DEAD BRANCHES, DEAD TOPS & DEAD TREES: THE INTERACTION OF WATER STRESS, INSECTS & DISEASE

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The sudden appearance of dead branches, dead tops, or dead trees can alarm anyone, especially tree growers. In Oregon, these symptoms can be unusually dramatic and are often widespread. The following information describes the damage that is often observed and discusses the usual causes and treatment strategies.

DAMAGE DISTRIBUTION & SPECIES AFFECTED

Damage occurs throughout the state, but is most severe in urban areas, on the fringe of forested areas, and on shallow, rocky, or droughty soil types. Trees growing near roads, ditches, pastures, or in areas of soil disturbance or abundant competing vegetation are most frequently affected. Damage to Douglas-fir is especially common and will be the focus of this discussion. Damage is most evident on former grass/pasture lands or on dry south aspects, while much less frequent on more contiguous or undisturbed forest areas. Trees growing beyond their natural range or from non-local seed sources generally are at an increased risk of water stress compared to locally adapted trees or drought-tolerant species such as Ponderosa pine.

THE PRIMARY AGENT - WATER STRESS

The most common cause of the damage described above is water stress inside the tree. Water stress results whenever water loss exceeds uptake long enough to cause plant damage or disturb its physiological processes. It usually results from a lack of available soil moisture due to drought, which in turn depends on the water storage capacity of the soil and on the rate at which plants take up water through their roots and evaporate it through the foliage. Water stress often affects groups of trees because they share common soil and environmental conditions that can affect their rate of uptake and the degree of water stress.

Because water storage capacity varies among soil types, water stress will develop in trees on some sites sooner than others under the same weather conditions. Trees exposed to full sunlight and greater air movements tend to lose water faster than trees growing in a closed canopy. Sudden changes in the stand that expose the crown can also increase the rate of water loss or competing vegetation can intercept water from tree roots during periods of low rainfall. Soil compaction can also stress trees by damaging roots, reducing aeration, and preventing water infiltration.

Trees respond to water stress in a number of ways. Low levels of stress reduce stem and root growth, while under more severe drought conditions, water content may drop to a critical level where trees are irreversibly damaged and branches (Figure 1), portions of the crown (Figure 2), or entire trees may suddenly die (Figures 3). It is

often difficult to gauge the level of stress, as many of the tree's internal responses to water deficits occur without visible outward indicators.

WATER STRESS PATTERNS IN OREGON

In Oregon, water stress injury usually occurs in late summer or fall after trees have formed buds. Periods of greater moisture and cooler temperatures may initially improve tree water balance; however, the warmer, drier conditions of late winter and spring often cause previously stressed trees to rapidly decline. Examinations of discolored branches or tops in early spring usually show little evidence of insects or disease, and are more often the result of water stress the previous year. If damage is due to these other agents, it will usually become more obvious as their activity and development increases in late spring and summer.

Water stress from winter events is also common. Low temperatures, especially following a warm period, can damage sapwood and impair water transport to branches and foliage. Severe needle desiccation and drop, especially in areas like the Columbia River Gorge, occurs as the result of slower water movement in the soil, along with dry, East winds and sunny weather that cause increased water loss.

Water stress can also induce the loss of older foliage in the fall. This occurs as the tree mounts a “drought-resistance” response by reducing the total surface area of the foliage and subsequently lowering the rate of water loss. It is especially apparent in Ponderosa pine and Western red cedar around the Willamette Valley each year.

SECONDARY AGENTS - INSECTS AND DISEASES

Healthy, vigorous trees usually resist attacks by insect and disease agents by producing defensive chemical compounds. Tree stress, especially water stress, can reduce the production of these compounds and decrease the tree's ability to withstand attacks.

INSECTS

Populations of insects that attack weakened Douglas-fir trees build during or following extended periods of drought or other events that cause water stress. Common insects include the Douglas-fir twig weevil, which kills smaller branches and twigs, causing trees to appear drought-stressed (Figure 4). Damage by the Douglas-fir engraver beetle also causes symptoms similar to water stress, as larger branches or the entire top is killed (Figure 5). Swellings and splits in the bark, tiny emergence holes, and boring dust distinguish twig weevil damage (Figure 6), while engraver beetles have a distinct vertical gallery that can be found under dead patches of bark (Figure 7).

DISEASES

Several canker-causing fungi also infect and kill branches or stems, giving them an appearance that is often similar to water stress. Cankers are most visible in spring and summer, 1-2 years following water stress, and are distinguished by portions of bark becoming sunken and discolored (Figure 8). On young Douglas-fir, these dead areas are reddish-brown and contrast well with the gray-green color of healthy bark. Removing a portion of the bark in affected areas reveals dead tissue underneath (Figure 9).

OTHER AGENTS

There are a number of other insect and disease agents that cause damage and mortality to both water-stressed and healthy trees each year. If the symptoms do not

appear to fit those agents discussed here, it may be best to consult your local Department of Forestry, Extension office, or private forestry consultant for identification of the problem. Forest Health Notes on many agents can be found at: ***http://oregon.gov/odf/privateforests/fh.shtml***

TREATMENT STRATEGIES: WHAT YOU CAN DO

Most tree damage occurs on disturbed sites and is due to a combination of factors including soil conditions, tree species, and weather patterns. It is unlikely that stress will be alleviated by simply altering a single factor. Rather, improvement will come from an accumulation of many moderate changes to relieve stress and increase vigor.

- Prevent soil compaction caused by vehicle or animal traffic near trees. Livestock can compact surface soils and damage fine roots, most of which lie within a foot of the soil surface. Clay soils are especially vulnerable.
- Avoid direct damage to trees and roots by grazing animals or by machinery.
- Reduce competing vegetation and apply mulch to maintain soil moisture (1-3 inches is usually sufficient).
- Irrigate landscape trees during dry weather. Apply water slowly over many hours so it penetrates to tree roots or use drip irrigation lines.
- Do not alter drainage patterns (ditches, ponds, etc.) near established trees.
- Plant trees that are well suited for the site; use local seed sources and species that are adapted to your soil types. On sites where Douglas-fir mortality is occurring it may be advisable to plant Ponderosa pine or hardwoods.
- If insect larvae or branch/stem cankers are evident, prune and destroy affected branches to reduce the spread of these agents.
- Do not fertilize during drought conditions. Fertilization stimulates foliage production and can increase a tree's water requirements.

FUTURE OUTLOOK

Although we have had above-average moisture statewide in recent years, localized dry conditions have continued to occur in some areas. Such conditions will likely increase over a larger geographic area in coming years, consistent with historical weather trends. In the meantime, the best course of action is to begin preparing your trees for the next period of sustained, dry weather by following sound silvicultural principles in consultation with your local State or private service forester.

For Additional Information About Insects & Disease, Contact:

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Alan Kanaskie, ODF Pathologist, 503-945-7397, akanaskie@odf.state.or.us
Website: ***http://oregon.gov/ODF/privateforests/fh.shtml***

FIGURES

Figure 1: Dead branches caused by water stress in Douglas-fir.

Figure 2: Top-kill in Douglas fir caused by severe water stress and winter injury.

Figure 3: Older Douglas-fir dying from water stress due to severe soil compaction.

Figure 4: Branch tips of Douglas-fir killed by twig weevils.

Figure 5: Branch and top-kill due to Douglas-fir engraver beetle.

Figure 6: Swelling of the branch, boring dust and exit holes indicate twig weevils.

Figure 7: A dead patch of bark peeled back shows the gallery of the Douglas-fir engraver.

Figure 8: An elongate canker (reddish-brown area) on a Douglas-fir stem due to a fungus.

Figure 9: Stem canker on Douglas-fir cut away to show dead tissue beneath.