University of California

Making a Difference for California

Agriculture and Natural Resources Landscape Notes



September 2013

The Effects of Drought on Shade Trees

his is the second year of unseasonably low rainfall totals for many communities in California. Some counties recorded record low annual precipitation levels resulting in a water emergency. In my town of Ojai, California, creeks are dry where normally they run season long, and wells are drying up all over our valley. The drought is now so severe and threatening, that Ventura County currently has Federal disaster drought area status (see the following link: http://www.usda.gov/ wps/portal/usda/usdahome?navid=DISASTER ASSISTANCE). Ojai has no supplies of "state water": all water is stored as surface runoff in Lake Casitas or in the Ojai groundwater basin. When these supplies run out not only plants but people will get thirsty.

As water supplies are depleted, the cost of water will escalate. Many water agencies have increased rates to cover the cost of aging infrastructure, labor rates, and other costs. Water fights are contentious. Ojai will be voting this week on taking power over one of its water purveyors using eminent domain in a classic battle of people vs. water profits. Years of water rate increases has made water increasingly prized and landscapes have "browned" all over town as supplies were reduced or eliminated from landscape uses (figure 1). California water is expensive. In some ways this is helpful because expensive water encourages conservation rather than thoughtless waste. As water consumers experience higher rates they

are turning off the water to nonessential uses such as landscapes. In the absence of landscapes environmental benefits such as cooling, pollutant regulation, runoff prevention, storm-water capture, dust control and carbon sequestration are lost or severely diminished. The heat island effect increases in urban areas as water is withheld.

In response to the cost of water and as people become more water responsible, there is a trend to remove turfgrass and put in drought tolerant landscaping.



Figure 1. The result of zero applied water during a two year drought--No Landsape!

Within the last six months three of my close neighbors have converted to nonturf low water consuming landscapes (figure 2). Trees are valued above turf and often retained. When turfgrass is removed, the sprinklers that previously irrigated it are retrofitted for drip irrigation. Trees once reliant on turfgrass over -irrigation may not be able to obtain sufficient water from the new, lower volume, drip irrigation systems (figure 3). No standard number of drip emitters has been identified as a specification for use in supporting large, mature trees. Many people have the mistaken notion that large trees don't need any supplemental water.



Figure 2. Landscape remodeling for lower water use has less turfgrass, mulched areas and trees.

As trees grow, they require more water not less. The larger a tree is, the more leaves it has and thus the greater transpirational surface area for water loss. A young tree irrigated frequently during establishment requires little applied water once rooted into landscape soil because it can scavenge water from surrounding landscape irrigation. However, this assumes that the landscape receives some irrigation or rainfall. In landscapes receiving less than ten inches of annual rainfall, trees often need supplemental water. Large trees balance their water needs by developing extensive root systems to explore greater soil depths reaching water not accessed by other plants. Trees store water in the wood of their roots stem and branches, but this will only provide a temporary supply. In drought years, water is not replenished at deeper soil levels: no deep reserve for trees remains to draw upon. Summer is a time to irrigate large trees if they show symptoms of stress.

How does drought stress manifest visibly in trees, shrubs and plants generally? The most



Figure 3. When turfgrass is removed during landscape renovations, Estalbished tress such as this Alder may suffer from the drought.

obvious visual symptom is wilt. Plants wilt when the demand (draw) from the atmosphere exceeds the ability of the plant to transpire (pull water from the soil into roots and through the plant to the atmosphere through stomata). This can occur when rapid, sudden heat pulls too quickly and a plant is unable to keep pace with its water need or when the soil has become excessively dry and physically lacking water reserves. Wilt is temporary if the water deficit is made up through irrigation or rainfall. It can be permanent if the water columns in the wood are ruptured--a process plant physiologists call cavitation. All plants rely on a continuous column of water from the root tip to the leaf. If that column is broken, it cannot be reconnected. If cavitation is widespread in the plant, it has usually reached the permanent wilting point and cannot recover. Many other symptoms of drought stress can occur. Many plants will sunburn and leaves will develop burned areas in their centers. Sunburn occurs when insufficient water flows through the leaf (transpiration) for cooling purposes. Heat accumulates in the center of the leaf and burns the tissue. Most sunburn usually occurs most on the south side of a tree where solar exposure is most intense. Sunburn is permanent damage and leaves do not recover. Leaf drop or defoliation often follows sunburning of leaves. Some trees shed leaves in advance of drought as a mechanism of drought avoidance. Other symptoms of drought stress are generalized dulling of foliar color, reduced shoot growth and reduced leaf size.

While most consider drought bad, some stress is good. It allows a tree to slow its growth rate, reduce foliage production that, during drought, it would otherwise not be able to support. Stress comes in many forms. In consecutive drought years an added stress is imposed by salt build-up in the root zone. Rainwater is essentially salt free so when rain falls frequently and with abundance, salts are dissolved in soil and moved through the soil profile to a deeper level away from most absorbing roots. When we irrigate with municipal water, it usually has a much higher salt content than rainwater, and since trees use this water, they leave behind most of the salts in soil. Without leaching rains, repeated irrigation and water use by trees results in increased salinity in the root zone. Salinity inhibits osmosis at the root cortex and imposes stress on the tree. Trees can resist this by building up solutes on the inside of their root endodermal cells to keep water flow favorable into the roots (solute balance). There are limits on how much salt a tree can tolerate outside its roots. When days are long and hot and demand for water is high, osmotic stress can be particularly damaging. Also, as trees or other landscape plants deplete water from soil, salts are left behind, and because the quantity of water is dropping, the concentration of dissolved salt in the remaining water increases. The drier the soil is, the saltier the remaining water becomes. This imposes a great osmotic challenge for the tree to overcome. When salt levels outside the roots equal those in the root, water flow slows or stops and the plant can wilt. Despite its being higher in salts than rainwater, soil salts can be leached with municipal water. Irrigations should be long and penetrating, so that soil is wetted several feet deep. This will require irrigation with low volume emitters and long (often) repeated run cycles. Try to leach soils summer and fall if no rain falls.

Some California native trees are adapted to summer drought. One of the most adapted species is the California chestnut tree, *Aesculus californica*. This tree is a drought avoider. It grows rapidly while moisture is available from spring rains, but as summer heat and dry soils increase, it drops all of its leaves. The tree remains dormant in the hottest

months of August and September. Pruning can also help trees be 'drought avoiders'. Summer pruning to reduce canopy leaf area will cut transpiration and allow trees to survive. This is essentially what happens when the Oak Twig Girdler bores mines in oak twigs of the coast live oak. Drought stressed oaks attract the beetles which then prune off foliage so that the tree does not continue to dehydrate. Summer pruning is not recommended for all trees though. Pines and Eucalyptus emit volatile organic compounds that attract bark boring beetles which can kill summer pruned trees, especially those already impacted by water deficits. Pruning oak trees in the hottest summer months should also be avoided since they are affected by a number of bark boring insects.

Another strategy for surviving drought is to remove competing landscape plants. Removing selected trees, shrubs and turfgrass will leave valuable soil moisture for specimens worthy of retention in the landscape. Removing plants and mulching will save water by cutting evaporation from the soil and leaf surfaces of the removed or competing trees shrubs or turfgrass. Since many landscapes are over-planted, selective removal of plant material and installation of new hardscape or other landscape features can improve the look of a garden while cutting its water use dramatically. Permeable hardscape, such as interlocking pavers, may be preferred over less permeable surfaces so that water can infiltrate into the soil below it.

Several years back anti-transpirant leaf sprays were advocated for cutting tree water use. These soon faded from use and recommendation because they didn't work well. When they do work, they cause injury to trees during warm dry weather and periods of low soil moisture. Trees need to transpire water in order to cool their canopies. Pruning can relieve water loss by cutting down on transpiration. Less leaf surface means less water loss. When summer pruning, never remove so much foliage that green barked or thin barked trees are over exposed to sunlight. *Prunus*, *Malus*, *Pyrus*, camphor, avocado, birch and many other trees are sensitive to sunburn on sun exposed branches. Sunburn on both leaves and branches is increased when a tree is in drought stress.

Fertilization is not recommended during drought because fertilizers are salts and they add to the osmotic potential of soil and thus increase drought in trees. Never fertilize a drought stricken or wilted tree.

How do you know if your trees are suffering from drought? Of course, the previously mentioned symptoms of wilt, sunburn and leaf drop are key indicators, but there are other symptoms as well. Careful examination of the trunk of your tree may show a lack of bark expansion or growth cracks. When trees are water stressed, trees stop growing. Prolonged drought, old age and disease can cause a tree to not develop growth cracks. Becoming familiar with normal growth cracks is helpful in identifying drought stress because a healthy tree will usually have them on the main stem. Another symptom of drought is that trees produce fewer and smaller leaves. Shoot lengths (measured from the terminal bud scars from last winter) will also be shorter than normal. Finally, drought affected plants, including trees, will have an off color grey green (dull) instead of grass or bright green. The dulling of foliage color is quite noticeable.

The best solution for a drought stressed tree is irrigation with high quality water, preferably rainwater. When rain is lacking we make do with municipal or well water. Where do we place the water? I suggest keeping the main stem (trunk) or bole of the tree dry in summer as this is a time of increased activity for *Armillaria* root rot which can be devastating on summer irrigated trees, particularly oaks, California pepper, and *Prunus* sp. Since all soils in California are quite variable and hold different amounts of water, irrigation frequency and run times for emitters are also variable. There is no 'one size fits all' recommendation. The general rule that an inch of applied water will penetrate 12 inches of soil is a good guide but this should be checked in every situation to see how a given irrigation is penetrating the soil. Probing with a soil auger or digging with a shovel is suggested until you understand what to expect with run times on any given site. Handheld moisture meters, while helpful for wet dry evaluations, are not as accurate as actually digging or taking your own samples.

This week the forecast is for hot to extremely hot weather in the inland valleys of Southern California, with no end in sight. The long days and hot temperatures will continue to exacerbate the drought in landscapes. Consider supplemental and leaching irrigations for large trees, beyond the extent of in-ground irrigation systems. Flooding with a dripping or slow running hose is effective as long as runoff is monitored and managed. A good soaking every month this time of year will save many trees from a premature death.



Entomological Association of Southern California



Quarterly Meeting



September 10 9:00 am - 3:00 pm

9:00 a	m: me and announcements
Mark I	10:30 am: Hoddle, University of California, Department of Entomologyes on Asian citrus psyllid biocontrol in Southern California.
	11:00 am: y reports
Mark I	am to Noon: Hoddle, University of California, Department of Entomology and palm weevil invasion in Laguna Beach"
	- 1:00 pm: on your own
Matt E "Urbai	2:00 pm: augherty, University of California Dept. of Entomology infestations of the Asian citrus psyllid: how effective are intial and nursery treatments?"
Anna Count <i>Biolog</i>	3:00 pm: Howell, University of California Cooperative Extension Ventura y and Biocontrol of the Lewis Spider Mite: an emerging pest in perries