Disease Stresses of Urban Trees

By

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Survival of trees in today's cities emphasize their tenacity and ability to adapt. Not only do they survive weather, insects and disease, but they manage to survive man's machinery, concrete and soil disturbances.

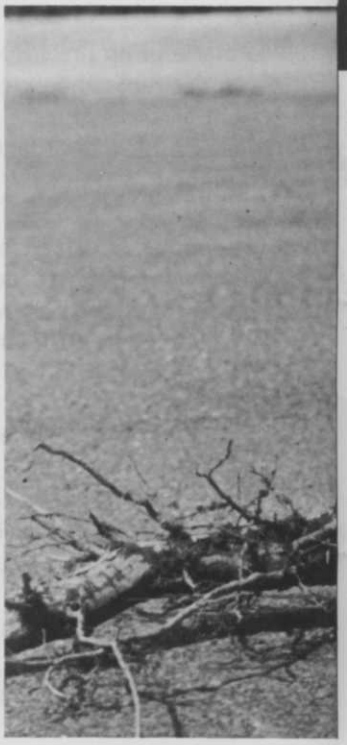
Even native tree species may be regarded as exotic when planted along streets and around homes, because of the many unnatural environmental stresses placed on them. The effects of clay fill, soil compaction, rapid runoff of water and the reflected heat from buildings are compounded by natural hazards.

The total effect of all stresses determines the vigor and ultimate survival of all plants. The evaluation of all potential stress factors must be considered in the selection of tree species for future planting.

Noninfectious Diseases

Environmental Stresses

Of all the stresses related to climate, prolonged dry periods and soil-water deficiencies have the greatest effect on the amount of growth a tree produces each year. The cambium growth either slows down or completely stops, depending upon the amount of available soil moisture. Drought will not only affect growth during the current growing season but can affect growth in later years. A summer drought affects the number of leaf



Feathery water sprout growth resulting from topping or dehorning as commonly practiced in some areas of the country.

initials formed in new buds, which produce shoot growth in the following year. A reduction in both the number and size of leaves directly affects the amount of carbohydrates and hormones produced the following year.

Frequently, tree declines are associated with excessive soil moisture, due to excessive rainfall, and with prolonged drought periods. Decline and permanent damage to the root system usually results. Some of the major diebacks and declines resulting from too much or too little moisture are birch, sweetgum, maple and ash dieback and oak and sycamore decline.

Other Stress Factors

Low-Temperature Injury

Plant tissues may be injured when temperatures drop near or below freezing. Freezing conditions following a gradual drop in temperature are seldom harmful to most trees after they have started to go dormant in the fall. However, a rapid drop in temperature following a period of mild weather can cause extensive damage. Trees exposed to winds or direct sunlight are more likely to be injured than those in sheltered locations. Low-temperature injury usually occurs on species planted outside their natural range, especially those moved from a mild climate to a severe climate.

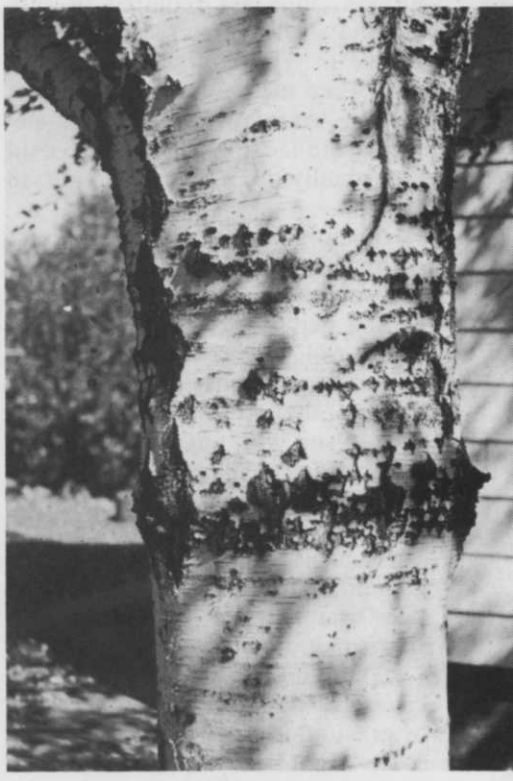
A sudden drop in temperature following a warm autumn may cause the death of plant tissues that are not mature enough to withstand freezing conditions. The injured tissue is often confined to succulent shoot growth that is still internally active beyond the point of normal growth cessation. Terminal dieback will become evident the following spring.

Low-temperature injury during the winter dormant season affects the roots, trunk bark, twigs, and vegetative and flower buds. This injury occurs following abnormal warm periods during the winter months. Poor drainage, the genetic character of the root system, lack of snow cover and soil type are other factors that contribute to root injury during the dormant period.

Frost cracks on trees are caused by the expansion and shrinkage of bark and wood, which cause internal mechanical stress and result in the cracking or splitting of the wood and slipping of bark at the cambium layer. Tree species commonly affected by frost cracks are London

Root decline associated with wet, poorly drained soil. All photos courtesy of Illinois Natural History Survey.

Mechanical girdling by a wire.



Sapsucker injury on white birch.

plane, oak, elm, maple, horse-chestnut, linden, tuliptree (yellow-poplar), and willow. Frost cracks on London plane trees often reopen when the air temperature falls to 8°F and remain open until temperatures warm in late winter. Usually these cracks never close completely, making entrance easy for insects and woodrotting fungi and eventually causing deterioration of the heartwood.

Frost-heaving many times affects newly planted trees. Ice formation in the friable soil around and under new trees often displaces or heaves the tree and causes root damage. Displaced trees lean and the displaced root systems do not settle to their original levels.

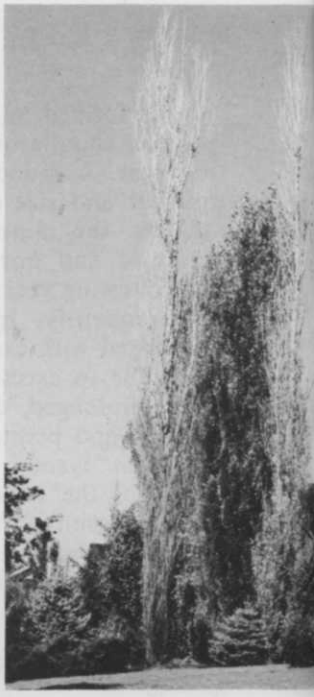
Soil Nutrient Deficiencies and Soil Pollution

Of the 16 nutrient elements commonly required for normal tree growth, nine are required in substantial amounts and seven are required in relatively small amounts. Abnormal metabolism may result if one or more of the essential elements are lacking, or if they are in abnormally high concentration in the soil.

Factors that regulate the amount of nutrients absorbed by tree roots are concentration of the nutrients, topsoil depth, texture and structure of the soil, type of subsoil, soil pH, and soil compaction. The greater the depth of the topsoil, the greater volume of soil with physical, chemical, and biological characteristics favorable for root growths. Soil texture and structure affect the water-holding capacity, aeration and nutrient content. Heavy clay soils afford poor water drainage, aeration and nutrient availability.

The subsoil is important becauase of its effect on the drainage of gravitational water from the topsoil. A tight heavy subsoil will cause frequent waterlogging of the topsoil during rainy periods. Soil compaction affects aeration and water infiltration into, and percolation through, the topsoil. Root penetration and development are poor in heavy, compacted, poorly drained soils.

Soils in urban areas, particularly along streets and around homes are often excellent examples of poor soil conservation and management. The refuse left from basements, foundations, storm sewers and water- and gas-line excavations is usually spread over the surface. This type of deep subsoil is often heavy clay, variable in nutrients, and low or lacking in organic matter. It usually contains limited amounts of both nitrogen and potassium and can be deficient in several of the other essential elements.



Sycamore decline believed caused by water stress and a canker disease.

The nutrient most often lacking in plant growth is nitrogen. There is considerable evidence that under natural conditions most of the nitrogen in the soil accumulates in organic forms from the biological fixation of atmospheric nitrogen. The bulk of the nitrogen absorbed from the soil by plants is stored in decomposed plant material. Microorganisms in the soil must break down plant material into simple inorganic components before the nutrients are re-used by trees. When nitrogen is lacking, it causes pale green foliage, stunted top growth, and yellowing or drying of the older leaves, especially during droughts. Good fall color on maple, oak, and many other tree species is often an indication of nitrogen deficiency and general poor vigor. Maples and oaks that have been fertilized in the spring, and given supplemental watering during dry periods, usually remain green longer in the fall and do not develop good fall coloration.

Chlorosis occurs on several tree species due to the lack of iron, manganese, magnesium, boron, and zinc. The most common deficiency of pin oak, sweetgum, maple, baldcypress, hackberry, white oak, and several other deciduous or evergreen species is the lack of iron or manganese.

Symptoms of iron chlorosis develop on pin oak when the soil pH is 6.7 to slightly more than 7.0. Many pin oaks appear normal for years when not disturbed by construction or other soil disturbance. Lawn fertilization and watering with city water often change the soil pH after a few years. Many fertilizers contain large amounts of calcium carbonate. Although this chemical

Numerous trees in a screen planting dying from Cytospora canker. Useful life expectancy is sometimes less than 10 years.

Pin oak chlorosis is a serious problem in soils with high pH.

does move slowly through the soil, frequent applications of calcium carbonate over the years will change the soil pH.

Some pin oaks growing in nursery rows and along streets remain a normal green color, while many others become chlorotic. This variation among pin oaks suggests that some genetic difference may occur and that it may be possible to select cultivars tolerant of high pH.

Stress Caused by Air and Soil Pollution

It has been estimated that more than 50 percent of the American population live in areas of constant air pollution. All urban trees are living in constant soil or air pollution of one type or another.

Gaseous air pollutants, such as SO_2, halogen compounds, ozone, ethylene gas, and nitrogen oxides cause visible foliage injury to different tree species.

Natural pollutants such as hydrocarbons from the conifers, methane gas from the marshes, hydrogen sulfide from decaying vegetation, air-borne soil particles, pollen, fungus spores, volcanic dust, and radiation have been in existence during the evolution of trees. For thousands of years, tree species have been naturally selected for surviving the environmental stresses caused by these pollutants.

Published reports indicate that 2,4-D and 2,4,5-T may cause extensive injury to foliage due to aerial drift of the spray and to volatile materials that evolve after application. Much of the injury was believed to result from improper application and former use of highly volatile forms of the herbicides.

Visible chemical injury on non-target plants is evident each year, and in 1975 over 10 percent of the tree and shrub specimens sent to the diagnostic laboratory of the Illinois Natural History Survey showed definite symptoms of chemical injury. A high percentage of the chemical injury resulted from the use of weed killers such as 2,4-D in lawn fertilizers and from surface spray applications. Much of the damage is apparently caused by applications that create fine particles easily carried by air movement to non-target plants.

Vascular Wilt Diseases

Oak wilt has caused loss of some oak trees in suburban areas of the Midwest where new homes have been constructed in stands of native oak. The recreational value of some parks and forest preserves has been lost due to the loss of oaks. Oak wilt is known to affect all species of oaks, but it is most serious among species of the red oak group. Oaks in urban areas do not appear to be threatened by this disease.

Many trees and shrubs are affected by Verticillium wilt, a vascular fungus disease. It is the only vascular disease that affects such a wide variety of unrelated annual and perennial plants. The disease is rare in forest stands but is becoming increasingly prevalent in ornamental plantings, especially in temperate regions of the world. Presently, 60 tree and shrub species and varieties are know to be susceptible. Symptoms can be difficult to diagnose on some of the less susceptible tree species. Trees weakened by the dis-

ease, because of the death of portions of the root system, may be more susceptible to the effects of other stress factors.

Leaf Diseases

Spray control is usually recommended for most leaf diseases to prevent loss in foliage and ornamental appearance. Loss of ornamental effect is often temporary, but loss of foliage, if severe, may have a long-term effect. Synthesis, movement, and storage of food reserves is lowered even in vigorously growing trees. Older and less vigorous, slower-growing trees are more seriously affected, since the decrease in growth is often greater the following year. Awareness of the disease susceptibility of various tree species to leaf diseases will permit proper timing of effective fungicide sprays. Improper timing of spray applications may make them worthless and expensive in time and money. Few leaf and canker diseases, except powdery mildew and scab, can be eradicated by fungicide spraying. Several leaf diseases are erratic in their severity and usually are important if heavy defoliation occurs early in the growing season for two or three consecutive years. Often it is more practical to apply water during drought periods than to spray. Unless trees are low in vigor, they will usually respond well to applications of fertilizer in the spring and supplemental watering during dry periods of the summer.

Control of Infectious Tree Diseases

There are at least four major concepts of control for infectious tree diseases: exclusion, eradication, protection, and resistance. Each of these control procedures is important in limiting tree loss from infectious diseases.

Exclusion

Exclusion refers to control procedures that prevent the movement of plant pathogens or disease agents into areas where they are not known to exist. Seeds and vegetative parts used for reproductive purposes are often treated to prevent the introduction of undesirable organisms into new areas. When symptoms or other signs of infectious organisms are present, the infected plant material can be culled. Disease agents, such as viruses in the seed or other plant material, are easily transmitted in plant material used for propagation and, therefore, are difficult to control. Nursery inspections for certification and state quarantines have been effective in limiting the movement of certain insects and diseases to new areas of the country. United States quarantines are adopted to control the importing and exporting of plant materials, and these materials are subject to inspection and in some cases fumigation before they are shipped.

Eradication

Activities associated with remov-

Before Dutch elm disease, shade and trees covered the landscape. After Dutch elm disease, or any devastating tree disease, we must start over.

ing or destroying all or parts of an infected tree constitute control by eradication. Destruction of diseased trees, removal of alternate hosts, and chemical therapy are procedures that may be used to control some of the infectious diseases we have in urban situations. Eradication of a canker disease on an individual infected tree is often the primary means of control; however, it may fail if the infectious organism has progressed into the trunk, or if the tree is weakened and subject to multiple infections throughout the branches and twigs. Control of Dutch elm disease by eradication of diseased elm trees has contributed to the significant decrease in annual loss in most communities that also spray to control the insect vector. Control of chestnut blight by eradication has not been effective, and all such efforts to lessen tree losses have failed.

Removal of alternate hosts to rusts has not proved practical in ur-

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Sycamore anthracnose leaf diseases such as this tend to devaluate the home from the presence of a denuded tree.

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ban situations simply because no one wants to destroy an ornamental plant until it is practically dead. If, however, more thought were given to planting, crabapples and hawthorns would be located at greater distances from susceptible junipers and a reduction in the amount of infection on all hosts would be realized. The judicial use of rust-resistant varieties of crabapples and junipers would help to eliminate the problem.

Chemotherapy is a control method that may be used as an eradicant or a protectant. Various procedures have been used in testing chemicals that inhibit development of a pathogenic agent within a tree. Those procedures that have shown the greatest promise for internal therapy involve either soil injection or direct injection of chemicals into the vascular system. Although entomologists have recommended several systemic chemicals to control insect pests, plant pathologists have only a few compounds that may be effective chemotherapeutants. There have been many disappointments in the research work with chemotherapeutants, particularly in the systemic control of vascular diseases such as Dutch elm disease, oak wilt, and Verticillium wilt. Research plant pathologists currently working on chemotherapy are still optimistic that compounds such as the solubilized forms of benomyl and TBZ (thiabendazole) may prove to be effective chemotherapeutants, particularly for Dutch elm disease control.

Protection

Fungicide and bactericide sprays often must be used to prevent ornamental loss of leaves and fruit. Complete control of a leaf disease by protective fungicides is seldom achieved, especially during those years when disease incidence is severe. Improper timing of spray application, use of the wrong fungicide, and excessive rain often result in failure to control many tree diseases effectively. Even with the limitations of time and knowledge, spray control should be used if the climatic conditions may be optimum for severe infection and heavy defoliation early in the growing season. I discourage the use of more than two applications of a protective spray, because the limited amount of added protection usually does not justify the added cost of labor and chemical.

Tree Selection and Future Maintenance

Urban tree selection has changed considerably during the past 30 to 50 years. Elm, pin oak, London plane, American sycamore, and Norway maple were formerly the most common species selected. All were relatively easy to transplant and grow and, therefore represent

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the most common tree species lining our streets in many parts of the country. Each of these species has serious disease problems that now require high maintenance costs. To reduce these costs, a more scientific selection of tree species is needed.

Very few of the smaller communities have a tree ordinance to control shadetree replacement. In many Midwestern communities, homeowners have replanted street trees and maintained them at their own expense. Unfortunately, tree selection was left to the discretion of the homeowner.

Midwestern city arborists and homeowners are perplexed by the problems of selecting maintenance-free tree species. There are, in fact, no maintenance-free tree species; but some require less maintenance than others. Many tree species are relatively free of infectious-disease problems but are affected by insect and non-infectious-physiological disease problems.

At least 10 species have been recommended in Illinois for replacing elms lost to Dutch elm disease. It was further recommended that municipalities avoid planting high percentages of only one or two species to avoid large losses if and when a serious disease or insect epidemic occurs. Experience over the past 25 years has proved that 10 different species are not enough.

If a vascular disease, such as Verticillium wilt, were to become a serious problem in any one area of the country, it could not be eliminated by any known control measure. We will apparently have to live with the problem and hope that future resistant varieties are developed. Randomized planting of susceptible species and limiting each susceptible species to less than 5 percent of the total tree population should provide the most effective means of limiting future tree loss. □

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