

Tree Decline

A natural forest typically begins as a large group of small trees, perhaps as many as several thousand to the acre. Over a period of many years, the numbers are reduced to only a few large trees per acre. Foresters, farmers and gardeners have long realized that an acre of land can produce only a certain amount of plant growth for either many small stems or for a few large ones.

In general, the plants that survive are those that are best adapted to local growing conditions and those best able to compete effectively for sunlight, moisture and plant nutrients. There is a tendency for the strong plants to get stronger and the weak plants to get weaker, eventually resulting in a natural thinning process. As the eventual losers decline in vigor, a few will pass out of the picture each year. Periods of drought, early and late frosts, wide fluctuations in temperature, insect and disease epidemics, wildfire and other forces may speed up the natural selection process.

As with humans, a decline in vigor makes plants more susceptible to other problems (Figure 1). Insects and diseases, alone or in combination, may cause tree decline and eventual death. In unmanaged forests, natural forces determine which trees are removed. In managed forests, professional foresters make the decisions about which trees will be removed to achieve management objectives.

This publication focuses on what takes place in the process of tree decline and how it is distinguished from tree death. The latter may be specifically attributed to particular single causes such as oak wilt, Dutch elm disease or pine wilt disease. Whether a tree declines as part of the forest or as a shade tree in a yard, some of the same general principles and causes are often involved. Understanding the reasons for decline may help you prevent, reduce or sometimes reverse decline of your yard or woodland trees.

Stress as a cause of tree decline

Various stresses cause reduced tree vigor and allow secondary diseases and insects to cause further decline or death of branches, roots, or sometimes entire trees. One of the major causes of stress in trees is planting them in locations to which they are not suited. Some examples:

- Planting acid-loving trees in alkaline soils increases the likelihood of stress.



Figure 1. Various stresses cause reduced tree vigor and allow secondary diseases and insects to cause further decline or death of branches, roots or sometimes entire trees. (Photo by Robbie Doerhoff, Missouri Department of Conservation)

- Planting warm-weather trees in cold climates or moisture-loving trees in droughty soils almost guarantees a life of stress.
- Planting trees that require full sunlight in the shade of other trees will also cause stress. A small pine tree planted in the shade of a group of oak trees will never fully develop.
- Trees that have the potential for large size should not be planted in confined locations. For example, oak, pecan or other trees that develop large tops and wide-spreading root systems should never be planted in a 4-foot by 4-foot hole in a sidewalk or street location. Such trees are generally short lived under these conditions.
- Planting trees that are intolerant of air pollutants where high levels of pollution are expected is not a good idea. For instance, trees such as white pine, larch, sugar maple, white ash and yellow poplar, which are sensitive to ozone, should not be planted along freeways where traffic is heavy. Instead, trees more tolerant of ozone such as eastern redcedar, black locust or bur oak should be considered.
- Planting a tree that normally grows on dry upland soils in low swampy areas is unwise. Wet area species such as pin oak, red maple, sycamore, sweetgum or bald cypress could be among the logical choices in such situations.

Another major cause of stress in trees is allowing too many of them to occupy an area. Crowded trees compete with each other for nutrients, moisture and sunlight. Not all will survive when trees increase in size. Although some trees

will eventually dominate, their growth is slowed and stress is created until the final survival decision is made by nature.

Many other factors also place trees in stressful situations and eventually lead to their decline:

- Periodically, extreme conditions such as severe drought or flooding occur. Disease or insect epidemics may sometimes affect enough trees that people become concerned about the situation. Heavy defoliation can be caused by insects such as the variable oak leaf caterpillar, green striped maple worm, the elm leaf beetle and the gypsy moth. Repeated heavy defoliations seriously weaken trees and may well lead to problems that can show up several years later. In the United States, oak species periodically decline on a massive scale. In general, these situations have involved adverse weather factors combined with defoliation by insects or diseases. Finally, attacks on weakened trees by such things as root rot or trunk cankers or tree-boring insects result in serious decline and eventual death.
- A similar situation often occurs on a smaller scale among shade trees following new residential construction. Soil compaction by construction equipment, grade changes resulting in root damage from soil removal, or root smothering by fill dirt are among many factors that cause stress. Decline may not become evident for several years.
- Compaction or other alteration of the soil over the roots will occur where the children's swing set or the family dog pen is placed. Other residential yard activities may further contribute to the problem. The slightly acid soil that oaks prefer may be altered by applying lime recommended for many turfgrasses.
- Alterations of natural drainage to move water swiftly away from the house also may reduce the moisture available to the shade trees.
- Construction of driveways, sidewalks and streets can drastically modify the environment to which large shade trees have grown accustomed in early life. Many woodland trees are simply unable to survive the changes associated with their urbanization.

Many stress situations such as those listed can be avoided by checking with a tree care professional or by acquiring a knowledge of the cultural requirements of different tree species and the characteristics of the area in which the trees are located or will be planted.

Symptoms of decline

Symptoms of decline may develop quickly or they may not be noticeable for years. Early symptoms include premature fall coloration, late spring leaf development, decreased twig and stem growth, leaf scorch, death of tissues between the leaf veins, and premature leaf drop. Later symptoms include dieback of larger limbs and branches; sprouting from the trunk of the tree; heavy seed crops; foliage noticeably smaller, lighter green and sometimes produced in tufts or clumps on sprout-origin

tissues. The foliage over the entire tree may also look thinner in decline conditions.

Certain fungi that cause stem canker or root infections are often associated with the decline of many tree species. When trees are under stress, physiological changes occur in the roots, allowing the fungi to infect and kill them. In the autumn, clusters of mushrooms may form at the base of trees that have been infected. These growths indicate that root and trunk infections are present.

Many wood-boring insects are also associated with the decline of trees. The ash borer, bronze birch borer and the flatheaded apple tree borer are examples of insects that breed in various hardwood tree species that have been weakened by drought, defoliation or other adverse conditions. Scale insects are also commonly associated with tree stress.

Minimizing stress and tree decline

Tree decline can often be minimized by taking these preventive maintenance steps:

- Avoid placing trees in a stressful situation. This includes selecting species of trees that are suited to the conditions of the planting location or modifying the planting site to suit the requirements of the species.
- Do not try to grow more trees in an area than it will support. Woodland owners should consult professional foresters to determine how many trees of different varieties an area will support. Similar professional advice is available to homeowners about shade tree care. Your local MU Extension center can assist you in getting this type of advice.
- For planting in stressful situations, select species that are the most tolerant of the existing type of stress.
- Remove weak and dying trees to help prevent the buildup of secondary insect and disease problems. This practice can be carried out while making harvests for fuel wood or when thinning a group of trees. Decisions about which trees should be removed or left to grow should be made with some foresight.

In caring for trees in a yard, more intensive control measures may be justified. Get an accurate identification of the problem by submitting samples to a plant diagnostic clinic. Very few foliar diseases on mature trees need to be treated with fungicides. Raking and removing fallen leaves may reduce a source of inoculum. Dead limbs may be pruned out, when warranted, to remove sources of disease or insects. Care should be given to avoid spreading disease on pruning tools by sterilizing the pruning tools with wood alcohol, household bleach or other approved disinfectants.

Nutrient deficiencies can be corrected by proper fertilization. Mulches to conserve moisture, prevent deep freezing and prevent soil crusting are usually beneficial. But do not apply mulches too deeply around stems. Properly timed watering will reduce moisture problems.

Watering to reduce drought stress

Even large, well-established trees can be damaged by a severe drought. A few well-timed irrigations can greatly reduce the stress encountered by trees during a drought and may prevent the onset of decline.

During a midsummer drought, it is common for about $\frac{1}{4}$ inch of water to be lost from the soil per day. Under these conditions, most available water would be depleted from the root zone of a tree within 14 days. If the soil is a clay loam, to completely replenish soil moisture in the tree root zone (to a depth of 18 inches) would require about 3.5 inches of water.

Fortunately, it is not necessary to wet the entire tree root zone. Irrigation applied to turf will usually supply enough water to trees in a lawn to greatly reduce drought stress. However, where turf and tree roots exist together, a rapid depletion of soil moisture will occur. These areas require more water than areas where few tree roots are present. A large mulched area under each tree will allow fine tree roots to grow near the soil surface without competition from grass roots and will allow more efficient irrigation and fertilization of both trees and turf.

If valuable trees are located in a nonirrigated area, a deep soaking irrigation every two or three weeks during a drought will prevent excessive drought stress from developing. Application of 2 to 3 inches of water over half the surface area contained within the drip line will be of great benefit to a drought-stressed tree. It may be necessary to irrigate on two or three consecutive days to apply this amount of water without runoff.

After irrigation, the soil should be moist to a depth of at least 12 inches and preferably 18 inches. Keep track of the number of inches applied with a rain gauge. The depth of water penetration usually can be estimated by pushing a $\frac{3}{8}$ - or $\frac{1}{2}$ -inch diameter steel rod into the ground. The rod will stop when it reaches dry soil.

An effective way to water smaller trees (up to 3 inches in stem diameter) is with leaky buckets. To water a tree about 2 inches in stem diameter, place four 5-gallon buckets 2 feet from the trunk in a square pattern. Two or three holes should be punctured in the sides of each bucket near the bottom so that the water will drain out in about five hours. The buckets should be refilled and moved to dry areas under the same tree two or three times and then moved to another tree. To water smaller trees, use the same procedure but with two or three buckets. If the drought persists, the tree should receive a watering cycle every week or 10 days.

A permanently installed drip irrigation system will achieve the same results as the leaky bucket technique with much less effort.

Overwatering can also seriously damage trees. It takes 62 gallons to apply 1 inch of water to 100 square feet. Applying

this quantity of water for several days to a soil that already has a good moisture supply can suffocate some of the tree roots. Inexpensive timers are available that can be attached to the outside faucet to ensure that the desired amount of water is applied.

Prevention of tree decline

Here are some ways to prevent the common causes of tree decline:

- Make sure new trees get off to a good start through proper methods of planting, fertilization, watering and pruning.
- Avoid wounding the tree with mowers, construction or logging equipment, nails, brace wire girdling, etc.
- Do not use harmful herbicides either directly on the tree or in the soil beneath it. Always follow the directions printed on the label. Damage caused by the use of de-icing salt is a common problem. It is often overlooked because of the time that passes between salt applications and the appearance of injury symptoms.
- Do not top trees to shorten their height or change their shape.
- Keep leaves, the tree's food manufacturers, healthy. Do not overfertilize or apply pesticides unnecessarily and always follow the directions on the label.
- Avoid soil compaction of the root zone to maintain proper moisture and air penetration to the roots.
- If you decide that a tree must be subjected to changes in soil grade, seek professional advice on modifying the impacts. Your local MU Extension center will have publications on how to protect trees from grade changes or they can refer you to professional assistance.
- Evergreen trees rarely survive a complete defoliation. However, most deciduous trees can tolerate one defoliation. A second defoliation in the same year or in two successive years may trigger a decline situation. Take extra precautions to avoid repeated defoliations.
- It is helpful to know what kind of trees you have in your yard or wood lot. Most species have their own specific problems. Knowing the causes of tree decline and understanding how to keep your trees thrifty and healthy will help prevent early decline or premature death of your favorite trees. Your local MU Extension center can help you find the information and sources of assistance you need.

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