Unlike forest trees, urban trees must adapt to a number of environmental stressors. These include compacted soils, contaminants, diseases, high temperatures, mechanical damage, restricted root systems, and more.

In cases where water stress occurs over a short period of time (such as a single growing season), homeowners will observe wilted leaves, leaf scorch, or leaves prematurely dropping from the tree. The effects of long-term (more than a growing season) drought on plant health are less obvious, but more serious.

Because Mississippi has experienced increasingly frequent periods of drought in the past several years, it is important for homeowners to learn how to identify symptoms of drought stress and how they can keep their trees healthy.

**Signs of Drought Stress**

Droughts stress trees and cause them to be more susceptible to diseases, pests, and structural damage than they would be under normal, healthy conditions. Without water, trees are unable to uptake and transport minerals or nutrients. There is no metabolic process, including photosynthesis or the manufacturing of food for the plant. During a drought, the fine root hairs die, reducing the tree’s capacity to absorb water. Drought effects can vary, depending on tree species, health, vigor, and location of the tree.

Drought symptoms include browning across the entire tree; however, large areas of dying foliage will exist on the side of a tree crown with a damaged root system. Immediate visible effects include wilting, scorch, and defoliation (loss of leaves).

**Scorch.** Leaf scorch occurs when leaves turn yellow-brown starting from the outside edges (Figure 1). Leaves can also become chlorotic (yellow or yellow-green).

**Defoliation.** Because the root system is damaged, the tree often loses its canopy, starting at the top and middle of the crown (Figure 2). Canopy loss is an adaptation to aid in balancing foliage with the diminished root system.
Similar to broad-leaved species, conifers respond to drought from outside to inside, starting with the tip and moving downward as fine feeder roots die. The needles turn shades of yellow, red, and brown (Figure 3).

**Producing seeds and suckers.** Other indications of stress include heavy seed production and suckers (Figure 4) on the side of the tree (also known as epicormic branching). However, these symptoms could result from a number of causes in addition to drought stress.

(left) Figure 3. Long-term drought effects on *Pinus* spp. Source: William M. Brown Jr., Bugwood.org
(right) Figure 4. Epicormic branching. Source: Joseph O'Brien, USDA Forest Service, Bugwood.org

(left) Figure 5. Ips beetle. Source: Ronald F. Billings, Texas A&M Forest Service, Bugwood.org
(right) Figure 6. Armillaria root rot. Source: USDA Forest Service – Northeastern Area, USDA Forest Service, Bugwood.org
**Insects, parasites, and diseases.** Additional indicators include boring insects (Figure 5), root rot (Figure 6), spider mites (Figure 7), and mistletoe (Figure 8). Pine beetles are common in severely drought-stressed pine trees. A common observation in drought-stressed Mississippi pine trees is the Ips beetle.

Hypoxylon canker (and other cankers) is more likely to develop because the tree has reduced capacity to isolate small wounds, which allows invasion of a variety of pathogens (Figure 9). Close inspection may reveal small, poorly formed buds.

**Branch dieback and breakage.** The previous year’s drought may not become evident until spring, when weakened branches break in spring storms. Decline can continue for the next couple of years as the tree uses up its energy reserves and tries to resist diseases and pests taking advantage of the effects of drought stress. As the drought persists, branch dieback continues in the same pattern, starting at the middle top and spreading into the interior of the crown.

**Death of the tree.** After a few years of water stress, the entire plant may eventually die, even if rain or irrigation becomes available. Armillaria root rot, for example, may take years to kill the tree, even after the drought has ended.
Alleviating Drought Effects

Medium-sized trees can transpire (lose water) at a rate of around 80 gallons per day or up to 2,000 gallons per week. The task for the homeowner is not supplementing rainfall, but helping the tree survive until it rains again.

The soil should be moist to a depth of 12 inches below the surface. Slow, deep watering is preferred over fast, shallow watering. Water for a long time to saturate the soil to a great depth and encourage deep root growth for better adaptation to the site. Newly planted, 2- to 2.5-inch caliper trees need at least 1 inch of rain per week, but they do not have enough water-absorbing roots.

Soaker hoses. Whether you have an established or new tree, a good approach is to place a soaker hose around the base of the trunk for a half-day of watering once a week. You want to water when there is dew formation (just before daylight) to avoid evaporation. Watering before daylight does not alter the natural cycle of wetting and drying, and it’s easier on your wallet.

Sprinkler system. One way of measuring water irrigation using a sprinkler system is to place a can next to the tree and stop watering when 2 inches of water accumulate in the can. In contrast to slow watering systems (such as soaker hoses, drip emitters, and watering bags), sprinkler systems are designed for turf rather than trees. These systems are not ideal for trees and can lead to excessive watering and root rot. The goal is to apply moisture to the soil without exceeding the infiltration rate.

Mulch. Mulching helps keep moisture around tree roots and encourages microbial and insect life underneath as organic matter decomposes. Apply 2–4 inches of mulch to the drip line (the imaginary ring constituting the edge of the tree crown). However, mulch should not be piled against the trunk; the trunk must be in contact with fresh air to prevent fungal growth.

There are several types of mulch. Pine straw is effective, pleasing to the eye, and does not attract wood-boring insects or float away like bark or wood chips. The downside to pine straw is that it breaks down faster than woody material. Stone or chopped up tires can also be used; however, these are expensive, and they don’t add nutrients to the soil as organic mulches do as they decompose. It can also be difficult to weed in artificial mulch. If yard leaves are used, they should not be piled against the trunk, and, again, the pile should not be over 4 inches after settling.

Other Considerations for Planting and Managing Trees

- Plant tree species that are suited to your site. In other words, do not plant a water-loving tree in a dry location. Consider xeriscaping (using plants adapted to dry climates) or landscaping.
- Do not fertilize trees that are water-stressed. Fertilizers are made of salt and can make conditions worse. Nitrogen encourages growth, which would increase the tree’s demand for water.
- Do not prune a drought-stressed tree except to reduce the risk of branch failure. Pruning to compensate for root loss is rarely effective and can be detrimental to the tree.
- Be aware of any restrictions on water use that may apply to your community.
- Trees on a slope or on sandy soils may need more watering than trees in soils that hold more water. Trees on a slope may also need a soaker hose or drip emitter.
- Never transplant a tree during a drought; it will not survive because it won’t be able to establish its root system.

Trees are readily adaptable to water stress, but long-term drought conditions can lead to decreased overall tree health and increased likelihood of tree death. Signs of prolonged drought stress include leaf scorch, dieback, and root problems. Homeowners can lessen the effects of drought by planting the right tree in the right place and using slow, systematic irrigation and mulch.