

Effects of Drought on Trees and Shrubs[®]

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Recurring and prolonged periods of drought seem to have become commonplace in many regions of the country in recent years. The effects on trees and shrubs can often be seen in both natural and man-made landscapes during the severest of droughts as leaves wilt, show marginal scorch, or prematurely drop from the plant. However, the long-term effects of drought on the health and survivability of woody plants are less obvious.

Carbohydrates produced in green tissue by photosynthesis are used as substrate for other synthesis reactions in plant cells. Among the products normally manufactured from these carbohydrates are fats, proteins, growth regulators, and many secondary metabolites. Secondary metabolites are responsible for many of the defense mechanisms a plant needs to thwart infectious diseases and certain insects. These metabolites include oleoresins, tannins, and alkaloids. Initially, there may be an increase in the production of secondary metabolites in drought-stressed plants as carbohydrate is redirected to the synthesis of these products. However, as the severity of drought persists the amount of these metabolites decreases and plants become vulnerable to secondary attacks by certain insects and diseases.

With prolonged drought, there is also a break down of the photosynthetic machinery itself, which further compromises the health of the plant. Before a plant can resume normal growth rates, rebuild damaged plant structures, and resume synthesis of growth regulators and secondary metabolites needed for self-defense, it must re-establish the photosynthetic machinery and normal functioning of the stomates. During this process, food reserves are consumed to compensate for reductions of photosynthetic product. Therefore, visible symptoms of drought-related decline may not be evident for weeks, months, or years after the drought event. Further decline will often take place while repairs to root system, photosynthetic apparatus, and morphology are made.

SYMPTOMS

Direct Effects. Effects of drought can be characterized as short term and long term. Direct (immediate) effects of drought damage include wilting, scorch, and some defoliation due to loss of turgor in plant cells, irreversible shrinkage of cell membranes, and increased synthesis of abscisic acid.

Long-term Effects. Long-term symptoms of drought include dieback of branches and death of the plant as the plants capacity to absorb water is damaged. Other long-term effects relate to the reduction in synthesis of secondary metabolites and include increased susceptibility to disease infections and insect invasions as the plant's ability to ward off these problems is diminished.

During a moist year, in particular, it is difficult to attribute poor plant health or pest invasion to a drought event that occurred a year or two earlier. However, there are certain diseases that are most likely to occur due to drought-related stresses. These diseases, in combination with weather history at the site, can be used in the diagnosis of drought-related problems.

Among the types of diseases likely to occur in response to drought-related stress are root rots, cankers, wood rots, and wilt. These disease include armillaria root rot, nectria canker, cytophora canker, diplodia tip blight, rhizosphaera needlecast, and verticillium wilt.

Insect Problems. The invasion of wood-boring insects such as bronze birch borer, black stem borer (an ambrosia beetle), and other bark beetles, noticeably increases in trees that are drought stressed. Studies have shown a correlation between the levels of the secondary metabolite, oleoresin, and a plant's susceptibility to invasion by wood-attackers. A healthy tree produces oleoresin which acts to deter feeding by bark beetles and wood borers. When a tree is severely stressed, there is a decrease in oleoresin production and a corresponding increase in borer attacks.

CONCLUSION

While drought conditions are alleviated with a return to normal rainfall patterns, plant practitioners need to be aware that the negative effects of drought on plant growth and health may continue to be a problem for many years. It is important to keep this in mind when evaluating the causes of plant problems.