Diagnosing Plant Problems - An Analytical Approach

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This article is the fourth in a five-part series of articles on diagnosing plant problems. The goal of these articles is to provide you with some guidelines for determining the causes of plant problems. This information will mainly apply to landscape plants, but it should also be useful for indoor plants. Some of the information in this series of articles has been adapted from extension publications from Oregon State and Washington State Universities. In the first two articles, plant stress and the five-step diagnostic process were discussed. In the third article, some characteristics of disease and insect problems were covered. In this article, plant problems due to construction damage and environmental extremes will be discussed. The final article of the series will cover plant problems due to nutrient deficiencies and chemical toxicities.

Nonliving Factors – Noninfectious Disorders of Plants

Nonliving factors can damage plants or even kill them. These factors are considered noninfectious since the damage remains on the effected plant rather than "spreading" from plant to plant. Many nonliving factors, such as chemicals, construction, minerals, machine use, and weather, cause noninfectious disorders. Damage to plants will typically be seen on several species or genera of plants in a mixed planting bed or field. The disorders or problems can cause acute stress or chronic stress (see the first article in this series – Taproot March/April 2002 page 13 - for descriptions of these types of stresses). The damage from noninfectious factors may show as a pattern on groups of plants. The damage may also be uniform and repeated from plant to plant. Some nonliving factors can cause similar plant symptoms, such as a herbicide or a mineral deficiency causing chlorosis. Therefore, closely examining plants for additional clues along with asking plenty of questions will help you to make the correct diagnosis. Of course, experience and knowing how particular plant species or cultivars grow will be very useful when diagnosing noninfectious disorders of plants. This article will provide you with some ideas about plant problems due to construction or extreme weather conditions.

Diagnosing Construction Damage

Have you heard about or had this type of experience? Someone builds a house or vacation cabin in a wooded area and decides that the existing trees should be kept because of their beauty, rustic effect, energy savings (shade effect), etc. The person hires a contractor and a circular area up to 10 feet from the trunks of certain trees is fenced off so that the trees' roots are protected. The contractor completes the construction, and within the first two months a only few branches die on a couple scattered trees around the house. The new homeowner now hires a landscape maintenance company to take care of the property. During the next two or three growing seasons, more branches begin to die on the plants, particularly those in the highest parts of the trees. Seeing the continuing decline of the trees each year, the homeowner becomes upset with the landscape maintenance company, accusing the firm of doing shoddy work since the trees continue to dieback. The landscape maintenance company is sure the work is being done

properly. What is the problem? Most likely the cause of this problem was the original construction that was completed when the house was built.

Construction damage to plants can sometimes be easily seen (e.g., broken leaves or roots) or can be much more subtle and difficult to diagnose (e.g., fill soil over the root system or soil compaction). Construction can cause acute and chronic stress. Construction damage is often difficult to diagnose because the time between construction and plant symptoms becoming visible can be quite long. This lag period depends on the plant species, soil type, and extent of the plant damaged. Certain symptoms, such as wilting, can appear with several days, whereas other symptoms may appear several years after construction. Some trees may take five to seven years to die. This lag time often causes the blame for plant damage to be shifted to other causes, such as a landscape maintenance firm. In addition, the delayed symptoms of plant damage prevent timely treatment of the plants to try to alleviate the problem(s).

Symptoms of construction damage can vary, depending on the type of injury caused. Typical symptoms can include slight wilting and a small number of leaves dropping off the plant at the time of construction. Months or even years later, plant growth may be stunted, with leaf size being smaller than normal. One way to determine if plant growth is stunted is to examine several branches to determine the growth rate of the plant over the last several years or back to the time when construction was completed. Another symptom of construction damage is twig dieback. Branches growing farthest from the root system are often the first to die due in part to a lack of adequate roots for support. Conifers may also have excessive needle drop. A fourth symptom that may be seen on deciduous plants is early fall color of leaves or early leaf drop. Perhaps only several branches are affected on the shrub or tree. Keep in mind, however, that early fall color of leaves on deciduous plants is a good general indicator of stress, so some other factor could be causing the leaves to change color early in the fall. A fifth symptom sometimes seen in severe cases is off-season blooming by the plants. Some species may bloom off-season when they are about to die. Another symptom of construction damaged on plants (and those under chronic stress in general) is weakened resistance to pests. Root rots or verticillium wilt can infect the plants. *Cytospora,* a fungal disease, usually attacks stressed plants. Insects, such as borers and aphids, seem more attracted to stressed plants than healthy ones.

As mentioned above, construction can damage plants in some subtle ways. For instance, changing the grade by adding fill soil will damage existing plant roots by reducing their supply of oxygen. One indicator of adding fill soil over the root system of a tree is to look at the soil around the base of the trunk. Most trees normally have a flair or wide base where the trunk meets the soil. If the trunk appears straight, similar to a telephone pole, then the grade at the site was most likely raised by adding soil (filling over existing soil). Soil compaction can also be a subtle problem that can have enormous consequences. Compaction can crush roots, prevent gas (oxygen and carbon dioxide) exchange in the soil, and prevent roots from growing into new soil due to their inability to penetrate dense soil. An additional subtle change that can be caused by grading is drainage patterns in the soil. Grade changes can shift drainage so that water accumulates in different areas. If plants are growing in areas that accumulate water, then the plants will likely succumb to flooding (see next section on environmental extremes).

In summary, construction damage is often difficult to diagnose since the symptoms may be absent for several years after the work is completed. Look for minor symptoms during or soon after construction. The chronic stress caused by severed roots, compacted soil, or waterlogged soil slowly take their toll on the plants. Branches, particularly those farthest from the root system, may be among the first to dieback, and this symptom may be seen for several years until the plant adjusts to a reduced root system.

Environmental Factors – Weather Extremes

Plants grow best when they receive certain amounts of water, minerals, and sunlight, all under temperatures that support biological processes. Some plants tolerate more water than others, whereas some species prefer warmer temperatures compared to others. Once the environmental conditions become extreme, plants can become stressed and display certain symptoms. Sometimes these symptoms are distinct, and at other times symptoms may be similar for two distinctly different problems. Weather records can be useful when trying to diagnose plant problems due to environmental factors.

One environmental factor to consider is temperature. Typically, temperature extremes can damage plants. High temperatures can affect root and shoot growth. The optimum temperatures for most plant shoots are usually between 75 and 80°F, since physiological processes are completed rapidly in this range. As temperatures increase above 85°F, some physiological processes become affected, and plant growth can be inhibited. If temperatures rise too high, plant tissues can be damaged. On a large tree, leaves on the southwest sides of the plant are often damaged when the temperature is too high. The southwest side of the foliage is most often affected since the sun is usually in the southwest sky during the hottest part of the day. Leaves on the north or northeast side of the tree or plant may be unaffected. Leaf margins and shoot tips are often the most severely affected by high temperatures since they are farthest from the root system, the source of water. Because water is required to cool foliage located at distant parts of the plant, heat stress and drought stress symptoms appear similar and may be interrelated. Leaves and stems located near a wall or surface (e.g., sidewalk) that reflects the suns rays can readily be injured by heat stress.

Cold temperatures can affect plants in different ways. Frosts may cause problems in late spring or early fall. In addition, very low winter temperatures can cause problems for plants. Frost will damage the least hardy tissues on plants in spring and fall, so knowing how woody plants acclimate to the cold and break dormancy in spring should provide clues about the involvement of frost or cold temperature causing plant damage.

Woody plants become acclimated to cold temperatures in a particular sequence in the fall of the year. The terminal buds on stems are the first plant parts to become hardy, and as temperature and the amount of light received decrease, the lower regions of the stems eventually become hardy. Therefore, branch crotches or the bases of stems are often the last tissues to become cold hardy. Cold damage seen at the bases of stems or at branch crotches may be do to a fall frost or freeze. In the spring, the process is reversed, with the terminal buds on plants starting to grow first, so they are less hardy (along with newly expanded shoots) and more

susceptible to frosts than are lower parts of the stems. This pattern may provide a clue about the cause of plant damage.

Roots are more susceptible to cold damage than are shoots. For example, the shoots of saucer magnolia (*Magnolia* x *soulangiana*) will tolerate temperatures down to about -30°F, but its roots will only tolerate temperatures down to 23°F before they are killed. For plants grown in the ground, cold temperatures usually cause few problems. Root systems of container plants are exposed to air temperatures, however, and lack the temperature buffer provided by the ground. As the air temperature decreases, the root temperature also decreases. Cold damage to root systems may be difficult to detect at first. Damaged roots may appear dark tan or black in color. They may also have a water-soaked (translucent) or spongy appearance. Damaged roots often lack new growth (white root tips) or new root hairs. Shoot symptoms due to root damage from cold temperatures are usually seen only after shoot growth resumes. Despite the root system being damaged, buds may open and leaves expand, though perhaps they are smaller in size than normal. As leaf transpiration increases during warm spring days, however, the damaged root system is unable to supply enough water. As a result, the plant wilts, and leaves may drop off the plant. If the root system is severely damaged, the entire plant may die.

Cold tolerance of plants has been rated for most landscape plants. Assuming the plants have acclimated properly to cold temperatures, they should be able to tolerate temperatures down to their observed limits (the cold hardiness rating). If temperatures drop below the hardiness rating, the plants may become damaged. Flower buds are often the first plant parts to be damaged by cold temperatures. Vegetative (foliar) buds are usually the second tissues damaged by very low temperatures, and stem tissue may be the last tissue damaged by extreme cold temperatures. Cold temperatures can damage tree trunks in several different ways. Due to space constraints for this article, consult an arboriculture book for descriptions of cold damage to trunks.

Water extremes, in particular flooding and drought, can affect plant growth. Flooding causes problems by limiting the amount of oxygen roots can receive. Roots of flooded plants lack sufficient oxygen for respiration. Since energy from respiration is needed for active water uptake as well as mineral uptake, symptoms of flood stress include wilting and nutrient deficiencies. Roots in flooded or saturated soils often turn purplish or dark tan in color. They may also appear water-soaked or translucent. Lower leaves may also fall off as the plant responds to reduced water uptake. Keep in mind that a saturated soil as well as standing water can induce flood stress.

For drought stress, roots are unable to take up enough water to meet transpiration demands by the leaves due to a lack of water in the soil. Drought-stressed plants may initially wilt and later have nutrient deficiencies and lower leaves dropping off. Note how symptoms of drought and flood stress are initially similar even though these two conditions are at opposite ends of water extremes! As with heat stress, leaves and stem tips on the most exposed parts or those farthest from the root system are the first ones affected. The margins (edges) of these leaves eventually become brown and necrotic. Areas between veins on leaves also turn brown and die. Be aware that withholding water from a plant can be used to regulate its growth, but failing to supply enough water to meet the plant's needs can result in injury.

When analyzing a site for problems caused by the environment, keep in mind that some environmental problems can be "fixed" to help the plant survive or tolerate a site, but others may be remedied only by spending plenty of money. Modifying a site to improve environmental conditions can be expensive but still fail to help the plants grow well. The bottom line is to install landscape plants that will tolerate, or better yet thrive, where they are planted!

Diagnosing plant problems caused by construction and environmental extremes can be difficult. Construction damage may be seen months or even years after the construction was completed, causing someone else to be blamed for the problems originating from failing to protect existing plants at a site adequately. Temperature and water extremes sometimes cause similar plant symptoms, so care is needed when diagnosing problems due to high or low temperatures. Likewise, initial symptoms due to too much or too little water (flood or drought stress, respectively) can be similar too, so weather records or examination of the soil should be completed to make the correct diagnosis. In the last article of this series, we will cover some plant problems due to mineral deficiencies and chemical toxicity.