RESEARCH LABORATORY TECHNICAL REPORT

BARTLETT TREE EXPERTS
SCIENTIFIC TREE CARE SINCE 1907

Drought and Landscape Plants

By The Bartlett Lab Staff

Moisture deficiency is the most common stress encountered in the landscape. Usually, this is a temporary condition and has minimal impact on plants. Periodically, though, drought conditions may persist for several months or years and can significantly affect plant health and survival. Unfortunately, extended droughts have become the norm. In the past decade, significant rainfall shortages have persisted for multi-year periods on at least two occasions in the eastern portion of the United States.

Effects of Prolonged Drought on Plants

Moisture stress adversely affects virtually every physiological process in the plant. The first response is closure of leaf stomata. This reduces transpiration water loss and acts as a defense mechanism. However, with the stomata closed, carbon dioxide is not absorbed and photosynthesis is curtailed. This reduction in photosynthesis ultimately limits growth and increases susceptibility to disease and insect pests.

Water stress also inhibits the production (synthesis) and translocation of essential materials in the plant. In addition to less carbohydrate (food) production, proteins, enzymes, growth regulators, mineral nutrients and other essential materials for life are not produced and/or translocated in the plant. These factors further contribute to reduced growth and development.

Restricted growth and vitality manifest as stunted chlorotic leaves, premature defoliation, crown thinning, bark splitting (Figure 1), and poor shoot growth. This smaller photosynthetic area further impedes the plant's ability to produce carbohydrates even after the drought has ended. Landscape plants typically require several years to recover fully from drought due to a lowered capacity for food production. Growth reduction is often most severe the year following drought. In combination with other stresses such as transplanting, root damage from construction, soil compaction, defoliation, and old age, trees can decline and die from drought injury.

Figure 1: Bark splitting as a result of drought stress

Drought-stressed trees often attract insect pests and disease organisms as well. Common insects and diseases found on drought-stressed plants include borers, bark beetles, and canker and root disease fungi. These secondary invaders accelerate decline and may ultimately cause the death of the plant.

Symptoms of Moisture Stress

Moisture stress symptoms on broadleaf plants are usually first evident on older foliage. Typical symptoms include wilting, chlorosis, browning of leaf margins (scorch), and premature defoliation. Eventually shoot growth and new foliage become stunted and chlorotic. On conifers, wilting and premature browning and drop of older needles occurs (Figure 2). New growth is stunted and needle tips become brown.

During prolonged droughts, twig and branch dieback may occur. Plants stressed by root loss may suddenly wilt and die.

Figure 2: Moisture stress symptoms in pom pom pine

Factors Affecting Plant Survival

The ability of landscape plants to survive drought depends on many factors which include the following:

Drought Severity

The length and severity of the drought are perhaps the most important factors influencing plant survival. Drought in early spring when water for growth is critical has the greatest impact on plant health and survival.

Plant Species

Some plants are inherently more tolerant of drought stress. Drought tolerance may be due to anatomical structures such as an aggressive, deep root system or thickened, waxy leaves. Drought tolerance may also be due to physiological responses within the plant.

Soil Conditions

Soil type, organic matter content, fertility levels and other soil factors affect drought tolerance. Plants growing in sandy soils with low moisture-holding capacities are most sensitive to drought. On heavy clay soils or those that are compacted, root growth is restricted, which can predispose plants to drought damage. Loam soils with at least 5% organic matter are conducive to root development and water retention. Nutrient deficiencies can intensify the effects of drought stress. A deficiency of nitrogen or micronutrients can further impede photosynthate production. Phosphorus deficiency can restrict root growth and potassium deficiency can interfere with normal functioning of the stomates affecting internal water relations.

Additional Stresses

Landscape plants are subjected to a wide range of stresses that can intensify the effects of drought. Root damage from construction, transplanting, soil compaction, and pavement over the root system have profound effects on plant survival. Landscape plants must compete with turf or other ground covers for water and nutrients, which also intensifies the effects of drought. Other stresses that weaken landscape plants include old age, defoliation from pests, bark wounds, reflective heat from pavement and buildings, and chemicals such as air pollutants, herbicides, and deicing salts.

Secondary Invaders

“Secondary Invaders" refers to insect pests and disease organisms that are capable of invading plants after they are stressed. Certain borers (Figure 3) are very prevalent in drought-stressed plants. For example, the two-lined chestnut borer invades the branches and leaders of weakened oak and beech feeding in the inner bark and sapwood by constructing galleries (tunnels) that impede the movement of water and nutrients. This can result in branch dieback, decline, and possibly tree death.

Figure 3: Example of a borer larva

Bark beetles are common pests of pines and other conifers. They feed in the cambium area of the trunk by constructing galleries. In addition to impeding water and nutrient transport, bark beetles may introduce a fungus that grows in the vascular system which further blocks water transport and accelerates decline. Certain spider mites and aphids are usually more active on plants during droughts. Heavy rains tend to wash mites and aphids from leaves. Drought also reduces beneficial insect populations that prey on mites and aphids.

Old plants subjected to drought stress are also likely to be invaded by root disease fungi. Armillaria is a common fungal pathogen that affects a wide range of trees and shrubs that have been stressed by drought and age. Phytophthora root rot also is more prevalent on plants when heavy rains follow severe droughts.

Canker diseases are common on drought stressed plants. Cankers are caused primarily by fungi which invade through wounds in the bark. Most of these fungi are weak pathogens that live primarily on dead twigs and branches. When live plants are subjected to moisture stress, these fungi invade living tissue causing girdling and dieback of branches and stems. Alleviating moisture stress usually prevents further ingress by the canker pathogen.

Preventive and Remedial Treatments

Drought-Resistant Plants

Utilizing drought resistant plants in the landscape, especially in low maintenance areas, is an effective method of minimizing the effects of drought. Consult the Bartlett Tree Research Laboratories or Cooperative Extension Service for a listing of drought-resistant plants for a given geographic area.

Irrigation

Most large landscape plants require one inch of water per week during the growing season. This is equivalent to approximately 750 gallons of water per 1000 square feet beneath the canopy. For new transplants, root damaged trees, or plants growing in sandy soil, water should be provided at least twice a week. Water should be concentrated on the root ball of new plantings. On established plantings in clay or loam soils, the recommended quantity of water should be supplied at least once each week. Drip irrigation systems or soaker hoses usually are most efficient since they irrigate only the root zone and minimize runoff. Tensiometers are also very effective tools for rapidly assessing irrigation needs.

Mulches

Mulches help conserve soil moisture and reduce competition for water from weeds. They add organic matter to the soil which promotes root development and improves the soil moisture-holding capacity. Mulched, natural areas eliminate competition for water and nutrients from turf or other ground covers. Any organic mulch including wood chips, shredded bark, bark nuggets, pine straw, leaves, etc., is useful for mulching. Wood chips from tree pruning operations are a particularly effective and inexpensive mulch. Mulches should be applied to a depth of 2-4 inches around landscape plants. Do not exceed this depth around trees as this could be detrimental. Preferably, mulches should be applied to the "dripline" of the plant whenever possible. However, a narrow mulch ring around plants is better than no mulch. Do not apply mulch against the stem or root collar of plantings.

Fertilization

Maintaining adequate soil fertility will help prevent nutrient stress and minimize the effects of drought. Slow release fertilizers are generally optimum for the

growth of woody plants. Avoid agricultural grade fertilizers which have a high salt content that can intensify drought stress. For best results, base fertilizer treatments on soil analysis results.

Fertilizer should be applied after the drought has ended and soils are recharged by rainfall. Applying nutrients during a drought will have little impact on plant growth because water is the limiting factor. High salt fertilizers can also severely injure plants if applied to dry soils.

The addition of commercially available mycorrhizae products that contain live fungal spores may be beneficial, especially on trees affected by root problems. Research has shown that these products may stimulate root growth, particularly when applied with fertilizer.

Pruning

Dead and dying limbs on landscape plants should be removed. These limbs may harbor insect borers or canker disease fungi that can contribute to further dieback and decline. If crowns are very dense, light thinning will help reduce demands for water and nutrients. Avoid significant pruning of live branches because this will add additional stress from defoliation and wounding.

Anti-Transpirants

Anti-transpirants are materials applied as sprays to the foliage which provide a barrier to water loss. These materials may produce a short-term benefit by reducing transpirational water loss. Anti-transpirants may be useful on recent transplants or when trees cannot be routinely irrigated for brief periods in summer.

Pest Management

Insect pests and disease organisms weaken trees by defoliation or by causing stem and root damage that impedes absorption and translocation of water and nutrients. Drought-stressed plants are particularly prone to pest infestations. Pests should be managed using integrated pest management (IPM) principles, a technique of periodically inspecting plants for pests and other plant health problems. When detected, pests are maintained below levels that impact plant health through cultural, biological, and/or chemical treatments.

Summary

Moisture stress from drought periodically affects landscape plants. The impact of drought on plant growth varies with the severity and duration of the drought as well as other factors including plant species, soil conditions, disease and insect infection, and other stresses. A comprehensive plant health care program featuring irrigation, mulching, fertilization, proper pruning, and integrated pest management is recommended to help landscape plants withstand the effects of drought.

Founded in 1926, The Bartlett Tree Research Laboratories is the research wing of Bartlett Tree Experts. Scientists here develop guidelines for all of the Company's services. The Lab also houses a state-of-the-art plant diagnostic clinic and provides vital technical support to Bartlett arborists and field staff for the benefit of our clients.