Drought Stress in Conifers

Forest Health Fact Sheet

February 2019

Drought damage in Western redcedar near Willamette Valley pine

Droughts can take a huge toll on Oregon's conifer trees. Often, it is the primary cause of dead branches, tree tops or whole trees. Trees may also respond to drought stress by reducing root and stem growth, dropping more needles, or by producing an abnormally high number of cones ("stress crop"). Symptoms of summer droughts are not typically visible until the following spring, although recent droughts have been severe enough for symptoms to appear in late summer or fall. Many trees being affected have survived previous droughts, even on marginal sites, but past stresses and increasing water requirements due to their large size have reduced their resiliency. **Drought stressed trees are often subsequently attacked by secondary agents such as insects and pathogens.**

Drought is a period with reduced precipitation and above average temperatures. Across all Oregon counties, 2013-2015 proved to be record drought years. Although these may be peaks in a drought cycle, trends show increasing average temperatures and decreasing average precipitation. In addition, winter snowpack has been disappearing earlier in the year and the duration of summer weather has been extended.

Drought conditions create water stress inside the tree and can reduce growth or cause mortality. Tree water stress is an internal shortage of water that occurs whenever water loss exceeds uptake long enough to cause plant damage or disturb physiological processes.
Drought damage in trees is due to one or all of the following factors:

- Lack of available soil moisture due to reduced precipitation, evaporation and/or runoff, poor water storage properties of soil (e.g., shallow soil, high rock or sand component) or competing vegetation.

- Reduced uptake by roots and translocation throughout the tree due to damage to roots or water-conducting tissues from mechanical equipment, compaction, diseases, etc. Poorly aerated or waterlogged soils can starve roots of oxygen and also decrease water uptake.

- Increased water loss due to exposure to wind (particularly easterly winds) and sun (particularly southern exposures), which increase transpiration and evaporation rates.

Damage typically is most severe 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. Symptomatic trees often occur in groups in close proximity to one another, which reflects similar soil and moisture conditions rather than contagion by canker pathogens.

Trees growing beyond their natural range or from non-local seed sources generally have greater risk of drought damage than locally adapted trees. Damage from drought stress can be difficult to diagnose because the symptoms are similar to other stressors that damage roots and inhibit water uptake, such as root disease, waterlogging, mechanical damage and compaction. 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 foliage desiccation and drop, especially in areas such as the Columbia River Gorge, occur when slow water movement in cold soil combines with dry, east winds and sunny weather to increase water loss.

Severe water stress can directly damage or kill trees, but also predisposes trees to attack by insects and pathogens. Many insects such as bark beetles are secondary, meaning that they can only contribute to mortality in already stressed trees. Similarly, several stem canker fungi often are latent in a tree and capable of causing disease only when the tree is stressed. Healthy trees are able to produce physical and chemical defenses that can either prevent entry from invading insects and diseases, or create an inhospitable environment barring their development or proliferation. If the production and

mobilization of defense chemicals are reduced because of water stress, certain insects and pathogens can damage or clog vascular tissues and kill all or part of a tree.

Major insects and diseases commonly associated with drought stress:

- Douglas-fir: twig weevils, bark beetles (Doug-fir bark beetle, pole and engraver beetles), flatheaded fir borer, branch and stem cankers
- Grand or white fir: bark beetles (fir engraver)
- Pine: twig weevils, bark beetles (Ips beetles, mountain and western pine beetles, red turpentine beetle, and Hylastes spp. which vector blackstain root rot), woodwasps
- Cedar: bark beetles (cedar bark beetles), wood-boring beetles

Our changing climate can also directly increase the impact of native and non-native insect pests. Mild winters reduce mortality of overwintering insects, extended spring and summer conditions allow for faster insect development and more generations, drier weather reduces incidence of diseases in insect populations, changing conditions allow for range expansion (latitudinal and elevational), and synchrony with natural enemies may shift. Some of these changes, such as additional generations, are not instantaneous but occur over the course of several years or more.

Drought stress mitigation guidance:

1. Select native *and* local, drought-tolerant species and cultivars that are appropriate for your site and soil conditions. On sites where Douglas-fir mortality is occurring it may be advisable to plant ponderosa pine (or the Willamette Valley ponderosa pine cultivar in the valley) or Oregon white oak.
2. Thin stands during normal years, not within a drought if possible (thinning can cause a short-term increase in water stress). Remove damaged, stressed or overly mature trees.
3. Control vegetation (especially grasses) that compete for soil moisture.
4. Remove or destroy freshly dead, dying trees and slash or blowdown created in the previous year to prevent insect infestations and outbreaks. Old dead trees are not at risk.
5. Avoid mechanical damage and soil compaction around tree root zones (from vehicles, grazing animals, etc. – especially during the wet season).

Relative Drought Tolerance for Tree Species

Tree species	Drought tolerance (1=high, 5=low)
Oregon white oak	1
Ponderosa/Valley pine	1
Incense cedar	2
Douglas-fir	3
Grand fir	4
Western redcedar	4

Developed by William Emmingham, Extension silviculturist emeritus, Oregon State University

Drought damage in Douglas-fir

6. Irrigate landscape trees during dry weather. Apply water slowly over many hours so it penetrates to tree roots, or use drip irrigation.
7. Apply mulch to landscape trees to retain soil moisture.
8. Do not alter drainage patterns (ditches, ponds, etc.) near established trees.
9. Do not fertilize during droughts. Fertilization stimulates foliage production and can increase water requirements.
10. Systemic pesticides used to prevent or control insect pests may be less effective because they rely on water for translocation to all tissues.

For more information on thinning, vegetation control and other drought mitigation recommendations contact your local ODF stewardship forester for guidance: http://www.oregon.gov/ODF/Working/Pages/FindAForester.aspx

More information:

Oregon Dept. of Forestry, Forest Health
http://tinyurl.com/odf-foresthealth
2600 State St. Bldg. D, Salem, OR 97310
503-945-7200

Current drought information:

U.S. Drought monitor and report
https://wrcc.dri.edu/wwdt/current.php?folder=pon10per
http://listsmart.osl.state.or.us/mailman/listinfo/owrd_drought_report