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report on
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DISEASE

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DECLINE AND DIEBACK OF TREES AND SHRUBS

"Decline" is a general term describing the gradual reduction of growth and vigor in a plant. "Dieback" refers to the progressive death of twigs and branches which generally starts at the tips (Figure 1). Trees and shrubs affected by the decline and dieback syndrome may die within a year or two after symptoms first appear or in some cases survive indefinitely. Corrective practices such as proper watering, fertilization, and pruning are not guaranteed solutions in all cases.

Decline and dieback may be caused by many factors (Figures 2 and 3) and is usually progressive over several years. Trees and shrubs of all ages may be affected, although this disease complex is usually associated with plants that have attained some size and maturity.

Figure 1. Dieback of maple caused by chemical injury.

Symptoms

Symptoms of decline and dieback are often subtle, slow in developing, and usually uniform throughout the crown. A tree or shrub in the dieback stage, however, may have localized symptoms such as apparently healthy twigs and branches adjacent to dead or dying twigs and branches. Dieback usually begins in the top of a plant and progresses downward, but it may start on the lower branches, especially with conifers.

General symptoms of decline and dieback may include pale green or yellow leaves, delayed spring flush of growth, scorching of the leaf margins, small leaves, reduced twig and stem growth, early leaf drop, premature fall coloration, and, as the disease complex worsens, thinning of foliage in the crown, dieback of twigs and branches, and production of suckers on the branches and trunk (Figure 1).

Leaf scorch, a yellow to brown discoloration of the leaf margins and tip, is commonly a part of the decline and dieback syndrome, however, lack of adequate soil moisture, resulting in less water reaching the leaf tips and margins can also cause scorch. Abnormally large seed crops, sometimes associated with decline, is a normal response to certain weather conditions. In some tree species, heavy seed production occurs normally every few years.

For further information contact Nancy R. Pataky, Extension Specialist and Director of the Plant Clinic, Department of Crop Sciences, University of Illinois, Urbana-Champaign.

Premature fall coloration, delayed spring flush, decrease in twig growth, and early leaf drop are typical symptoms of maple, oak, ash, honeylocust, birch and sweetgum decline and dieback, and the conditions usually become progressively worse each year with the leaves becoming smaller in size and fewer in number.

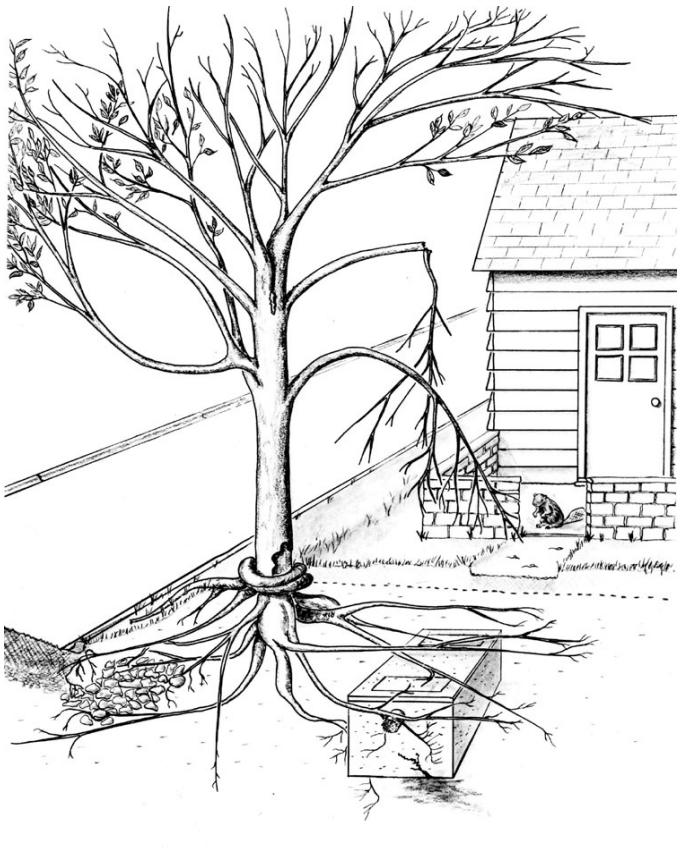

Figure 2. Site factors that can lead to tree decline and dieback (Purdue University photo).

Causes

Trees and shrubs are long-lived and over a period of years are subject to attack by a variety of insects and diseases (Figure 3), extremely high or low temperatures–especially harmful is a rapid drop in temperature following a period of mild weather in the fall or spring–(Figure 4), great fluctuations in soil moisture during long-term weather cycles, mechanical damage to roots from construction (Figure 5) or livestock, and numerous other environmental effects (Figure 2).

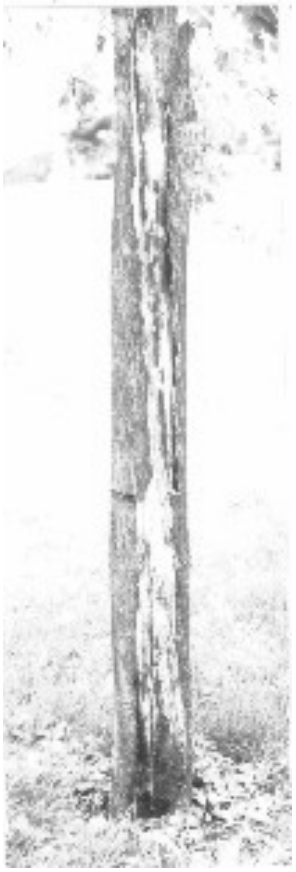

Figure 3. Red maple killed by rapid drop in temp after mild weather in winter.

These stress factors alone or in various combinations can reduce leaf and shoot growth (that is, initiate decline) and lead to dieback, although decline and dieback rarely result from a single stress factor. The combination of human impact on the local environment and natural climatic changes provides a multiplying effect that is more serious than any single factor. Usually a tree or shrub is first injured or damaged by disease (Figure 3), insect attack, or adverse soil or air environmental conditions (Figure 2). The damaged or weakened plant is then subject to attack by one or more secondary organisms or agents. For example, trees and shrubs weakened by drought or neglect are more susceptible to attack by borer-type insects and canker diseases than healthy, vigorous plants. Severe defoliation by leaf-eating insects, diseases, herbicides, hail, or wind at critical times of plant development also may initiate decline and dieback. If a defoliated plant develops new leaves late in the year, and if these leaves are, in turn, killed by an early frost, the plant will be low in food reserves and more subject to winter injury. Weakened trees also are subject to invasion by various fungi. Armillaria root rot, for example, commonly attacks and kills the roots of weakened trees. Many other fungi attack the lower trunk and buttress roots of weakened trees.

Of the many stress factors that can initiate the beginning of decline and dieback, those that weaken or damage the root system are perhaps the most threatening. In most instances of decline and dieback the deterioration of the root system or the blockage of normal root functions occurs **before** any symptoms are visible in the crown. The root system is especially vulnerable to changes in the soil

environment. Soil compaction, changes in the soil drainage pattern, excessive soil moisture (from rain or poor drainage) or lack of water (from prolonged drought), the removal or addition of soil over the root system (Figures 1 and 5), soil compaction, and chemical injury from excess deicing salt, pesticide (Figure 7), or fertilizer all can weaken the root system of trees and shrubs. An excess or deficiency of water, in particular, can lead to permanent root damage. Ash, birch, honeylocust, maple, oak, and sweetgum trees are particularly sensitive to an excess or deficiency of water.

Trees and shrubs planted improperly or in unfavorable locations will also be stressed by poor root growth and development. Planting trees and shrubs too deeply or incorrectly (Figure 6) or in sites with poor drainage, mineral deficiencies or imbalances, a soil reaction (pH) that is too alkaline, poor soil type, or soil compaction should be avoided. Paved sidewalks, driveways, streets, building foundations, patios, septic tanks, and other obstructions can greatly restrict the growing space for proper root development. If a balance between the crown and root system cannot be maintained, the tree or shrub will be weakened, and decline and dieback may develop a few years after transplanting.

Because so many factors can cause decline and dieback, the primary causes are listed below in the approximate order of general frequency:

1. Poor soil structure and drainage (important when the soil is predominantly clay)

2. Herbicide injury to foliage, roots, or other parts (Figures 3 and 7).

3. Poor transplanting procedure and lack of proper maintenance after transplanting (Figure 6).

Figure 4. Many diseases on this "sick" tree could result in decline and dieback. All diseases would not occur on the same tree. Diseases are: 1, Root-lesion nematode; 2, root-knot nematode; 3, root pruning by nematodes; 4, stubby-root nematode injury; 5, root rot; 6, crown gall; 7, fruiting bodies of Armillaria root rot fungus; 8, fruiting body of Ganoderma wood and root rot fungus; 9, fruiting bodies of Fomes wood rot fungi; 10, trunk canker; 11, cedar-quince rust on hawthorn; 12, cedar-hawthorn rust; 13, cedar-apple rust; 14, mosaic; 15, downy mildew; 16, apple scab; 17, leaf spot; 18, powdery mildew; 19, black knot of plum and cherry; 20, wetwood (slime flux); 21, fire blight; 22, American mistletoe; 23, 2,4-D injury; 24, witches' broom; 25, fruit rot (apple); 26, overwintering canker of fire blight; 27, wilt; 28, leaf curl or blister of peach, cherry or plum; 29, leaf blister (oak); 30, sooty blotch and flyspeck of apple; 31, leaf blotch; 32, shothole; 33, anthracnose; 34, ringspot; 35, sooty mold; 36, tar spot, 37, leaf scorch; 38, apple scab on fruit, 39, twig and branch canker (drawing by Lenore Gray).

4. Construction damage–cutting and removal of roots (Figure 5).

5. Significant damage to trunk or major limbs (mechanical injury from lawn mowers, vandalism, vehicles, squirrels and other rodents, livestock, etc.) (Figure 2).

6. Repeated defoliation by insects or diseases, especially such leaf disorders as scorch, anthracnose , rust, and leaf spot or needle blight (Figure 3).

7. An extended drought in combination with high temperatures and strong southerly winds

8. Vascular diseases–such as Verticillium wilt, oak wilt, or Dutch elm disease (Figure 3).

9. Soil nutrient deficiencies

10 Insect borer injury to the trunk or branches.

11. Canker disease–(Figure 3).

12. Excessive soil moisture

13. Extremely low winter temperatures or a rapid change in temperatures (Figure 4).

14. Poorly formed or girdling roots (Figures 2 and 6).

15. Soil compaction from vehicles or heavy construction equipment

16. Fungal root and trunk decays such as Armillaria root rot (Figure 3).

17. Lightning injury

18. Soil fill or removal (Figures 1 and 5).

19. Bacterial wetwood and slime flux

Identification

The exact cause or causes of decline and dieback needs to be identified so that corrective steps may be taken. Accurate diagnosis is often difficult however, especially on older trees. Usually an on-site examination of the diseased tree is required to assess the influence of the environment and to inspect for foliage, branch, trunk, and root problems. Laboratory examination of diseased leaf, twig, or branch specimens may confirm that an infectious disease problem exists (Figure 3). A careful examination of the roots, trunk, and soil conditions can reveal some basic causes for decline. In some cases, a precise diagnosis can be made only by a combination of field and laboratory examinations. It is very important to consider both the site and the past care given the plant. The following steps, as well as the answers to the questions posed, may help to determine the underlying cause or causes of the decline and dieback.

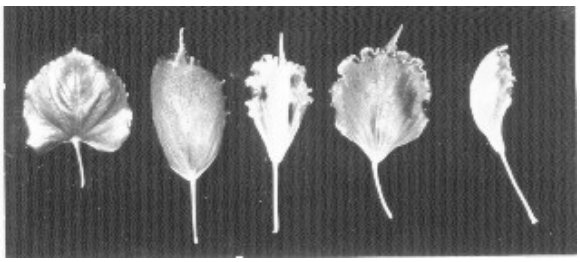

Figure 7. 2,4-D injury to redbud leaves.

1. Determine the case history of the plant and general area: Has severe and repeated defoliation by insects, disease, or another cause occurred in recent years? Has severe drought or other adverse weather factors affected the plant in recent years? Has the soil been saturated or flooded for extended periods? Has there been construction work near the tree in recent years causing trunk or root damage, soil compaction, or soil deterioration? Has there been soil or root removal? Has there been soil fill? (If unknown, observe whether the normal trunk flare is visible at the soil line. If not, determine the depth to the buttress roots.) Has the water table in the area changed? The use of a soil profile tube is essential in making many of the observations concerning soil problems.

2. Examine nearby vegetation: Is there evidence of injury to surrounding trees, flowers, shrubs, vegetables, fruits, turfgrass, or weeds that would suggest general environmental (Figure 2) or toxic symptoms? Is the tree or shrub's root system subject to salt accumulation from winter ice control along nearby sidewalks or streets? Is there a toxic sewage disposal field or gas line near the root system that may be leaking?

3. Consider chemical treatments to or near the tree or shrub: What is the history of pesticide use, particularly herbicides or "weed and feed" combinations? Was a soil sterilant or biocide used in a nearby gravel driveway or sidewalk?

4. Examine leaves for foliar diseases and insects.

5. Eliminate the possibility of a vascular disease, that is, oak wilt, Dutch elm disease, Verticillium wilt, or mimosa wilt, by considering the pattern of symptom development and by examining for internal sapwood discoloration.

6. Have a professional arborist determine the year(s) or period(s) of tree stress by examining the amount of twig growth and the width of growth rings in the wood. Also have the arborist check the pattern of annual stem elongation to determine if and when growth has slowed or stopped. (The arborist will examine the growth of annual rings over the last several years with an increment hammer or borer.)

7. Examine branches and trunk for extensive cankers that may be the cause of damage or that may be associated with an environmental or other stress.

8. Examine trunks and buttress roots for evidence of injury, for example, a sunscald, fire, mower, frost crack, or lightning injury. Look for loose bark (tap the bark and exposed roots and listen for a telltale hollow sound). Check for mushrooms or conks of wood and root decay fungi. Fungal fruiting structures are most common in spring and fall following periods of wet weather.

9. Carefully excavate the buttress roots for evidence of fungal decay, poorly formed roots, girdling roots or twine, and similar problems.

Control

Once the symptoms of decline or dieback are evident, it is difficult to stop or reverse the progress of disease. The key to control is **early detection and prevention**. The following measures will aid in maintaining the health of trees and shrubs.

1. Match the tree or shrub to the site. A common mistake is to select trees and shrubs that grow to a large size and to plant them where the roots are confined, such as between the sidewalk and street or close to a building. Many shade trees have very specific site requirements and grow poorly if these requirements are not met. Common mistakes are planting pin oak and sweetgum trees where the soil reaction is neutral or alkaline (pH 6.5 or above); planting white pines, peaches, cherries, plums, roses, yews (*Taxus*), and white oaks in poorly drained soil; and planting pines, spruces, Douglas-fir, or other evergreens that may reach a mature height of 100 feet or more and a crown width of 50 feet on both sides of a sidewalk on a narrow city lot. In these cases the trees eventually will become crowded and decline because of competition for sunlight and soil moisture. Maintain wide spacings between trees and shrubs based on their size at maturity.

2. Maintain plant health. Plant properly in a deep, fertile, well-drained soil. Cut and remove all tying material and the container, and spread the roots into a natural position. Fertilize every year or two in early spring or late fall (after leaf drop) following a soil test report and the suggestions of Extension horticulturists at the University of Illinois at Urbana-Champaign. Using a lawn sprinkler, water heavily with the equivalent of an inch or more of rainfall (soil moist 12 inches deep) at about 10- to 14-day intervals during drought periods. Watering is beneficial during relatively dry autumns to insure that the roots have adequate moisture during the winter dormant period. A two-to three-inch mulch of wood chips will benefit most trees and shrubs, as will the elimination of all grass competition to tree and shrub roots, although this may not be practical in many situations.

3. Avoid changes in the growing site. Any change in the growing site of a tree or shrub may cause decline. A delicate balance exists between a plant's root system and its environment. Any change in drainage, any damage to the roots from trenching or construction, or any other site change almost always results in root damage and decline. This process is usually irreversible, and prevention is the key to control. Soil fill will induce drought, reduce the exchange of gases to the roots, and lead to invasion by root decay fungi. Removal of four inches of topsoil can destroy 50 to 75 percent of the essential feeder roots and provide injuries that increase the chances of root or trunk decay and infection by Verticillium wilt or other diseases. If fill must be added, be aware that the tree may suffer and may die within 1 to 10 years depending on the depth and type of fill and the kind of tree if proper precautions are not taken. Trunk wells are worthless and should be avoided.

4. If soil compaction is a problem, apply two to three inches of wood chips and eliminate foot and vehicle traffic over the tree root area.

5. Avoid wounding the trunk and roots whenever possible. Avoid pruning that opens the crown excessively and increases trunk and scaffold limb exposure to summer or winter sunscald and frost crack. Wrap young, thin-barked trees to reduce these problems. Prune crossing branches and double leaders when the branches or leaders are still small. The resulting wounds will heal much more rapidly and completely than larger wounds from major branch removal. If branch, trunk, or root wounds occur, promptly and properly repair them. Protect the base of young trees from lawnmower damage by placing a ring of black plastic tubing several inches away from the base.

6. If decline or dieback symptoms appear, and no specific cause can be determined, try fertilizing and watering. Judicious pruning to remove all dead, dying, diseased, and crowded or rubbing branches may also reduce the stress on the root system and encourage renewed vigor. To avoid spreading disease-causing organisms, disinfect all tools by dipping or swabbing them with 70 percent rubbing (or wood) alcohol before using them on another plant.

7. If trees and shrubs have been defoliated recently by disease(s) or insects, take extra precautions to prevent repeated defoliation. Most established trees and shrubs will tolerate one defoliation. Repeated defoliation during the same or succeeding years may result in fatal decline. Where practical, control foliar-eating insects following the suggestions of Extension entomologists at the University of Illinois at Urbana-Champaign. If disease is the problem, check suggestions by Extension plant pathologists at the same institution. Insect and disease control suggestions can also be obtained at your nearest Extension office.

8. Treat trees in decline. If trees and shrubs are in the early stages of decline or dieback, follow the suggestions outlined above for routine watering, fertilization, and pruning. You may also wish to call a competent, licensed arborist to check for such things as girdling roots, an unfavorable soil pH, and damage by borer-type insects and to treat the plant(s) where needed. Pruning may be desirable and necessary to remove dead, dying, and diseased wood, to reduce the crown size and put it into balance with a weakened or reduced root system, and to promote new growth. With proper care and management, plants can often be maintained, and the rate of decline reduced or further problems prevented.