The Effects of Artificial Shade on Seedling Survival on Western Cascade Harsh Sites

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Artificial shading produced significant increases in survival of 1st year seedlings on four of six Western Cascade harsh sites. Shading minimizes environmental stresses of limited soil moisture, solar radiation, and excessively windy conditions. However, shading does not compensate for low available soil moisture levels.

At numerous locations throughout the western cascades, reforestation is a difficult undertaking. Many sites have harsh environmental conditions presenting problems to conventional tree planting. Difficulties include intense solar radiation, limiting soil moisture, soils with high levels of coarse material, excessively windy environments, and vegetative competition. Planting failures occur frequently, resulting in loss of growth, additional expenses, and frustration for reforestation foresters.

Artificial shade has long been known as an effective way to increase survival of seedlings planted on harsh sites (*1, 6, 8*). Numerous methods have been used worldwide (*4*), and recently tree shading has received increased attention in Western United States reforestation efforts (*2, 3, 7*).

Methods and Materials

In May 1978, a study was initiated on the Rigdon Ranger District, Willamette National Forest, to evaluate the effects of tree shading for protection of seedlings on a high-elevation harsh site. This particular unit had been planted three times and was still understocked. The site had limiting soil moisture late in the growing season and experienced excessively windy conditions, with high levels of solar radiation. A tree shading study was designed to determine if this technique would increase survival.

After the first growing season, the results were dramatic and encouraging. The artificial shading produced significant increases in survival. The survival of unshaded trees was 29 percent, compared to 90 percent for the shaded trees. This represents a 210-percent increase in survival over unshaded trees.

With these findings in hand, several additional harsh site units were selected for testing the method. Units that had experienced plantation failures because of environmental extremes were again selected. All units had been treated with a clearcutting harvest method. All units had a southeastern, southern, or southwestern exposure with elevations between 1,600 and 3,400 feet above sea level.

On June 7, 1979, the second phase of the study was initiated. Two hundred 2-0, bare-root Douglas-fir seedlings were planted on five additional sites. A 24-inch "scalp" to remove competing vegetation was provided for each planted tree. Planting was done with a tree planting hoe. For randomly selected trees, protection was provided by an 8- by 18-inch, commercially produced, heavy-duty paper tree shade (fig. 1). The shade was placed 3 inches from the planted tree at a 180-degree aspect on the south side of the tree (fig. 2).

Results and Discussion

Results after the second phase of the study were again encouraging. Artificial shade significantly increased tree sur-

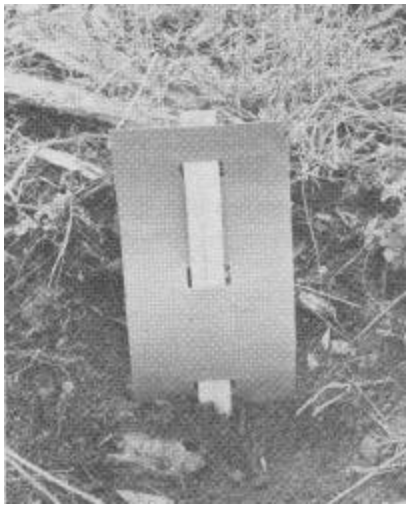

Figure 1.—*Commercially produced tree shade.*

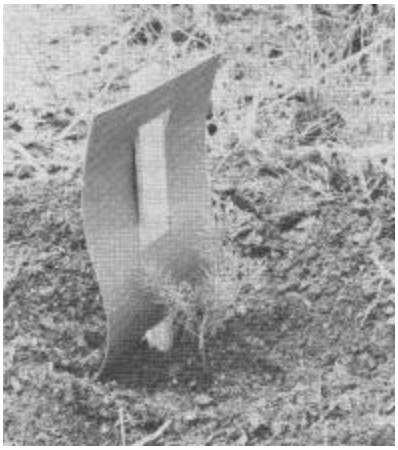

Figure 2.—*Shaded tree.*

vival on most of the sites studied (table 1). Artificial shade increased survival to a point where the unit was considered successful (320 trees per acre or more) on four study areas. The other two sites (Pine Creek No. 2, Feather No. 1) had increased survival rates, but not enough to consider them stocked stands.

The percentage of coarse soil material played a significant role in these two unsuccessful units. This percentage was calculated by measuring the amount of soil material exceeding 2 millimeters in diameter in the upper 10 inches of soil, the upper 10 inches being the rooting zone of the newly planted trees. The two units contained 54 percent and 64 percent coarse material, with soil textures classified as gravelly clay loams and gravelly cobbly loams. These units probably had insufficient soil moisture to support the planted tree during the growing season. This study suggests a strong correlation exists between the percentage of coarse material in the soil and increased survival due to shading. While data are somewhat incomplete, the study suggests that, when coarse material exceeds about 45 percent, survival—even with shading—falls off drastically.

This is probably a response to insufficient soil moisture to carry the tree through the growing season. While shading can compensate for some decreased moisture levels, it cannot substitute for inadequate levels. These inadequate levels appear to occur with about 45 percent coarse material in the study site soils.

Table 1.—*Comparison of shaded and control (unshaded) tree survival*

Unit	Coarse Material[1]	Soil texture	Date	Trees planted	Control		Shaded	
					Trees alive	Survival	Trees alive	Survival
	%					%		%
Modoc #2	20	Thick	6/7/79	200	100		100	
		clay loam	9/21/79		28	28	58	58
Gumbo # 13	31	Clay loam	6/7/79	200	100		100	
			9/21/79		45	45	83	83
Wolf Mountain #11	35	Thin sandy	5/19/78	100	48		52	
		loam	10/13/78		14	29	47	90
Crabapple #8	37	Clay loam	6/7/79	200	100		100	
			9/21/79		34	34	100	100
Pine Creek #2	54	Gravelly	6/7/79	200	100		100	
		clay loam	9/21/79		1	1	9	9
Feather #1	64	Gravelly	6/7/79	200	100		100	
		cobbly loam	9/21/79		4	4	19	19

[1]Percentage of soil material exceeding 2 millimeters in diameter in the upper 10 inches of soil.

A third unit (Modoc No. 2) had lower survival results than expected. Survival, even with shading, was only 58 percent. While this was a significant increase over the unshaded trees, the results were not as high as expected. These lower results may be explained in part by noting the unit's soil texture. Modoc No. 2 soils are classified as thick clay loams. Although fine-textured soils can hold more soil moisture, these types of soils frequently have less available moisture. Therefore, the lowered survival results are thought to be a response to less available soil moisture in the thick clay loam soil.

These results include any operational problems of planting and stock variability. An attempt was made to minimize planting-related mortality by using good planting techniques.

Conclusions

Artificial shading produced significant increases in survival on four of six western Cascade harsh sites studied. This additional survival amounted to as much as a 210-percent increase over unshaded trees. Shading minimizes the environmental stresses that reduce survival on the type of sites studied. These stresses include limited soil moisture, solar radiation, and excessively windy conditions. However, shading cannot compensate for limiting levels of available soil moisture. Where coarse soil materials exceed approximately 45 percent (of the study soils), enough soil moisture was not available to see the plant through the growing season. Even though trees were shaded, shaded-tree survival was only 9 percent and 19 percent on soils with coarse material levels of 54 percent and 64 percent.

When soil textures are so fine as to make a significant portion of the soil moisture unavailable, survival of trees, even with shading, is decreased. The planting unit with a thick clay loam soil resulted in lower survival results than expected during the study. Commercially produced tree shades are available and reasonably priced. Increased survival rates can offset increased costs of tree-shade materials and the labor required to install them. Increased survival rates may also eliminate any need for replanting. Recent studies on Bureau of Land Management lands have found tree shading to be economically reasonable on certain sites (*5*).

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