Diagnosing Abiotic Disorders of Landscape Plants

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Landscape plants can be injured by biotic and abiotic agents. Abiotic or nonliving agents include environmental and physiological factors, such as water deficit, aeration deficit, and nutritional deficiency. Biotic agents are living organisms such as insects, pathogens, nematodes, and viruses. Whether the cause is biotic or abiotic (or both), an accurate diagnosis is virtually always needed to remedy the ailment. This paper addresses a key element of the diagnostic process and then describes symptoms associated with selected abiotic disorders. For a detailed discussion of both topics, see Costello et al (2003).

Although there are many steps involved in the diagnostic process, a vital first step is the accurate identification of the plant. It is critical to know the genus and species to determine whether the existing condition is normal or abnormal. In some cases, what may look abnormal may be a natural trait for the species. For instance, bald cypress (*Taxodium distichum*) is a deciduous conifer that turns orange brown before losing its needles in the fall. Not knowing that this is normal for bald cypress may lead to the misguided determination that a problem exists. With an accurate identification, however, this condition would be recognized as normal and no further action need be taken. Similarly, the shedding of leaves in cork oak (*Quercus suber*) in spring and the defoliation of California buckeye (*Aesculus californica*) in early summer both may be thought to be problematic if it was not known that these traits are normal for the species. Certainly, there are a number of other steps in the diagnostic process (e.g., symptom identification, site inspection, management history, etc.), but an accurate identification of the plant is a necessary first step.

Symptoms are the external and internal reaction, response, or alteration of a plant as a result of disease or injury. Some symptoms are diagnostic, meaning that they are characteristic of a problem and lead directly to a diagnosis. Other symptoms are nonspecific, or not indicative of a particular problem. Here, symptoms associated with 5 abiotic disorders are described briefly, some diagnostic and others nonspecific.

Water Deficit

Symptoms range from slow growth to death of the whole plant. The level of injury depends on the severity and duration of the deficit and the sensitivity of the plant. Common symptoms include growth reduction or cessation, leaf necrosis, leaf drop, shoot dieback, and whole plant decline. For deficits that are relatively mild, but last for

extended periods, slow growth may be the only symptom expressed. When deficits are severe, however, leaf necrosis and branch dieback are more likely (depending on the species). Plants located in hot, windy, nonirrigated sites are prone to water deficit. In addition, plants in limited soil volumes (containers or small planting pits) frequently experience water deficits. Although many landscapes are irrigated, water deficits can occur if irrigation schedules are inadequate or if irrigation systems are not properly designed and/or installed.

Aeration Deficit

Similar to water deficit, aeration deficit can produce a range of symptoms from slow growth to death of the whole plant. When oxygen supply or availability is below a critical level for a short period of time, an acute deficit occurs. Symptoms include wilting, extensive leaf drop, and dieback. Roots may appear discolored and water-soaked. Relatively mild aeration deficits that persist over an extended period of time may cause chlorosis, slow growth, and leaf drop. Plants that incur chronic deficits are prone to root disease and stem cankers. Commonly, aeration deficits are caused by excess water in the root zone, typically due to excessive irrigation and/or poor drainage. In such cases, water displaces air in soil macropores and oxygen diffusion is impaired. Grade changes (fills) have been thought to cause aeration deficits, but this has not been supported by research.

Mineral Deficiency

For woody plants that are well established in landscapes, deficiencies of nitrogen, phosphorus, and potassium are relatively uncommon. They can occur, but are not frequently found in California landscapes. Microelement deficiencies (iron, zinc, and manganese) are relatively common, however. In particular, iron deficiency can be found in many landscapes and on a number of species. Symptoms are distinctive: interveinal chlorosis of the youngest leaves. In some cases, the tips of leaves and shoots are blackened. Typically, this deficiency results from an elevated soil pH level, above 7.5 for many species. Species vary in susceptibility to iron deficiency, however, with sweetgum being an example of a sensitive species. Treating with chelated iron is an effective way to diagnose and treat (short term) this deficiency. Manganese deficiency causes symptoms similar to iron deficiency, while zinc deficiency causes leaves to be stunted and clustered at the end of shoots.

Specific Ion Toxicity

Although a number of ions can be phytotoxic, those that cause injury most commonly are boron, chloride, and sodium. Boron injury is distinctive: marginal chlorosis, necrosis, and pitting occur on leaves, typically in mid to late summer. Necrosis may appear black. Species vary substantially in sensitivity to boron, with some species showing no injury in the same location as severely injured species. For evaluations of species tolerance or sensitivity to boron, see Costello et al (2003). Sodium injury appears as a foliar mottling and interveinal chlorosis that progresses to necrosis of leaf tips, margins, and between

veins. Chloride toxicity causes stunted growth, chlorosis, necrosis of leaf tips and margins, bronzing (in some species), and premature abscission of leaves. Both sodium and chloride can accumulate in soil from applications of deicing salts, fertilizers (containing sodium or chloride), and irrigation water. Recycled water can contain concentrations sodium and chloride that are phytotoxic for certain species (e.g., *Sequoia sempervirens*).

Salinity

Soils contain a mixture of water-soluble salts that are necessary for plant growth and function. When present in high concentrations, however, salts can injure sensitive plants. When absorbed by roots, salt toxicity is first expressed as stunting of growth and yellowing of foliage. In broadleaf species, leaf necrosis and defoliation usually follows. Typically, the symptoms are most severe on the edges and tips older leaves where salt accumulation usually occurs. For conifers, needles turn yellow, then brown from the tip downward and defoliate. In severe cases, plants are killed. Injury can result from the foliar application of salts, typically from salt spray (in coastal areas), deicing salts, and irrigation spray. Symptoms include marginal chlorosis of leaves, defoliation, premature fall coloration, and delayed spring leafout. The degree of injury depends on the sensitivity of the plant to salts and the concentration of accumulated salts in the soil. For evaluations of the sensitivity of landscape species to salt levels, see Costello et al (2003). Irrigation water and fertilizers are key sources of salt in landscapes. Irrigation water should be analyzed for salt content, regardless of source (municipal, well, river, etc). Recycled water can have high salt levels and should be analyzed frequently (at least monthly). Select and apply fertilizers to minimize salt accumulation, particularly in poorly drained soils.

In addition to the abiotic disorders described above, a number of others occur in landscapes, including sunburn, cold and high temperature injury, wind damage, gas injury, air pollution, herbicide toxicity, and mechanical injury. Each of these disorders have relatively distinct symptoms that can be used to link the problem with the cause. It is important to be aware of the array of disorders and their respective symptoms to develop accurate diagnoses and effective treatment recommendations.

Reference

Costello, L.R., E.J. Perry, N.P. Matheny, J.M. Henry, and P.M. Geisel. 2003. *Abiotic Disorders of Landscape Plants: A Diagnostic Guide*. University of California Agriculture and Natural Resources Publication 3420. Oakland, CA. 242 p.