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WOODY PLANTS UNDER STRESS

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When people see their woody plants (shrubs and trees) decline, they often want a "magical" treatment to make them lush, green and healthy again. But no magic exists. This publication should help you understand some common causes of woody plant stress, how stress leads to decline and what measures, if any, can make the tree healthy again. Remember, however, that all trees and shrubs like every living organism, will eventually die.

What Causes Woody Plant Stress?

All living organisms exist in a world of stresses. Here we are emphasizing unusual stresses that negatively affect normal health and growth of woody plants in a home landscape. Because plant problems arise from physical, chemical, biological and climatic factors, this publication defines stress as visible effects on your woody plants of one or more of these factors. You may see abnormal color or color changes, unusually small leaves, fewer leaves than normal, or a variety of other symptoms. (See also Cooperative Extension Publication, ID-52, Environmental Stresses on Woody Ornamentals).

Plant Ecology and Physiology

First, let's review a woody plant's structure by looking at a tree. Each section of the tree performs unique functions but all are necessary for it to grow in a healthy manner.

Photosynthesis or food-production takes place in the **crown**. Foliage utilizes water and nutrients taken by roots and combines them with carbon dioxide from the air and energy from the sun to produce carbohydrates that fuel life processes of a tree. When something interferes with normal photosynthesis, the tree produces less food for ongoing life and less reserves for the future. The time of year when photosynthesis is disturbed determines whether this year's or next year's growth is affected. Early season problems tend to affect the current year's growth, while late season problems tend to affect the next year's reserves.

The **trunk** (or bole) physically supports the crown, conducts nutrients and water up from the roots to the crown and conducts food down from the crown to the roots. Protected by bark, it serves as the tree's vital circulatory system. Inner bark is where new woody material is formed each year and also is where the transport system is located.

The **roots** support the plant, absorb water and nutrients from the soil for photosynthesis and "breathe." Their location is important. Because 90% of a tree's small feeder roots are in the top 6 inches of soil, the root system often extends outward from the trunk much farther than the branches. Many people mistakenly think that roots end at the dripline (the farthest edge of the branches), but they usually extend much farther. Therefore, fertilizing and other cultural practices should start within the dripline and extend outward at least half again as far as the distance from trunk to dripline.

Note: Since roots do not observe property lines, you may need to water and fertilize your neighbor's property to help one of your stressed plants.

Physical Stresses

The Wrong Place

Consider a plant's native environment. Species of plants have adapted to specific conditions over millions of years. Take the dogwood: in its native habitat it grows under forest trees or near the forest edge, always in partial or full shade. Leaves and stems die when the tree grows in full sun, because of heat and the wind's drying effects. Such constant stress may also make the tree more susceptible to insect and

disease attack.

Any time you place a plant into an environment where it is not native, you are removing it from conditions where it has thrived and are placing it in a stressful situation. In a new location it may be attacked by new insects or diseases or it may affect or be affected by other plants. Imported plants put in areas with soil types and/or climatic conditions similar to their native environment will probably have a better chance of surviving than ones not so well located. Follow these guidelines as you plant:

- **Don't put plants into locations that they will outgrow.** Be sure to ask how big your tree or shrub will be when mature before you buy it from a nursery. How far will its crown spread? How tall will it be? How big around will the trunk be? Because tree roots extend far beyond the spread of the crown, you should expect the root system to expand twice as far as the expected mature crown spread.
- **Avoid physical barriers** such as building foundations and paved roadways. They inhibit the root system's expansion and therefore shorten a tree's life span.
- **Avoid planting large woody plants in shallow soils** with solid bedrock underneath. Such soils will force the root system to stay abnormally close to the soil surface where it may be more prone to drought and may require more regular watering during dry periods. This situation also makes trees more prone to windthrow.

Soil Compaction

Good soil for plant growth must be loose enough to provide spaces for air and water. Compaction is compression of soil so that these spaces are reduced in size and number. Factors affecting soil looseness include:

- Foot traffic from people and/or animals (either livestock or pets);
- Vehicles;
- Paved driveways, sidewalks and roads, that limit the effective functioning of tree roots beneath them;
- Construction, that often compacts soil with heavy equipment;

Further construction problems include:

- Removing soil from the root zone, which causes exposure and root mortality;
- Adding soil to the root zone which causes overfilling and reduces the oxygen essential for root respiration (breathing). If fill is unavoidable, use tile drainage with a tree well. Consult a certified arborist or landscape contractor before beginning construction.

Pruning

Poor pruning practices, especially topping of trees, harm trees and shrubs. Aside from being unsightly, topping removes all normal leaf-bearing woody material and causes heartrot. Trees are weakened because they must take extra energy from their reserves to produce new foliage-bearing branches.

Topping trees to avoid power lines simply aggravates the problem. Trees will form many fast-growing water sprouts that grow vertically and soon interfere again with the lines. Careful directional pruning, done by a trained arborist, encourages branches to grow primarily away from lines and can permanently solve the problem.

Not only is the method of pruning important but the time of year can also be critical to the plant's continued good health. **Know what methods are appropriate for the woody plants you have.** (For more detailed information see Cooperative Extension publications HO-59, Pruning Landscape Shrubs, and ID-55, Warning: Topping is Hazardous to Your Tree's Health.)

- Some deciduous trees are best pruned during the dormant season (winter, early spring).
- Certain flowering shrubs and trees should be pruned only after flowering.
- Pines, spruces, maples, elms, beech, birches and yellowwood may "bleed" excessively if pruned in late winter or spring.
- Many shrubs and trees benefit from shearing or trimming during the growing season, but usually not in early spring when buds first break.

Bark and Wood Damage

Bark and wood on tree trunks are often inadvertently damaged by bicycles chained to trees, automobile collisions and carelessly operated lawn mowers or weed trimmers. Every nick on the bark provides a potential entry site for insects and disease organisms that are constantly present in the environment but normally excluded by the physical barrier of intact bark. Further, removal of bark not only interrupts circulatory activity at that point, but inhibits the tree's ability to make new woody material for that year. If the wound is not fatal (e.g. complete girdling of the tree) energy will go into its healing. Interruption of the two-way transport of carbohydrates, nutrients and water disrupts the ability of either crown or roots to perform effectively.

Chemical Stresses

Plants can also be seriously damaged by toxic materials in the atmosphere or soil. Air pollutants, such as sulfur and nitrous oxides from fossil fuel combustion (e.g. vehicles, power plants, industries) can cause localized problems such as "burn" on roadside plantings of trees or shrubs constantly exposed to vehicular exhaust. Ozone, another atmospheric factor that occurs naturally at low levels, damages leaf tissue at high concentrations. Studies indicate that acid deposition, whether as solid particles, fog, dew or other precipitation, does affect acidity of soil, but it is still unclear whether such acidification is enough to be harmful to roots or tree growth.

Salt applied to roads for snow or ice control can infiltrate soil around woody plant roots. Salt can change the soil pH and damage roots, in turn affecting leaves and branches dependent on those roots for water and nutrients. Spray that cars whip up off salted streets can float like fog for up to 100 yards, killing or damaging stems and buds on nearby dormant plants. Evergreens suffer even more severe damage from salt than broadleaved trees because they carry live foliage during winter months. Likewise, excessive application of fertilizer or injection of fertilizer into soil in localized spots can also kill roots they contact.

Biological Stresses

Some obvious problems for woody plants are insects and diseases. Such stresses often create holes in leaf tissue, obvious discoloration, or distortion of leaf shape in one form or another. Defoliating insects, such as gypsy moth, are capable of completely removing live foliage in spring and early summer. Often trees and shrubs can produce a second set of leaves after such defoliation, but repeated defoliations weaken plants considerably. Once weakened by such activity, trees and shrubs often become more susceptible to secondary invaders such as boring insects and canker fungi. (Several Cooperative Extension publications are available on insects and diseases of shrubs and trees. Contact your county Extension agents for details.)

Climatic Stresses

Weather patterns are never stable. Extremes in heat and cold or sudden temperature changes have occurred when, normally, a slow warming or cooling trend might have been expected. Also, long periods when the soil has been excessively dry have been followed immediately by periods when the soil has been saturated. These stresses have killed many established plants and badly damaged others.

The interaction of wide swings in weather causes the greatest plant damage. For example, in 1983 Kentucky experienced the second worst drought of the century and many trees and shrubs were forced into dormancy during the growing season. Fall brought rains and unseasonably warm temperatures. Instead of beginning the normal process of hardening off for winter, many plants began putting on growth. When all-time record lows were experienced in December and January these plants were killed or severely damaged. For example, southern magnolia (at the northernmost edge of its natural range in Kentucky) was severely damaged, in most cases losing its evergreen foliage and dying. Many trees and shrubs continued to show symptoms of decline in years following the 1983 drought. Long term effects of severe climatic conditions are not unusual in woody plants.

Periods of saturating rains in spring when trees and shrubs are beginning their new shoot and leaf growth are particularly damaging. Water excludes oxygen from soil and can result in "suffocation" and death of the lower root system. This lower root system is necessary for uptake of water and nutrients during dry

periods when feeder roots close to the soil surface may dry out and die. If drought damages feeder roots after saturating rains have damaged the deep root system, woody plants will suffer.

Too little water can be equally, if not more, damaging. Although you cannot remove excess water from the soil, you can water trees and shrubs during dry periods. One to 2 inches of water must enter the soil each week during spring, summer and early fall. If the 1-2 inches does not occur as natural precipitation, you must supplement it. A little sprinkle each day (for example, a tenth of an inch or less) will be more harmful than helpful and results in the formation of surface roots.

Spotting Symptoms

How can you tell your plants are declining from stress? Careful observation and common sense are the keys. Look for dead limbs, leaves that are off-color (pale green or yellowish in summer), leaves drying out or margins (edges) of leaves turning brown, premature leaf drop, premature fall coloration in late summer, holes in leaves or skeletonized leaves (no green part, just veins), very short areas of new twig growth, and the presence of insects and/or diseases.

You can be organized about your observations.

- Watch newly established woody plants carefully throughout the first two growing seasons.
- Take pictures of valuable trees and shrubs annually to help you detect changes from year to year.
- Ask for help from your county extension service. Submit samples (including branches, twigs and several leaves) through your county extension office when the problem first occurs.
- If necessary, your county agent may consult the Plant Disease Diagnostic Lab or one of the Extension specialists in Horticulture or Forestry at the University of Kentucky. Careful and frequent observation is important because once the problem is easily visible, it has already become serious, if not irreversible.

Treatment

What can you do once you know that a plant is suffering from severe stress? The following list includes some very practical steps. If you do not yet have serious problems, these suggestions may be preventive medicine.

Avoid Drought Stress

If your plants have suffered from drought stress, make sure they do not suffer that stress again.

Landscape plants should receive at least the equivalent of 1 ½ inch of rainfall per week during the growing season. If there are dry spells, water with hose or sprinkler until enough water has collected in a pan. If this level of watering causes runoff, three shorter periods of 1/2 inch of water each time during the day may be necessary. When watering, remember that tree roots extend well beyond the dripline. Use a soaker hose or some other slow-release method of watering, and move it around the tree area during the soaking period.

Mulching 2 or 3 inches deep with some organic material (compost, sawdust, woodchips, etc.) around newly planted shrubs and trees will help retain moisture for roots and provide protection to the trunk from lawn equipment.

Prune

Get the advice or services of a trained certified arborist or qualified landscape contractor for corrective pruning on your tree. You should remove dead limbs from the affected tree because of potential liability from falling branches, and selectively remove other limbs to improve the plant's form or health.

Removing some live material will reduce the demand on the root system and allow the whole tree to renew itself. Never top the tree or remove more than a quarter of the live crown.

Fertilization

When deciduous plants go into dormancy in the fall, apply fertilizer to improve their vigor the following growing season. If you already fertilize your lawn around trees, additional fertilization should not be necessary. Otherwise, you can apply (at normal lawn application rates) ammonium nitrate or a complete

fertilizer (e.g. 10-10-10) divided into equal parts two or three times during fall or winter (November to January). The ground should not be frozen and it should be free of snow cover when applying fertilizer. Most woody plants will show better summer and fall color, fuller growth and greater hardiness following this treatment. Fertilization can be repeated annually or biennially for as long as rapid growth is desired or the stress continues.

Some plants may be too old or severely damaged to show positive results from the addition of fertilizer. Nitrogen added to trees under severe stress may actually increase the rate of decline. These severely stressed plants may put on more top growth than the root system is able to support resulting in depletion of stored carbohydrates. However, these severely stressed plants may recover on their own if watered and protected from other injurious factors. Making a decision is a judgment call in which you should consult a certified arborist or other green industry professional who has had extensive experience in saving declining trees.

Conclusion

Good management of your valuable woody plants may involve both "preventive" and "curative" medicine. Tips to remember for maintaining healthy plants in your home or farm landscape include:

- Plant species that are adapted to Kentucky's climate and plant them in situations that mimic their natural environment.
- Monitor woody plants during the growing season for signs of abnormal growth or general poor health, as well as for signs of harmful insects or diseases.
- Be very careful with equipment such as mowers and weed trimmers so that you do not damage tree bark.
- Keep trees and shrubs adequately watered during dry periods.
- Fertilize lightly during late fall or early winter to improve growth for the following year.
- If you are unsure how to prune trees and shrubs correctly, have a trained arborist or landscape contractor do corrective pruning of dead or dying limbs.