

COPING WITH DROUGHT

A Guide To Understanding Plant Response To Drought

To develop and maintain sustainable landscapes, we need to understand the stressors that affect plant growth. North Carolina is subject to extremes of weather, from hurricanes to droughts. Although it is difficult to predict the frequency of these weather events, experts indicate we can expect greater severity, particularly of drought.

How do we come to understand the impact of extreme drought on our landscapes, and how can we cope? The first step is to educate ourselves.

Experts consider a plant to be drought tolerant if it can withstand a moderate period of limited moisture. This does not imply that a drought-tolerant plant prefers hot, dry conditions or that the drought will not adversely affect the plant. Woody plants are typically more tolerant of water stress than herbaceous plant varieties because they can store more energy in their roots and woody tissues.

How do plants respond to water stress? When a plant's roots experience a period of limited soil moisture, the plant hormone abscissic acid (ABA) signals the closure of stomata (small openings found mainly on the underside of leaves). Closure of stomata reduces transpiration (water lost from a plant through its leaves). Transpiration serves to cool the plant by pulling water and nutrients from the soil throughout the plant. A prolonged drought will therefore negatively affect plant growth by reducing the plant's capacity to regulate its temperature, and with less water, the plant can experience a nutrient deficiency, thereby reducing photosynthesis. When photosynthesis is



Witchhazel showing leaf scorch

Photo courtesy of Dr. Barbara Fair

reduced, the plant may become energy starved and be unable to support all its activities.

Woody plants exhibit both short- and long-term responses to drought. Short-term symptoms are similar to those experienced by herbaceous plants and include wilting, marginal leaf scorch (browning along edges), and loss of some foliage in an effort to preserve energy. In the long term, after severe drought, twigs and branches may die back. You may notice a reduction in flower and fruit production and a decrease in leaf size. Eventually, the damage can kill a plant, sometimes years after a drought.

Young and recently planted trees or shrubs are more susceptible to death from water stress. They have not had time to establish their root systems fully. Some plants, particularly turf grasses, will go dormant, which is normal. Based on the extent of damage to your landscape plants, you can decide to either prune the dead material or replace the plant.



Hydrangea Limelight™ showing leaf loss to conserve energy

Photo courtesy of Dr. Barbara Fair



Love grass (center) surrounded by other drought-tolerant plants: Indian hawthorn (front), liriope (far middle) and dwarf yaupon holly (far right)

Photo courtesy of Dr. Barbara Fair

How do plants adapt to dry conditions or regular drought periods? Many drought-tolerant species have thick, waxy, or hairy leaves that minimize water loss. These leaves are generally small. Some plants, such as cacti and succulents, open their stomata only at night to capture the carbon dioxide necessary for photosynthesis, when cooler temperatures mean a reduction in water loss. Plants wilt when faced with a limited water supply. Wilting redirects the leaves, reducing the amount of solar heating they intercept. Many herbaceous plants avoid drought by completing their life cycles before the annual dry period. Once established, a variety of ornamental and turf grasses grow well in hot, dry areas, and many are native to North Carolina.

In contrast, cool season turf species protect themselves by going dormant. Your lawn will recover when sufficient moisture returns. Some plants have developed extensive root systems that let them access greater soil area and potentially more water. Highly adapted plants combine many of these traits not only to survive, but also to thrive in low-moisture landscapes. Matching drought-tolerant species to the appropriate sites in the landscape is a crucial step in developing sustainable landscapes.



Photo courtesy of Dr. Barbara Fair

Opuntia spp., prickly pear cactus

During the growing season, plants must use their energy for a variety of functions such as growth, reproduction, and protection. Because plants cannot escape from droughts, floods, or construction, they must be able to defend themselves. Therefore, they have evolved a complex system of chemical defenses that close over wounds and “wall out” decay, disease, and insect organisms. When resources are limited, such as water during a drought, a plant must conserve its energy. It will favor growth and reproduction over protection because producing the protective, secondary chemicals requires so much energy. When drought is severe, a plant will reduce the production of these compounds, thereby increasing its susceptibility to a variety of other stressors, as well as to attack by diseases and insect pests. Typically, disease will not become evident until a year or two after the drought. Therefore, it is often difficult to identify water stress as the primary causal agent. Numerous diseases, considered secondary factors in plant decline or death,

include such organisms as *Armillaria*, *Botryosphaeria*, *Cytospora*, *Diplodia*, *Fusarium*, *Hypoxyylon*, and *Verticillium* wilt.



Photo courtesy of USDA Forest Service Archive, USDA Forest Service, Bugwood.org

Verticillium

In the case of most disease organisms, drought stresses plants in the year or two prior to infection. When normal rainfall resumes or properly applied irrigation follows these drought periods, disease organisms moving through the soil’s water system have an opportunity to infect the weakened plants.

Many of the canker-causing diseases such as *Cytospora* of cherry and peaches, *Hypoxyylon* of oak, and *Botryosphaeria* of apple and rhododendron are fungi that live as bark saprophytes (organisms that live off dead or decaying matter). These fungi infect stressed plants, such as those that have experienced a drought, and may lead to death of woody tissues and eventually the entire plant.

Armillaria (shoestring root rot) and *Verticillium* are common soil organisms that may or may not lead to disease. Wide varieties of plants are susceptible to shoestring root rot, which typically leads to death. Our native woodland and landscape tree redbud (*Cercis canadensis*) and many stone-fruited species such as peaches are highly susceptible to *Verticillium* wilt.



Photo courtesy of Dr. Alan R. Biggs

Leucostoma personii (also known as Cytospora canker) on peach

Not only must you keep an eye out for disease symptoms during drought, but you must also look for indications of insect activity. Some insect species simply prefer hot, dry weather, such as the two-spotted spider mite (*Tetranychus urticae*). Their populations will be high during drought, so you need to be more diligent with control measures. For more information visit: <http://www.cals.ncsu.edu/entomology/extension.html>.



Armillaria mellea
mycelia fan

Photo courtesy of U.S. Forest Service

Other insects, such as flat-headed borers, prefer plants stressed by drought, flooding, or soil compaction. Symptoms of borer activity are loss of vigor, dieback, bark sloughing, and eventual death. The immature or larval stage causes the damage. You may find small holes (often less than 1/4 inch in diameter) on the trunk or on larger branches. These holes indicate the adult exit locations. Adults may be beetles or moths. Borer control is challenging, so keeping plants healthy is key to preventing damage. Irrigating trees in disturbed urban or suburban areas during extreme drought is one important step.

What can you do to help your plants cope with drought?

Designing sustainable landscapes that tolerate a wide variety of environmental conditions is the first step. Your landscape should be able to withstand climatic conditions ranging from periodic droughts to more than 40 inches of rain in a typical year.

Start with proper plant selection. Whether you have a penchant for natives or enjoy the unusual, select the right plant for your site. Each plant has particular cultural requirements, and not all species are drought tolerant, even if they are native to North Carolina. Research the plants that interest you. Contact an Extension agent, horticultural professional, or garden center expert for guidance. Match your plant selections to the soil, light, and hardiness zone of your landscape as well as to the desired mature growth characteristics for each location.



Photo courtesy of Dr. Barbara Fair

Magnolia grandiflora, southern magnolia

Remember, assessing the health of your plants throughout the year is an important component of any sound landscape management plan. Scout for insects or disease. Familiarize yourself with the symptoms of plant stress. Make sure to protect your soils, as they support the life of plants. Avoid walking or driving over plant roots to reduce compaction. Apply mulches or composts at the correct depths. Keep turf areas aerated and healthy so when it does rain, the water will reach the roots. Cut grass at the highest possible setting for your particular species, and use sharp blades! Prune trees and shrubs to maintain the health and growth form suitable for each species. For more advice on pruning techniques and timing, visit <http://www.ces.ncsu.edu/depts/hort/consumer/agpubs/ag-071.pdf> or contact an International Society of Arboriculture certified arborist.



Photo courtesy of Dr. Barbara Fair

Ilex vomitoria, Yaupon holly

For specific help and identification of insects and diseases, visit N.C. State's Plant Disease and Insect Clinic at: <http://www.ces.ncsu.edu/plantpath/extension/clinic/>. North Carolina will likely experience extreme droughts periodically, but we will also have years with higher than average rainfall. Choose your plants wisely to ensure that you are creating sustainable landscapes, come rain or come shine!

For tips on water conservation in the landscape, check out “Water Wise Works!” at <http://www4.ncsu.edu/~bfair/> or <http://www.tarheelgardening.com/>



Larkspur and corn poppies thrive easily when directly seeded and will withstand periods of little rainfall.

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