How Drought Stress Predisposes Trees and Shrubs to Diseases

Ethel M. Dutky, Plant Diagnostic Laboratory **www.plantclinic.umd.edu**
Department of Entomology, University of Maryland, College Park

Several weather extremes are common in landscapes in the mid-Atlantic region: winter cold, late spring frosts, summer heat and summer drought. In this presentation I will discuss some of what we may expect to see in landscapes in 2006 with an emphasis on diseases promoted by growing season drought stress.

Drought, extreme winter cold and heat injury all may produce similar symptoms. All three conditions create a situation for the plant where moisture is not adequate to maintain the proper water levels in plant tissues. In the past 15 years, more than half of Maryland growing seasons have been characterized by drought, with 2002 one of the driest in recorded weather history. The fall 2005 drought was long and brutal. Spring 2006 has also been dry, as was the winter. During this period, only three growing seasons (1996, 2003, 2004) had cooler than normal temperatures and above average rainfall. Landscape plants have been subjected to repeated growing season droughts, going into winter in a stressed condition.

Extreme winter cold is similar to summer drought in that frozen water is unavailable to the plant. The air is very dry as well. In the mid-Atlantic region we often have wide swings in winter temperatures, with days in the teens followed by sunny days in the 60's or even 70's. This fluctuation in winter temperatures may disturb the winter dormancy of the plant, making it more susceptible to winter damage. The primary mechanism of this winter damage is dessication (drying) of shoots, buds and foliage. Plant tissues damaged by cold injury are often more readily invaded by bacteria or fungi, so when the damage is noticed, it may not be obvious that the primary cause was cold, as fungal structures or bacteria are present. Plant hardiness zones are partially determined by the lowest winter temperatures, and when temperatures fall one or two zones below normal, many plants may be killed outright.

Mechanisms and symptoms of drought injury:

Plants are damaged directly and indirectly. Direct damage is from dessication of foliage, buds, bark and roots. Indirect injury includes inhibition of photosynthesis, and the resulting slowing of plant growth; the inability to make defensive chemicals. In conifers this includes reduced production of pitch or resin.

Plants react to water stress in a variety of ways. The first response is that stomates close, soon photosynthesis shuts down. On broad leafed plants, the leaves may droop, roll, and older leaves may yellow and drop. This reduces water loss, and reduces the amount of tissue requiring water. If water stress continues, the edges of leaves and inter-veinal areas will yellow and brown. This is usually symmetrical, starting at the leaf tips and working back.

Conifers are better adapted to withstand winter drought stress and cold extremes than summer heat and drought, which are very damaging. Look for drop of older needles followed by browning of needle tips. If the drought continues, even current season needles will droop, gradually yellow, then brown. Needle length and twig growth may be reduced. Many conifers also exhibit resinous bleeding cankers on large branches and main trunks.

As the drought becomes more prolonged, shoots dry out and die from the tips back. Eventually the entire plant wilts, becomes crisp and dry, and does not respond to irrigation. At this point, the plant may die or be so damaged that it has lost ornamental usefulness.

PLANTS AT INCREASED RISK

Scout key plants at greatest risk of drought damage.

Plants in the first year following transplant (installation) are at highest risk. Any plant in a difficult site (where soil has poor water retention: for example compacted clay soils, or sites with limited space) will be at increased risk. Plants with poor root systems, such as from nematodes, mechanical damage from construction, root feeding insects (root weevils) or disease (*Phytophthora* root rot, black root rot) will be less able to withstand drought stress. Shallow rooted plants are more likely to be killed by prolonged drought.

Established plants have a larger root system, and so are better able to withstand short droughts, but may be damaged by extended droughts.

Table 1. Plants that are **intolerant** of drought stress.

azaleas	Eastern white pine, *Pinus strobus*
rhododendrons	Eastern flowering dogwood, *Cornus florida*
ash, *Fraxinus* spp.	Kousa dogwood, *Cornus kousa*
tulip poplar, *Liriodendron tulipifera* (yellow leaves, leaf drop)	Norway maple, *Acer platinoides*
sweet gum, *Liquidambar* spp.	Japanese maple, *A. palmatum*
Skimmia, *Skimmia japonica*	horse chestnut, *Aesculus* spp.
Stewartia, *Stewartia* spp.	Canadian hemlock, *Tsuga canadensis*
English ivy, *Hedera helix*	Franklin tree, *Franklinia alatamaha*
flowering cherries, *Prunus* species and hybrids	ornamental plums, *Prunus cerasifera*

Select “tough” plants for difficult sites. A difficult site is one where drought stress will be more severe because of site orientation (south facing slopes, heat reflected from pavement or buildings), soil characteristics (sandy, gravelly, or heavy compacted clay) or restricted soil area (containers, traffic islands).

Table 2. Stress **tolerant** trees and shrubs.

Amur cork tree, *Phellodendron amurense* Amur maple, *Acer ginnala* Amur privet, *Ligustrum amurense* Anthony Waterer spiraea, *Spiraea* x *bumalda* 'Anthony Waterer' barberry, *Berberis* spp. bayberry, *Myrica pensylvanica* bearberry, *Arctostaphylos uva-ursi* birch (gray), *Betula populifolia* blackhaw viburnum, *Viburnum prunifolium* bush cinquefoil,*Potentilla fruticosa* chaste tree, *Vitex negundo* common witchhazel, *Hamamelis virginiana* most crabapples, *Malus* spp.	serviceberry, *Amelanchier* spp. Turkish filbert, *Corylus colurna* ginkgo, *Ginkgo biloba* glossy abelia, *Abelia* x *grandiflora* golden raintree, *Koelreuteria paniculata* holly (most), *Ilex* spp. ironwood, *Ostrya virgiana* Japanese pagoda tree, *Sophora japonica* Japanese tree lilac, *Syringa reticulata* Japanese zelkova, *Zelkova serrata* red maple, *Acer rubrum* Tatarian maple, *Acer tataricum* trident maple, *Acer buergeranum* mimosa, *Albizia julibrissin*	pin oak, *Quercus palustris* white oak, *Quercus alba* **Conifers:** Adams needle, *Yucca* spp. Atlas cedar, *Cedrus atlantica* yews, *Taxus* spp. Eastern red cedar, *Juniperus virginiana* Pfitzer juniper, most junipers Japanese black pine, *Pinus thunbergii* Mugo pine, *Pinus mugo* Scotch pine, *Pinus sylvestris* Norway spruce, *Picea abies* Colorado blue spruce, *Picea pungens* Serbian spruce, *Picea omorika*

DISEASES PROMOTED BY DROUGHT:

Drought stress promotes diseases through several different mechanisms. It may alter the plant's physiology, making it more susceptible. It may reduce the ability of the plant to produce defensive chemicals or to "out grow" the disease. More severe drought stress causes physical injury to tissues through drying; damaged tissues are then easily invaded by otherwise "weak" pathogens. Drought can make the plant more attractive to the insect vectors of some diseases.

Specific examples:

***Armillaria* root rot**, due to physiological changes in the stressed tree which stimulate the *Armillaria* fungus to shift into aggressive growth mode, and hasten death of the tree.

Dutch elm disease, because drought stressed trees become much more attractive to elm bark beetles (the vector fro the fungus), actually attracting them to lay eggs in the tree.

Pine wilt nematode, because drought stressed pines cannot make resin which may protect from "beetle maturation feeding" infection; and because drought stressed trees attract the long horned pine sawyer beetle vector to lay eggs in the tree (another opportunity for infection).

***Verticillium* wilt**, because drought stress inhibits the tree's ability to "wall off" the fungus. This allows the fungus to invade more of the wood. Drought stress increases symptom expression. Infected trees will exhibit much more severe symptoms following drought stress.

Many canker fungi appear to require that the tree be stressed in order for disease to occur. In many cases this is a complex situation where both drought stress as a pre-disposer and wet conditions to allow infection are required. Some example include *Botryosphaeria* cankers (redbud, apple, rhododendron, many others); *Cytospora* canker of conifers (spruce); *Cytospora* canker of *Prunus*, willow and maple; *Hypoxylon* canker of oaks; *Nectria* cankers in many hardwoods; Fusarium cankers (especially following late spring frost injury); *Seiridium* canker of Leyland cypress; *Diplodia* (*Sphaeropsis)* canker on two needle pines.

If plants have a root disease (fungal or nematode) they will be more rapidly and severely damaged by drought.

WHAT CAN BE DONE?

Control weeds and grasses in the root zone to reduce competition for water. Organic mulches can help conserve soil moisture and control weeds.

Irrigate to replace soil moisture in the root zone before severe drought injury symptoms appear. This is essential for the survival of recently transplanted trees and shrubs. Place highest priority for supplemental water on plants in the first 3 years following installation. **Gator bags** are very helpful!

Monitor for spider mites and control before severe foliar damage is seen. Hot, dry weather promotes spider mite population explosions. Damaged foliage does not recover.

Remove dead and dying trees as promptly as possible. This is important to prevent them from serving as breeding grounds for bark beetles and other borers.

Avoid planting highly drought susceptible and shallow rooted species (see table 1) in drought prone sites such as south facing slopes, traffic islands, containers, compacted soil. Select more drought tolerant plants for these difficult sites (Table 2).

Amend soil with organic matter to improve moisture retention and porosity, which will permit better root growth and plant establishment.

If the drought is persisting into early winter, consider irrigation to ensure that plants go into winter dormancy with adequate soil moisture.