Adapting Plantings for Prolonged Drought Conditions

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Deep planting stinger bar. Photo Credit: NRCS

*In the 2021 **Treeline survey**, 46% of respondents indicated a strong interest in learning more about deep planting as a climate adaptation strategy.*

Many areas around the world are experiencing prolonged drought. The Southwestern United States has been in a megadrought since 2000, the longest period since **800 CE**. Recent **research** from scientists at UC Santa Barbara indicates the megadrought and mega-pluvial conditions we have experienced in the 20th and 21st centuries, and are projected to experience under business as usual climate change scenarios, reflect a shift in the baseline.

In the **Pacific Northwest**, mean temperatures are projected to increase while overall precipitation is not expected to change significantly, though historic seasonal patterns may be exaggerated. Slightly more precipitation is projected to fall in autumn, winter and spring, and less in the summer. In most projections, more precipitation is expected to fall as rain, rather than snow, **reducing overall snowpack** and exacerbating dry conditions in the summer. In addition to impacts on human health, agriculture, and most other sectors, these cumulative changes will have implications on water availability within natural systems, and may warrant consideration of planting practices that can buffer the anticipated impacts of climate change.

One way that practitioners in the Southwestern United States have successfully established riparian cover despite nearly unrelenting drought is by planting their **stock deep**, so it is closer, or in some cases in direct contact with the water table. In the Pacific Northwest, this may be especially applicable in the dryland riparian areas of eastern Oregon and Washington, where degradation of these ecosystems, climate change, and other pressures have led to lowered groundwater levels and difficulty establishing native riparian cover. One **experimental study** along a tributary to the John Day River in eastern Oregon suggested that planting willow and cottonwood stakes in augered holes that penetrated the water table significantly increased overall survival. These researchers also looked at several browse protection strategies, and determined that vented plastic tree shelters in combination with deep planting led to the highest survival rates, possibly due to the favorable microclimate created by the tree shelter.

These experiments indicate that deep planting may be a viable strategy in restoring ecosystems that will experience more frequent drought conditions as the climate changes, though it isn't appropriate for all species. Rooting habits are an important consideration when deciding whether to plant deeper than typically recommended. Those plants that root readily from cuttings (willow, cottonwood, dogwood, etc.) may respond better to deep planting than those with slower growing, shallower or less vigorous root systems. Some trees and shrubs have bark that is sensitive to oxygen deprivation, and burying the stem too deep may result in bark deterioration which can expose the plants to increased risk of disease and pest infestation. Species that are often buried by sediment during flood events may be less susceptible to bark deterioration.

The following species are often planted by restoration practitioners across different ecoregions in the Pacific Northwest. Information on likelihood of deep planting tolerance was determined by a review of relevant literature related to physiological characteristics including ability and propensity to produce adventitious and rhizomatous roots, and tolerance of frequent flooding and subsequent burial by flood sediments. In most cases the likelihood of deep planting tolerance is an inference based on the above physiological characteristics, and should be taken as guidance for future experimentation and learning.

Common Name	Latin Name	Deep Planting Tolerant
Red Alder	Alnus rubra	Possible
Pacific madrone	Arbutus menziesii	Unlikely
Paper birch	Betula papyrifera	Unlikely
Red osier dogwood	Cornus stolonifera	Yes
Pacific ninebark	Physocarpus capitatus	Possible
Sitka spruce	Picea sitchensis	Unlikely
Black Cottonwood	Populus trichocarpa	Yes
Douglas fir	Pseudotsuga menziesii	Unlikely
Oregon white oak/Garry oak	Quercus garryana	Possible
Red flowering currant	Ribes sanguineum	Likely
Salmonberry	Rubus spectabilis	Likely
Willows	Salix ssps	Yes
Douglas spirea	Spiraea douglasii	Likely
Common snowberry	Symphoricarpos albus	Likely
Pacific yew	Taxus brevifolia	Possible
Western Red Cedar	Thuja plicata	Unlikely

It is important to note that deep planting is not a viable strategy for all species, including most conifer species. For example, planting Douglas fir too deep can reduce the amount of photosynthate produced by the crown, which supports root growth and can lead to decreased vigor or mortality. The impact of this strategy is also highly dependent on site conditions and may not be helpful in areas where plants have consistent access to water in the upper soil horizons through rainfall.

Planting practices aren't the only way to hedge our bets against plant mortality due to drought stress. Outplanting seedlings with well developed, healthy root structures can improve overall drought tolerances.

Root traits associated with better performance under drought:

- Small fine root diameters
- Long specific root length
- Considerable root length density

Learn more here.

Regardless of planting depth, obtaining plants with vigorous and healthy root systems, and employing correct planting techniques are crucial for plant survival, warns Forest Service Emeritus Scientist, Constance Harrington. "Asking for deep planting of a large root system can sound like a good idea but can misfire if seedlings are misplanted such that the roots are bent up at the bottom of the hole (J-rooted). Poor planting can cause problems down the road in survival and growth, so emphasizing correct planting is very important. I also like to loosen the soil at the bottom of the planting hole to encourage rapid rooting into deeper soils," she says. Overwhelmingly, the advice from experts stresses the importance of thoughtfulness in all aspects of ecosystem restoration. From site selection and preparation, to plant form, to planting technique and post-planting care, all elements of this process must be considered with care and attention to detail.

Tools used in deep planting:

- Hand operated and power augers — gas powered models, tractor or skid steer mounted, etc.
- **Stinger bar** attached to excavator or tractor
- **Water jet planter**
- **Electric rotary hammer drills** — can be used to penetrate frozen ground