

Sustainable Urban Landscapes

Understanding Decline in Trees

Stresses Lead to Decline

A gradual decline in health is a common problem for many trees in urban and rural areas across Iowa.

Symptoms may include stunted growth, premature leaf drop, late spring leaf development, sparse foliage, light green or yellow foliage, twig and branch die-back, or many other abnormal symptoms (Fig. 1). This publication focuses on the types of stresses that predispose trees to decline. Understanding these stresses may help you identify, prevent, or reduce stress-causing factors. Once a tree shows decline symptoms, it is often impossible to reverse the decline process.



Figure 1.

There usually is no single reason for tree decline. Often, a combination of factors reduces a tree's vigor, and stress on a tree can make it vulnerable to additional problems. Diseases and insects often capitalize on the tree's low vigor and accelerate its decline.

Trees survive stress temporarily by using stored food reserves, but once these reserves are used up, symptoms of decline begin to appear. Because trees are so efficient at storing food reserves, it may take two or three years after a stress episode before decline symptoms appear.

Poor Growing Conditions

One of the most common causes of stress is planting a tree species not suited for a particular site. Many species have specific site requirements. Some site characteristics that influence tree growth include soil pH, soil texture (the relative proportion of sand, silt, and clay), availability of nutrients, and drainage.

A good example of a site-limited tree species in many locations in Iowa is pin oak (*Quercus palustris*). When the soil pH is above 6.5, iron changes to insoluble forms that are less available to pin oaks. As a result, trees often develop a symptom called chlorosis—yellowing of leaves (Fig. 2)—which can progress to die-back of branches and eventual tree death.

Other common site problems in urban landscapes include barriers to root growth such as clay or rocky soil layers, buildings, sidewalks, streets, and utility pipelines. Restricted root growth can lead to symptoms of decline that show up gradually but increase in severity over time.



Figure 2.

Diseases and Insects

Certain insects and diseases can cause defoliation (loss of leaves), leading to stress. Most healthy trees can survive some defoliation, but defoliation year after year can cause decline and even death. Apple scab and anthracnose of shade trees are examples of disease that cause infected leaves to fall prematurely. The European pine sawfly, yellow-necked caterpillar, and Eastern tent caterpillar are insects that can cause severe defoliation. Leaf diseases and insect injury often can be recognized by carefully examining leaves.

Low Temperature Injury

Low temperatures can contribute to tree stress in several ways.

Winter Desiccation Injury. Desiccation is caused by drying winds and low temperatures during winter months, and is the most common with evergreen trees. Drying winds increase the loss of moisture from needles. Because the ground is frozen, lost moisture cannot be adequately replaced, and browning of needles results. This browning usually occurs on the south-facing portion of the plant.

Freeze Damage. Extended periods of very low temperatures or abrupt fluctuations in temperature can damage or kill plant tissue. The most common type of freeze damage occurs in the early fall or spring when the tree is not dormant.

Sunscald. Sunscald injury results in an area of killed bark on the trunks of thin-barked trees. It usually occurs on the south or southwest side of the tree (Fig. 3). Although the exact mechanisms of injury is not fully understood, low temperatures are involved. Either living bark tissues suffer lethal dehydration after exposure to bright winter sunlight, or tissues are killed due to rapid temperature changes at sundown. The dead bark and underlying tissues may be invaded by canker-causing pathogens, wood-rotting fungi, or wood-boring insects.



Figure 3.

Chemical Injury

Pollutants and chemicals such as herbicides, insecticides, fungicides, and road de-icing salts can cause stress in trees.

Herbicides such as plant growth-regulator types used to maintain weed-free lawns are often volatile, and can drift onto non-targeted ornamentals causing deformation and even death of foliage. Also, improper use of insecticides and fungicides can harm trees. Read the label of the chemical being used to learn proper application rates, to make sure the plant and pest being treated are listed, and if it can be used safely around trees and other plants.

De-icing salts used on sidewalks and roads to melt snow and ice can be toxic to trees. Certain species, such as white pine and crabapple, are sensitive to high salt levels in the soil and can show symptoms of leaf scorch or needle browning.

Construction and Mechanical Injury

Construction of buildings, patios, garages, driveways, sidewalks, and roads often compromises the growing environment of nearby trees. The majority of a tree's water- and mineral-absorbing roots are located in the top 6 to 18 inches of soil and can often extend well beyond the edge of the tree canopy (drip line).

A common practice during construction, changing the grade by removing or adding soil around existing trees, can be very damaging. Removing soil can disturb and injure many of the tree's roots. Also, the practice of trenching often severs major portions of the tree's root system (Fig. 4). Adding soil can reduce the movement of oxygen to tree roots, causing them to die (Fig. 5a and 5b). Soil compaction by heavy equipment and foot traffic also can reduce the supply of oxygen to the root system.



Figure 4.



Figure 5a.



Figure 5b.

Mechanical damage to the trunk of the tree caused by construction activities, mowers, and weed whippers can strip off bark and damage vascular tissue, reducing nutrient and water movement in the tree. Open wounds created by these injuries can serve as entryways for insects and disease organisms (decay-causing fungi).

Flooding and Overwatering

Saturated soils caused by flooding or overwatering often damage or kill trees. In saturated soils, water replaces air spaces in the soil, reducing oxygen levels and causing root suffocation. The degree of damage resulting from flooding depends on the time of year, flooding duration and water level, tree species, age, vigor, amount of sediment deposited, runoff chemicals in the water, the speed of the flood waters, and the drainage rate of the soil.

Trees usually are more susceptible to flooding during the growing season than during the dormant season. For more information, see Iowa State University Extension pamphlet SUL 1, *Understanding the Effects of Flooding on Trees*.

Overwatering trees by now allowing some drying time between waterings also can keep the soil saturated, reduce oxygen levels, and cause flood-like injury to root systems.

Drought

Trees need water to grow and survive. Water is a major constituent of trees, accounting for 50 percent of their fresh weight. Water also is important as a solvent. Mineral nutrients, sugars, and many other important substances are dissolved in water and transported around inside the tree. When tissues lack sufficient water, growth stops and tissues wilt. Therefore, when water is not readily available, trees cannot function normally and eventually will die. Like other stresses, drought stress weakens trees, making them susceptible to attack by disease-causing pathogens and insects.

Planting drought-tolerant landscape plants is the most effective way to reduce the direct and indirect effects of drought. Also consider supplemental irrigation during extended dry periods, mulching, and careful siting of plants.

Other Stress Agents

Tree Topping. Removing major portions of a tree to reduce the height is a common and unneeded practice (Fig. 6). This practice is detrimental to trees, and promotes weak growth that is susceptible to wind and ice damage. It also creates sites for insects and decay-causing pathogens. For pruning guidelines, see ISU Extension pamphlet SUL 7, *Topping-Tree Care or Tree Abuse?* and SUL 5, *Pruning Trees and Shrubs*.



Figure 6.

Girdling Roots. As the root system grows, it sometimes wraps around the base of the tree and begins to girdle or encircle the trunk at or slightly below the soil surface (Fig. 7). Girdling gradually restricts water and food movement in the tree, causing a reduction in vigor. Girdling roots can occur on many species. Removing a girdling root on younger trees often can help, but older trees already in decline may not recover. Removing large roots also can damage the structural strength of older trees. Remove girdling roots before planting, and contact a tree care professional or nursery specialist before removing any large girdling roots on established trees.



Figure 8.

Improper Handling and Planting

Root systems can be seriously damaged if a tree is dropped or receives rough handling before planting. When a tree is purchased from a nursery, the root ball and portions of the trunk often are wrapped with twine or wire. If this material is not removed at planting, it can stress and kill the tree by restricting growth.

An undersized and improperly prepared planting hole can lead to restricted root growth. Also, planting the tree too deep can be a detriment to proper tree growth. Trees planted improperly can often show decline symptoms within a few years after planting, or in the case of planting too deep the tree may not show symptoms for 5-15 years after planting. For planting and care guidelines, see ISU Extension pamphlet PM 1591, *Community Tree Planting and Care Guide*.

Preventing and Reducing Decline

The best way to avoid tree decline is to prevent stress before decline occurs. Not every type of stress is preventable, but often the potential for damage can be reduced.

Tree Selection. Before selecting tree species, analyze site characteristics, such as soil type (sand, clay, or loam), and availability of nutrients and drainage. Consider the location of existing vegetation, buildings, under- and above-ground utilities, sidewalks, roads, and other factors that might restrict growth. Try to anticipate any future changes in the site, such as new construction. Once the site is evaluated, select a tree that will grow well in the existing conditions. See ISU Extension pamphlets PM 1429e, *Street Trees for Iowa*, and PM 1429d, *Low-growing Trees for Urban and Rural Iowa*. Select species that are appropriate for Iowa and resistant to diseases.

Established Trees. Avoid actions that may damage any portion of the tree, either above or below ground. If you are considering new construction, contact a professional arborist or nursery specialist for guidance in preventing damage to existing trees. Lawn mower damage can be avoided by applying mulch (e.g., wood chips, bark) 2 inches to 6 inches thick within a circle extending at least 4 feet from the trunk. Mulching out to the drip line (edge of tree canopy) can benefit established trees as it copies nature's nutrient recycling system and reduces the need for supplemental fertilization and watering.

During drought periods, water newly established trees before they show stress symptoms. Deliver water slowly and thoroughly, and allow adequate time for the soil to drain between waterings. A week between waterings is a good guideline to follow, but the best way to assess soil moisture is to look at a small core or shovel sample of soil.

Proper fertilization can be used to promote and maintain good growth in established trees if nutrient deficiencies exist in the soil. A soil analysis will identify nutrient deficiencies. Base the amount of fertilizer to be used on the surface area to be fertilized. Apply fertilizer uniformly within the tree's drip line, and just outside the drip line as well. Be sure to use recommended rates, because over-fertilization can be harmful. Fertilize established trees in early spring, or late summer-early fall. Consult your garden center or nursery staff or a tree care professional for advice on fertilizer and application for each of your trees.

Managing Trees in Decline. Before taking any actions to help a declining tree, try to determine the possible cause(s) of the decline. It also may help to review the tree's history over the last five to ten years to determine if there were any conditions such as drought or soil disturbances that could have caused stress. It may help to have a tree care professional or nursery specialist look at the tree for girdling roots, insect or disease damage, nutrient deficiencies, or any other possible causes of stress. In most cases of decline, fertilization will not help when stress has been caused by factors other than nutrient deficiency.

Practices such as pruning out dead branches, routine watering, and mulching may extend the life of a declining tree. If the declining tree is a potential hazard to structures or human safety, the best practice is to remove the tree and plant a new one.

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