what works in practice is an important part of the decision-making process. Another consideration is that the trees we plant today will have to survive the environmental conditions present 50 years from now. So, we need to think about how to plan for a more uncertain future in terms of our changing and more variable climate. Climate resilience should be among the top concerns of arborists moving forward.

A list of drought-tolerant trees for **southern Nevada** was generated by consulting with tree professionals in that region. The southern Nevada tree list follows the northern Nevada tree list. Northern Nevada trees are listed in order of drought-tolerance ratings by surveyed arborists; southern Nevada trees are listed in alphabetical order. **All trees in these lists can be considered low-water-use (WF 0.5)**.

Some tree species could potentially be used in both areas. Check USDA hardiness zones of specific tree species to see if they will work in your part of the state. Visit https://planthardiness.ars.usda.gov/ and input your zip code to find the hardiness zone for where you live.

A factor to consider if you live in an area where drought stress is common is the plant's susceptibility to stress-related secondary pest infestation. Drought stress can cause greater susceptibility to secondary pest invasion. Although ash is a tough, drought-tolerant tree, adapted to urban conditions, **we did not include ash in the following tree lists because of its potential for invasion by emerald ash borer.**

Top-10 Drought-Tolerant Trees for Northern Nevada

1. ***Celtis occidentalis***
(common hackberry)

- ◊ USDA hardiness zones 2-9
- ◊ Size 20' - 30' tall; 15' - 20' wide
- ◊ Adapted to high soil pH, heat, cold and wind
- ◊ Moderately tolerant of salty soils
- ◊ Orange-red or purple berries are valuable to wildlife
- ◊ Golden yellow fall color
- ◊ Only major pest problem is hackberry nipple gall

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

2. ***Quercus macrocarpa***
(bur oak)

- ◊ USDA hardiness zones 2-8
- ◊ Size 60' - 80' tall and wide
- ◊ Adapted to high soil pH
- ◊ Tolerates heat, cold and wind
- ◊ Moderately tolerant of salt and boron
- ◊ Slow growth rate but long-lived; not suitable for small landscapes
- ◊ Very few pest problems

This young bur oak may eventually outgrow this small space.

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

Top-10 Drought-Tolerant Trees for Northern Nevada

3. ***Pinus ponderosa***
(ponderosa pine)

⇒ USDA hardiness zones 3-7

⇒ Size 60’ - 80’ tall; 30’ - 40’ wide

⇒ Fairly salt-tolerant

⇒ Requires deeper soils with good drainage and pH 6.5-7

⇒ Good for large areas as a windbreak

⇒ Bark has a sweet aroma

⇒ Do not plant within 30’ of a home in wildfire-prone areas

Photo credit: Paul Wray, Iowa State University, Bugwood.org

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

4. ***Gleditsia triacanthos var. inermis***
(thornless honeylocust)

⇒ USDA hardiness zones 3-9

⇒ Size 30’ - 70’ tall; 50’ wide

⇒ Fine-textured leaves provide a dappled shade

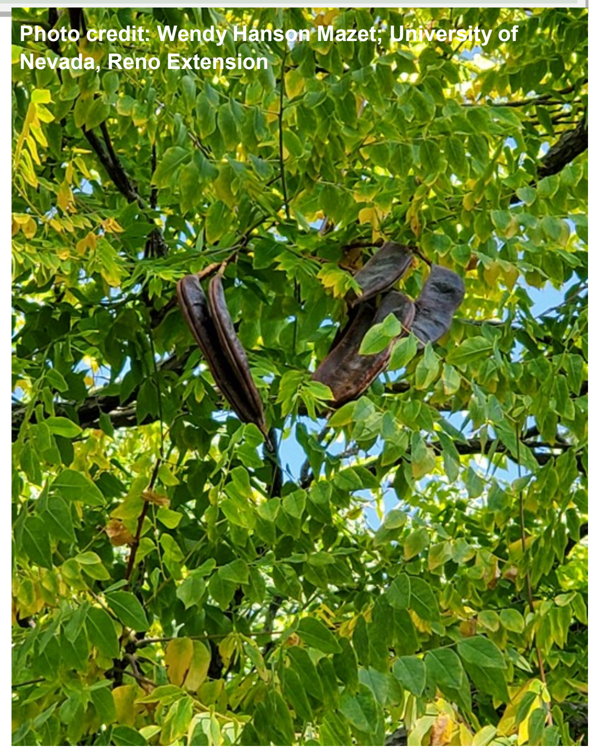
⇒ Tolerant of high soil pH, poor drainage and salt

⇒ Long, twisted pod-like fruits can be messy; select male/ seedless cultivars

⇒ Pod gall midge can be a problem in early summer

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

5. ***Gymnocladus dioicus***
(Kentucky coffeetree)



- ⇒ USDA hardiness zones 3-8
- ⇒ Size 60’ - 75’ tall; 40’ - 50’ wide
- ⇒ Shade-intolerant
- ⇒ 6” - 10” long fruits can be a nuisance; select male/seedless cultivar ‘Espresso’
- ⇒ Moderately tolerant of salt and boron; tolerates high-pH soils
- ⇒ No serious insects or diseases

6. ***Juniperus scopulorum***
(Rocky Mountain juniper)

- ⇒ USDA hardiness zones 3-7
- ⇒ Size 15’ - 20’ tall; 10’ - 15’ wide
- ⇒ Tolerant of high pH and salt; moderately tolerant of boron
- ⇒ Needs full sun and infrequent irrigation
- ⇒ Relatively pest-free, though spider mites are a problem in dry, dusty areas
- ⇒ Do not plant within 30’ of a home in wildfire-prone areas
- ⇒ Cultivars are available, including columnar forms

Top-10 Drought-Tolerant Trees for Northern Nevada

7. ***Malus*** **hybrids**
(crabapple)


Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

- ⇒ USDA hardiness zones 3-9
- ⇒ Size 15' - 20' tall and wide
- ⇒ Tolerant of high pH, salt and boron
- ⇒ Good tree for small landscapes and patios
- ⇒ Full sun provides best floral/ fruit display
- ⇒ Select fireblight- and scab-resistant varieties

8. ***Pinus nigra***
(black pine)


Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

- ⇒ USDA hardiness zones 4-7
- ⇒ Size 50' - 60' tall; 20' - 40' wide
- ⇒ Tolerant of salty and high-pH soils
- ⇒ Tolerates urban conditions
- ⇒ Winter watering is needed, if no snow cover, to prevent top dieback
- ⇒ Do not plant within 30' of a home in wildfire-prone areas
- ⇒ Cultivars are available

Top-10 Drought-Tolerant Trees for Northern Nevada

9. ***Quercus rubra***
(red oak)

- ⇒ USDA hardiness zones 4-8
- ⇒ Size 60’ - 75’ tall; 45’ wide
- ⇒ High salt tolerance but only moderately tolerant of high soil pH, with leaf chlorosis in high-pH soils
- ⇒ Good branch structure
- ⇒ Excellent fall color
- ⇒ Fairly pest-free

Photo credit: Paul Wray, Iowa State University, Bugwood.org

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

10. ***Crataegus phaenopyrum***
(Washington hawthorn)

- ⇒ USDA hardiness zones 3-8
- ⇒ Size 25’ - 30’ tall; 25’ wide
- ⇒ Small, tough tree with good adaptability to urban conditions
- ⇒ May sucker when near an irrigated lawn
- ⇒ Persistent fruit in winter, providing benefits to wildlife
- ⇒ Prone to fireblight, scale, borers and spider mites

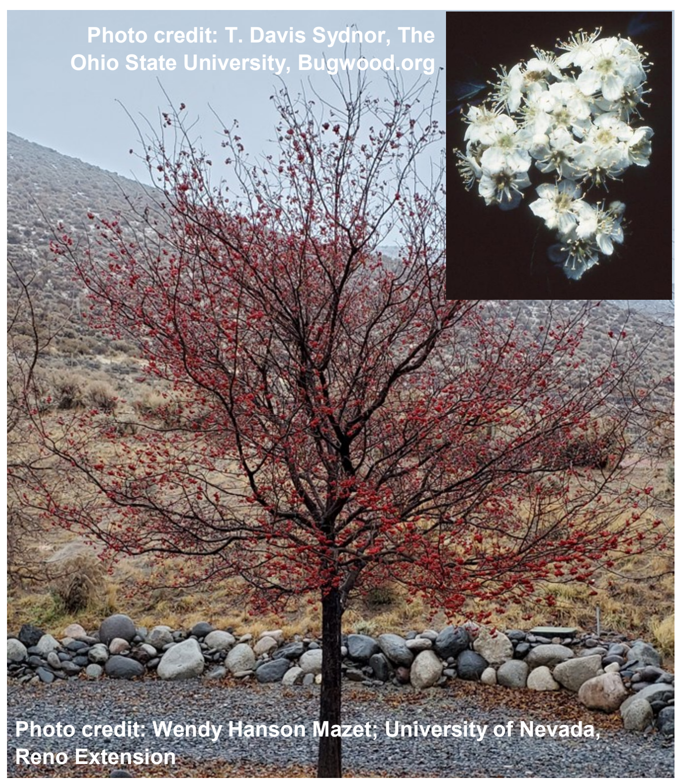


Photo credit: T. Davis Sydnor, The Ohio State University, Bugwood.org

Photo credit: Wendy Hanson Mazet; University of Nevada, Reno Extension

Top-10 Drought-Tolerant Trees for Southern Nevada

1. ***Acacia stenophylla*** (shoestring acacia)

- ⇒ USDA hardiness zones 8-11
- ⇒ Size 30’ tall; 20’ - 30’ wide
- ⇒ Evergreen; provides light shade
- ⇒ Yellow fragrant flowers in winter/spring
- ⇒ Tolerates high-pH soils, moderate salt; needs good drainage
- ⇒ Fast-growing; may develop root suckers

2. ***Chilopsis linearis*** (desert willow)

- ⇒ USDA hardiness zones 8-9
- ⇒ Size 40’ tall; 10’ - 20’ wide
- ⇒ Deciduous
- ⇒ Showy, fragrant flowers in spring or summer
- ⇒ Full sun to part shade
- ⇒ Tolerates high-pH soils; needs good drainage
- ⇒ Avoid excessive water to prevent overly rapid growth and fewer blooms
- ⇒ Look for seedless varieties

3. ***Cordia boissieri***
(Texas olive)

⇒ USDA hardiness zones 9-11

⇒ Size 15’ - 25’ wide and tall

⇒ Evergreen to semi-evergreen

⇒ White flowers with yellow throats; small, olive-like fruits attract birds and wildlife

⇒ Tolerates full sun and reflected heat

⇒ Tolerates high-pH soils; requires excellent drainage

4. ***Eucalyptus polyanthemos***
(silver dollar gum)

⇒ USDA hardiness zones 9-10

⇒ Size 40’ - 60’ tall; 30’ - 40’ wide

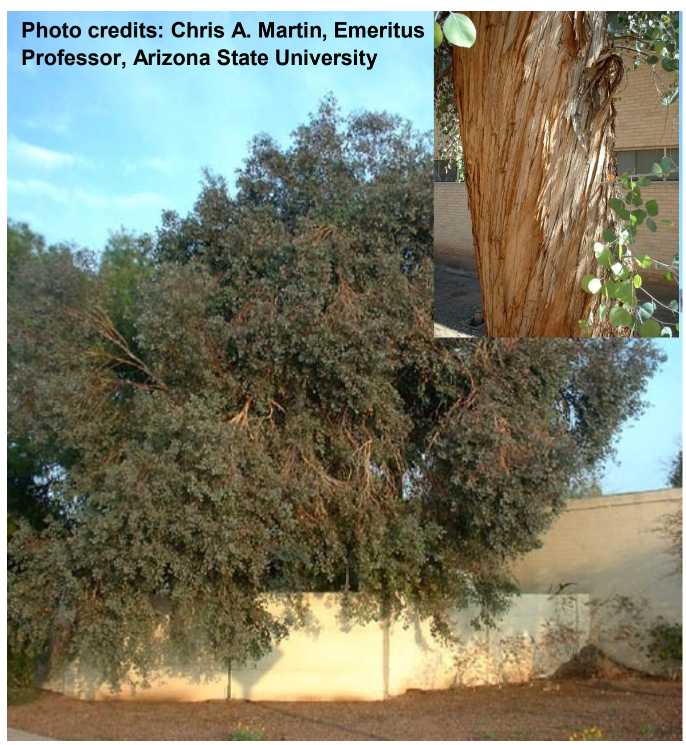
⇒ Evergreen

⇒ Cream-colored fragrant flowers in spring or summer

⇒ Full sun to part shade

⇒ Tolerates high-pH soils; needs excellent drainage

⇒ Use as privacy screen or windbreak



Top-10 Drought-Tolerant Trees for Southern Nevada

5. ***Parkinsonia x* ‘Desert Museum’**
(Desert Museum palo verde)

⇒ USDA hardiness zones 8-9

⇒ Size 25’ tall and wide

⇒ Thornless hybrid with an upright growth habit; smooth light green bark

⇒ Large yellow flowers in spring

⇒ Produces very few seed pods

⇒ Full sun; tolerates reflected heat and high-pH soils


Photo credit: Chris A. Martin, Emeritus Professor, Arizona State University

6. ***Pinus pinea***
(Italian stone pine)

⇒ USDA hardiness zones 7-11

⇒ Size 60’ tall; 45’ wide

⇒ Conifer, evergreen

⇒ Crown broadly arched, umbrella-shaped

⇒ Prefers full sun and well-drained soils, pH 7 to 7.5

⇒ Tolerates salty soils

⇒ Not suitable for small landscapes; seeds edible

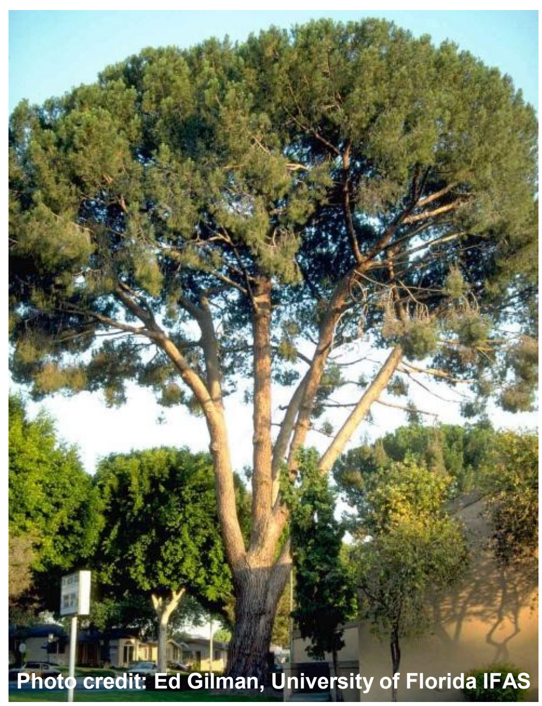


Photo credit: Ed Gilman, University of Florida IFAS

Top-10 Drought-Tolerant Trees for Southern Nevada

7. ***Pistacia chinensis***
(Chinese pistache)


Photo credit: Chris A. Martin, Emeritus Professor, Arizona State University

- ⇒ USDA hardiness zones 6-9
- ⇒ Size 25’ - 35’ tall and wide
- ⇒ Deciduous; excellent fall color
- ⇒ Flowers in spring; not showy
- ⇒ Crown round and symmetrical on older specimens when grown in full sun; becomes misshapen in shade
- ⇒ Tolerates high-pH, well-drained soils; heat-tolerant

8. ***Pistacia lentiscus***
(mastic tree)


Photo credit:
Lumbar~commonswiki, Wikimedia CC BY SA 3.0

- ⇒ USDA hardiness zones 9-11
- ⇒ Size 15’ - 25’ tall; 20’ - 30’ wide
- ⇒ Evergreen small tree or large shrub with aromatic, leathery olive-green leaves
- ⇒ Dioecious, with separate male and female trees
- ⇒ Female flowers produce bright red berries
- ⇒ Prefers full sun and well-drained soils; salt-tolerant
- ⇒ No serious pest or disease issues

Top-10 Drought-Tolerant Trees for Southern Nevada

9. ***Prosopis chilensis***
(Chilean mesquite)

- ⇒ USDA hardiness zones 8-11
- ⇒ Size 30’ tall and wide
- ⇒ Provides filtered shade
- ⇒ Full sun; tolerates high-pH soils
- ⇒ Best planted in groves for shade or privacy
- ⇒ Litter from pods can be a problem in heavily trafficked areas

10. ***Vitex agnus-castus***
(chaste tree)

- ⇒ USDA hardiness zones 6-9
- ⇒ Size 8’ - 10’ tall; 5’ - 8’ wide
- ⇒ Deciduous large shrub to small tree
- ⇒ Showy, fragrant purple flowers in summer attract butterflies
- ⇒ Dead wood and lower limbs should be removed in winter
- ⇒ Prefers full sun and well-drained soils; tolerates high pH
- ⇒ No serious insect or disease problems

THIS PAGE INTENTIONALLY LEFT BLANK

This publication was funded by the Nevada Division of Forestry through a subaward from the U.S. Forest Service.

Special thanks to the professional reviewers of this publication, who generously provided the benefits of their expertise and practical knowledge to improve this handbook. Peer editors included: Cayenne Engel, Nevada Division of Forestry; Lisa Ortega, ISA Master Arborist, Nevada Plants; ML Robinson, University of Nevada, Reno Extension; Ryan Sharrer, City of Reno Parks and Recreation Department; Molly Sinnott, ISA Certified Arborist, Sinnott Consulting; and Joey Lynn Watt, Star Nursery.