Irrigating the Home Landscape

K. S. Jones, Horticulture Associate, University of California Cooperative Extension
L. R. Costello, Environmental Horticulture Advisor, University of California Cooperative Extension

It's not easy to irrigate landscapes effectively and efficiently. Many factors need to considered, such as soil-plant-water relations, water loss rates from plants (evapotranspiration rate), species water needs, root distribution, environmental conditions, type of irrigation system (sprinkler, drip, hand, etc.), and application rates. It's a real challenge to develop a working knowledge of these factors, and irrigation management has become an area of specialization within the landscape profession.

Typically, home gardeners aren't interested in investing the time needed to develop a full understanding of all the factors pertaining to landscape irrigation management. (For those that are, a list of publications on this topic are listed in the references.) Usually, it's a "tell me what time it is, not how the clock works" approach. Unfortunately, we can't simply tell you "what time it is" for home irrigation ---- there's simply too much variability in landscapes (i.e., one size does not fit all). To be successful, home gardeners need some understanding of irrigation basics. The intent of this article is to give you an overview of the factors considered by irrigation specialists in developing schedules. These are factors that the home gardener should consider as well. With this information you should be able to 1) develop a better understanding of the elements that affect irrigation schedules, and 2) be able to make useful adjustments to your irrigation practices.

The basic factors considered here are water needs of plants, environmental conditions that affect water loss, root distribution, soil properties, and irrigation systems. For further reading on these factors, see the references.

Water Needs of Plants

To determine how much water to apply, it is important to know how much water a landscape needs to maintain health, appearance, and reasonable growth. Although the precise amount of water required to meet plant needs is not needed, it is important to know whether your plants are considered to have high, moderate, low, or very low requirements. Researched-based information on the relative water needs of landscape plants is sparse, but there is considerable observational experience on the subject among landscape professionals…enough to put most common landscape plants used in California in a list sorted into water needs categories from high to very low (fig. 1). "High" includes turf, tree ferns and hydrangea, while "very low" includes many junipers and native oaks. *A Guide to Estimating Irrigation Water Needs of California: WUCOLS III* gives evaluations for most landscape species used in California (see references). WUCOLS stands for Water Use Classification of Landscape Species. The Sunset Western Garden Book also provides lists of plants grouped according to water needs. These lists will help you understand the relative irrigation needs of the plants in your yard and can help you create hydrozones, or groupings of plants with similar water needs. Knowing water needs will give you an indication of irrigation levels needed in different parts of your landscape and adjustments can be made in the amount of water applied.

Environmental Factors and Microclimates

Temperature, wind, light intensity, and relative humidity are environmental factors that affect the rate of water loss from landscapes. The higher the temperature, light and wind speed and the lower the relative humidity, the faster water is lost from plants. Generally, the greater the potential for evaporation at a site, then the greater the amount of plant water loss.

In the period since the last drought in California, farmers and landscape managers have learned to fine tune their irrigation scheduling by using reference evapotranspiration (ET_0) rates for their locations. ET_0 is a measure of water loss from plants for a given location under standard conditions. The California Irrigation Management Information System (CIMIS) operates a series of weather stations that measure daily ET_0 values (fig. 2). The Water Conservation Office of the California Department of Water Resources (916-653-1097) has produced a map of California divided into 18 Reference Evapotranspiration Zones. The map also includes a list of historical ET_0 averages (inches per day) for each month in each zone. For example, in zone 1 (areas with coastal fog) the average rate for the whole month of August is 4 inches. In zone 18 (the Imperial Valley), the average rate is 8.7 inches. What this tells you is that if you live in Palm Springs, you will need to need to apply considerably more water to your landscape in August than if you live on the foggy side of San Francisco. *A Guide to Estimating Irrigation Water Needs of California: Part I, The Landscape Coefficient Method* is a manual landscape professionals use to estimate water needs by using reference evapotranspiration measurements.

Figure 1. *Fremontedendron sp*. A California native plant requiring no supplemental irrigation during years of normal rainfall.

As well as knowing the environmental conditions affecting plant water loss in your area, it's important to know the microclimates in your yard. Take note of the sunny or shady spots. Is one location windier than another? Are there areas of reflected light, such as a white, south-facing wall? The plants located in hot windy locations will need more water than those in cool shady locations. Make adjustments in the amount of water you apply: you should not use the same amount of water for all plants and all locations in your yard. Avoid irrigating plants in cool microclimates at levels equivalent to those in warm areas.

Figure 2. CIMIS Station

Soil Properties

Water needs and environmental conditions determine how much water to apply. The soil determines how much water can be applied at any one time. Soil is the water reservoir for plants: it retains water in the root zone. Soils vary in their capacity to hold water, with a fine-textured soil (such as clay) holding many times more water than a similar volume of coarse-textured soil (such as sand). Knowing the kind of soil and its water-holding characteristics are important factors to consider in irrigation management.

Soil is classified into three broad categories (sand, silt and clay) based on the size of its particles. Sand particles are relatively large with large air spaces between, while clay particles are very small (too small to be seen by the naked eye) and packed tightly together. Silt is in between. Loam has roughly equal parts of all three. A soil test from a laboratory can tell you exactly what soil type you have. The top row of the table "The Soil Moisture Feel Test" can give you some idea of what you have, while lower rows give a description how the soils feel at various moisture levels .

Soil Moisture Feel Test

Water % available	**Sand** Feels gritty	**Sandy/Loam** Feels slightly gritty	**Clay/Loam** Feels sticky when wet	**Clay** Feels vey sticky when weet
0% none (very dry)	Dry, loose and flows	Dry, loose and flows	Dry clods and powdery	Large, hard clods
50% time to water	Appears dry, won't hold together in a ball	Appears dry won't hold together in a ball	Crumbly, but holds together	Pliable and holds together
50-70% enough	Same as above	Forms a ball, but won't hold	Forms a ball and feels plastic	Forms a ball and can be squeezed into ribbons
75%-FC* plenty	Sticks and forms a weak ball	Forms a weak ball, not slick	Forms a ball and feels pliable and slick	Forms slick ribbons
At FC can't hold more	No free water observed	No free water observed	No free water observed	No free water observed
Above FC too much	Free water when bounced	Free water when kneaded	Free water when squeezed	Puddles

*FC = Field Capacity, or the moisture content following an irrigation when gravitational water has drained.

Sand has a high water infiltration rate, looses a lot to gravity and there is minimal lateral movement. Clay, on the other hand, absorbs water slowly, retains it a long time and there is considerable lateral movement. You can test this by digging a hole, filling it with water, and seeing how fast the water disappears and how far beyond the edges of the hole the water has moved laterally. Keep in mind that the plants you are irrigating will require the **same amount of water,** according to their species needs, whether they are in sand, silt or clay. The difference is *how much water is applied at one time* and *how frequently you apply the water*. In sandy soil, water should be applied frequently because water moves through the soil rapidly, and in small amounts to prevent water from being lost by drainage. In clay soil, water should be applied less frequently because clay holds water longer, and at a slower rate to avoid run off because clay absorbs water slowly.

Figure 3. Mixed plantings can present a challenge.

Root Distribution

Roots are the irrigator's target. Water applications should be aimed at the plant root zone. The size of this zone varies, however, depending on the plants being irrigated: turf, groundcovers, shrubs, trees, or vegetables. To hit the root zone, you need to have some understanding of typical root depth.

Also, root depth gives an estimate of the soil volume available to retain water for plant uptake. This is the volume that needs to be refilled during irrigations. Under watering and over watering results in the soil reservoir being partially filled or over filled. Just as you wouldn't try to pump 25 gallons of gas into a 15-gallon gas tank, you shouldn't be applying more water than can be held by the soil (in the root zone).

Most turf roots can be found within 6 inches of the surface. Many lawns have roots only 3 inches deep, while others may be greater than 6 inches deep. Water should be applied to wet the soil to a depth of the root system. The best way to determine root depth is to dig a hole and take a look. Measure root depth at several locations. Once depth is determined, turn on the irrigation system and time how long it takes for water to wet the root zone. Keep in mind that the root depth of turf may be shallow because of too frequent, short irrigations. If this is the case, then cut back irrigation frequency and water to a depth of 6 inches. Generally, turf requires irrigation through the entire dry season, with warm season varieties (e.g., Bermudagrass) receiving about 25 % less water than cool season varieties (e.g., Kentucky bluegrass). A new web site *The UC Guide to Healthy Lawns* http://www.ipm.ucdavis.edu/tools/turf contains information on irrigation as well as much more on lawn installation and maintenance.

Mixed plantings (trees, shrubs, groundcovers and flowers all in one location) present a difficult challenge (fig. 3) and some experimentation will be required to meet the needs of *most* of the plants. Again, dig holes and determine the rooting depth in several locations. Generally, irrigating to a depth of 24 inches is sufficient for most mixed plantings.

During the last drought, many trees planted in lawns died because they developed shallow roots dependent on water from lawn irrigations. While the amount of water applied to the lawn was adequate to keep them well hydrated, when the lawn irrigations stopped, drought-sensitive trees died. To avoid this in the next drought, water trees slowly to a depth of 24 inches a few times during the summer. Trees in sidewalk planting pits may have a restricted soil volume that requires more frequent irrigations.

Vegetable gardens containing both shallow-rooted and deeply-rooted plants require even moisture for optimum growth. If shallow rooted and deeply rooted plants are adjacent (e.g. radishes and tomatoes) care must be taken not to over-water or under-water one or the other. Allowing the soil to dry out between irrigations can cause stunting of plants or conditions such as blossom end rot in tomatoes.

Fruit trees require regular irrigation from bloom to harvest for optimum yields. After harvest, they can survive on a minimum amount of moisture without tree injury or reduction of crop size in the following years (Beutel 1977).

Flower beds that contain mostly annuals require moist soil. Many perennial plants are drought tolerant and need much less water than annuals.

Containers present another challenge: in most cases, the soil volume and water-holding capacity is small. Also, as the plants grow and the roots occupy more space, even less space is available for water storage. Most container plants will need to be watered 2 to 3 times per week from spring through fall (fig. 4). Large plants in small containers may need more frequent irrigations. Keep in mind that potting soils may become hydrophobic if they become very dry. As a result, irrigation water will not be retained. At planting, moisten container soils well, and then keep them moist.

Irrigation methods

All irrigation methods can be effective as long as they deliver water in sufficient amounts and at the desired rate. Whether you use sprinklers, drip emitters, or hoses, every system has benefits and limitations. It is useful to do a "before and after test" with whatever system you are using. Sometime after the rains have stopped and the soil is starting to dry, dig a hole down to about 6 inches and do the "feel test". Turn on your system and apply water for a typical irrigation period. When you're finished, dig again and examine the wet and dry zones. You may be surprised to find that the water did not penetrate as deeply as you thought, or perhaps you applied too much and the soil feels muddy. Repeat this test to determine the amount of time it takes to deliver water to the root zone of the plants you're irrigating. This should be the "run time" for your system. If water runs off before the end of the run time, then split your irrigation into two or more cycles. The objective is to deliver water to the desired depth without losing water to runoff.

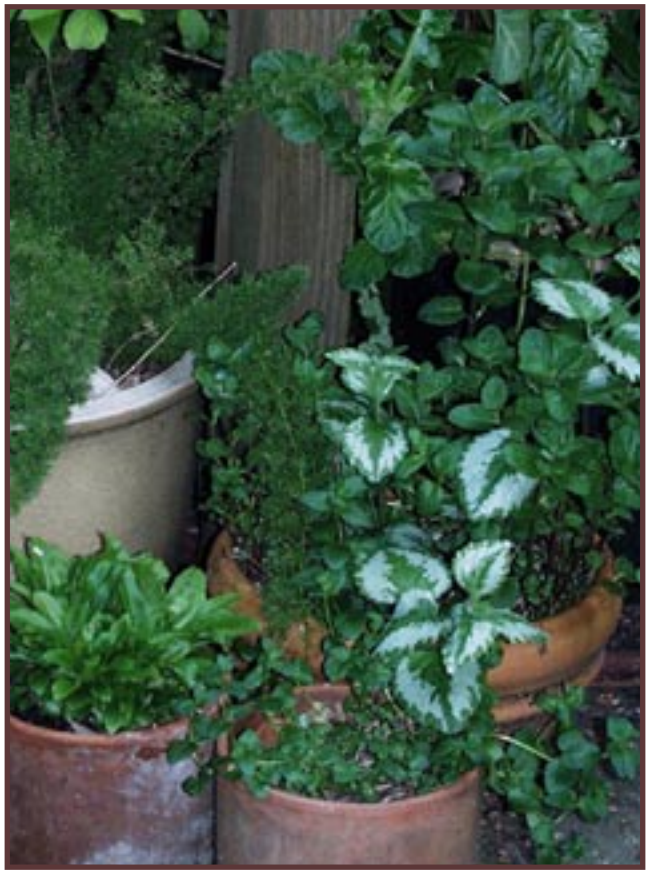

Figure 4. Plastic or glazed ceramic containers hold water longer than unglazed ceramic or wood.

Signs of Water Deficit or Excess

Plants that are stressed due to drought and dehydration are experiencing *water* deficits (fig. 5). An excess of water in the soil causes *aeration* deficits and encourages the growth of root rotting fungi. Acute water deficits are immediately obvious because the plant wilts or the leaves scorch. Chronic water deficits cause a slowdown or cessation of growth and are much harder to diagnose because a good knowledge of the plant's "normal" growth patterns plus observation over time is required. Acute aeration deficits cause roots to suffocate (due to lack of oxygen) and loose their ability to absorb water and nutrients. Wilting, leaf drop and even death of the plant is observed. Chronic aeration deficits cause many of the same symptoms as chronic water deficits and are equally difficult to diagnose for the same reasons. To make matters more complicated, both water deficit and aeration deficit symptoms can mimic symptoms of other biotic and abiotic disorders, such as salt injury, herbicide toxicity, root disease and nitrogen deficiency. This subject is covered at length in a new University of California publication, *Abiotic Disorders of Landscape Plants: A Diagnostic Guide.*

Figure 5. Early "fall color" is a sign of water deficit.

Conclusion

By understanding landscape species water needs, environmental conditions that affect water loss, soils, root distribution and irrigation systems, you should be able to make useful adjustments to your irrigation program. Keep in mind that it's not easy to water effectively and efficiently, but once you learn the basics, you should find that healthy and attractive landscapes can be maintained with only minimal amounts of water.

Some Dos and Don'ts

- Check your system carefully and fix broken sprinklers, drip emitters, or irrigation lines.
- Avoid overspray from sprinklers onto sidewalks, patios, or other areas that don't need to be irrigated.
- If you use an automatic irrigation timer, reset it 3 or 4 times during the year to adjust for the seasons.
- Do not leave sprinkler or drip systems on so long that water begins to run off into the gutter or away from the landscape.
- Know your plant materials and their water needs: some plants need to irrigated frequently, while others may not need any irrigation water.
- Use separate irrigation valves and programs for turf areas. Typically, turf requires much more water than woody plants.
- Irrigating shortly before sunrise is best for most plants. Avoid irrigating during windy periods.
- Apply organic mulch to the soil surface --- this reduces water loss due to evaporation.
- Check the soil moisture frequently. This will give a good indication of when you need to water.
- Monitor your plants regularly for signs of water deficit or excess.

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University of California Cooperative Extension
625 Miramontes, Suite 200
Half Moon Bay, CA 94019

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