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Should Ponderosa Pine Be Planted on Lodgepole Pine Sites?

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Abstract

Repeated radiation frosts caused no apparent harm to the majority of lodgepole pine (Pinus contorta Dougl.) seedlings planted on a pumice flat in south-central Oregon. For most but not all of the ponderosa pine (Pinus ponderosa Dougl.) seedlings planted with the lodgepole pine, however, damage from radiation frost resulted in reduced height growth.

Keywords: Radiation frost, pumice soil, lodgepole pine, Pinus contorta, ponderosa pine, Pinus ponderosa.

Introduction

In the pumice soil region of south-central Oregon, lodgepole pine (Pinus contorta Dougl.) usually occurs in pure stands on flats and basins, where cold air accumulates at night, whereas ponderosa pine (Pinus ponderosa Laws.) dominates the adjacent higher ground. Stand boundaries are often abrupt, coinciding with slight changes in topography. Reasons for this distribution pattern include superior frost tolerance of developing lodgepole pine cones (Sorenson and Miles 1974) and germinants (Cochran and Berntsen 1973) over ponderosa pine cones and germinants.

Occasionally lodgepole pine stands on level topography have an understory of younger ponderosa pine. Modification of the low temperature extremes at the soil surface by the lodgepole canopy probably allowed the ponderosa pine to become established. A few scattered mature ponderosa pines do exist in some lodgepole pine flats. These ponderosa pine trees are much older and taller than the lodgepole pine and may have started as understory trees beneath an earlier lodgepole pine stand.

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Table 1--Differences in height of lodgepole and ponderosa pines in four "frost pocket" locations in south-central Oregon, fall 1974¹

Site	Location	Elevation	Year ponderosa pine planted	Range in height	
				Planted ponderosa pine	Natural lodgepole pine
		Feet		Feet	Feet
Snow Creek	S1/2 sec. 10, T. 20 S., R. 8 E.	4,545	1934	8.0-15.0	26.0-33.0
Pipeline flat	S1/2 sec. 2, T. 25 S., R. 8 E.	4,460	1963	1.5- 5.0	8.0-15.0
Shevlin well	NW1/4 sec. 20, T. 28 S., R. 9 E.	5,025	1955	6.5-10.0	20.0-33.0
Shevlin yard	NW1/4 sec. 20, T. 28 S., R. 9 E.	5,150	1955	2.5- 6.5	11.5-13.0

¹Planting dates for ponderosa pine were obtained from USDA Forest Service records or estimated from ring counts of tree sections taken at ground line. Lodgepole pine at each site was 2 or 3 years younger than the ponderosa pine, indicating that 2-0 or 3-0 ponderosa pine stock was planted.

Planted seedlings do not germinate on the site or need to produce cones. Further, the frost resistance of 2-0 or larger seedlings of either species is thought to be high, provided the dormancy cycle has been correctly managed in the nursery (Cleary and others 1978). Therefore, practicing foresters periodically inquire about the possibility of planting ponderosa pine seedlings in clearcuts on flats and basins previously occupied by lodgepole pine. Such plantings have been attempted in several locations, but lodgepole pine has seeded in, overtopping the ponderosa pine (table 1). Where ponderosa pine seedlings survive, they are deformed or severely suppressed; frost damage to the needles is apparent during some growing seasons.

This paper presents further exploratory comparisons of the early development of ponderosa and lodgepole pine seedlings planted together on soils developing from Mazama pumice. Care should be taken in extrapolating the results to other soils and areas.

Further Comparisons

For the locations shown in table 1, the ponderosa seed source is unknown and may not be adapted to the site. Would the performance of ponderosa pine from appropriate seed sources be satisfactory? To partially answer this question, we planted 100 ponderosa pine and 100 lodgepole pine seedlings interchangeably at a 12- by 12-foot spacing on a "pumice flat" surrounded by lodgepole pine (NW1/4 sec. 31, T. 22 S., R. 11 E., Willamette meridian). Elevation of the area is 4,120 feet. The soil is an ashy over loamy, mixed Typic Cryorthent.

Early juvenile growth of lodgepole pine has been considered superior to that of ponderosa pine on comparable sites. We decided to compare differences in growth rates on the pumice flat with growth rates of the two species planted earlier on sloping topography nearby. Seed collected from the plantation site, 7.3 air miles west of the flat, was germinated in the greenhouse in the spring. The seedlings were kept in the greenhouse until mid-winter when the greenhouse temperature was slowly lowered to match outside temperatures. Next the seedlings were taken outside, then planted interchangeably in April on a 6-percent slope with a west-southwest aspect. The soil at this plantation is very similar to the soil of the pumice flat.

After six growing seasons in the plantation, over 300 undamaged seedlings of each species remained. The lodgepole pine seedlings averaged 2.7 feet in height, and the ponderosa pine seedlings averaged 2 feet. For the seedlings surviving after six growing seasons on the pumice flat at the end of 1983, average heights were:

<u>First planting</u>	<u>Second planting</u>
Lodgepole pine 2.4 feet	Lodgepole pine 2.4 feet
Ponderosa pine 1.2 feet	Ponderosa pine 0.96 feet

At the end of 1983, 8 of the 27 surviving ponderosa pine from the first planting and 8 of the 35 surviving from the second planting in the pumice flat resembled stunted bushes and appeared damaged from repeated radiation frosts. None of the lodgepole pine trees displayed reduced height growth that seemed related to radiation frost damage. Two of the ponderosa pines from the first planting were over 6.6 feet tall, and an additional nine trees appeared to be healthy and have been growing over 8 inches a year. Eight of the 35 ponderosa pines from the second planting also appeared fairly resistant to frost damage and may grow to size suitable for harvest.

Most of the mortality for both plantings on the flat has been caused by pocket gophers (*Thomomys* spp.). A few trees have also been destroyed by porcupines (*Erethizon dorsatum* Linn.). There is no indication that pocket gophers or porcupines prefer one species over the other. Crouch (1971) also noted no difference in the susceptibility of ponderosa and lodgepole pines to pocket gophers. Some of the trees, primarily lodgepole pine, have been attacked by the lodgepole pine terminal weevil (*Pissodes terminalis* Hopping); but in every case, a lateral branch replaced the destroyed terminal, and the height development of the tree appeared to be reduced slightly, if at all.

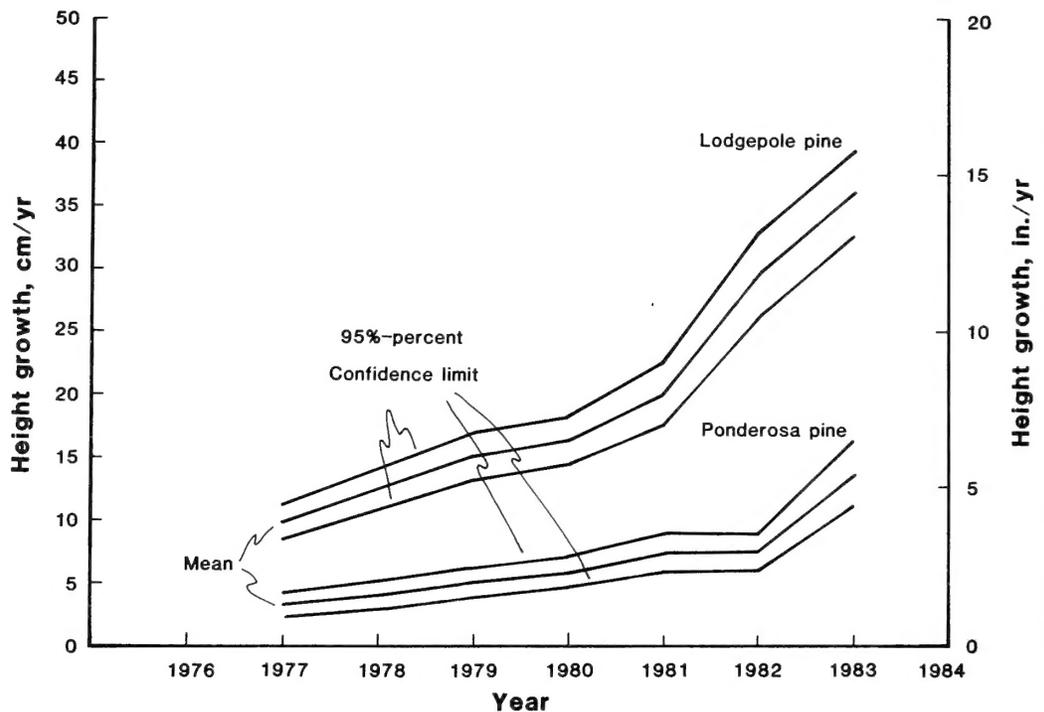


Figure 2.--Height growth per year for lodgepole and ponderosa pine seedlings planted in April 1975.

To obtain another comparison of species performance, we alternately planted 100 2-0 seedlings of each species at a 12- by 12-foot spacing in the spring 1975, on the pumice flat adjacent to the plantation established 4 years earlier. The seed came from zones compatible with this planting site; the seedlings were raised in the Bend Pine Nursery. A severe frost (17 °F minimum temperature in a standard weather shelter at the site) on June 19, 1975, caused no apparent harm to lodgepole pine seedlings, but there was obvious damage to 52 of the ponderosa pine seedlings. Height growth for 1975 was not measured. At the end of 1983, only 35 ponderosa and 40 lodgepole pine seedlings remained. Average heights of the surviving lodgepole and ponderosa pine seedlings were 5.2 feet and 1.9 feet, respectively, in the fall 1983, and height growth rates for this second planting have been significantly different since 1976 (fig. 2).

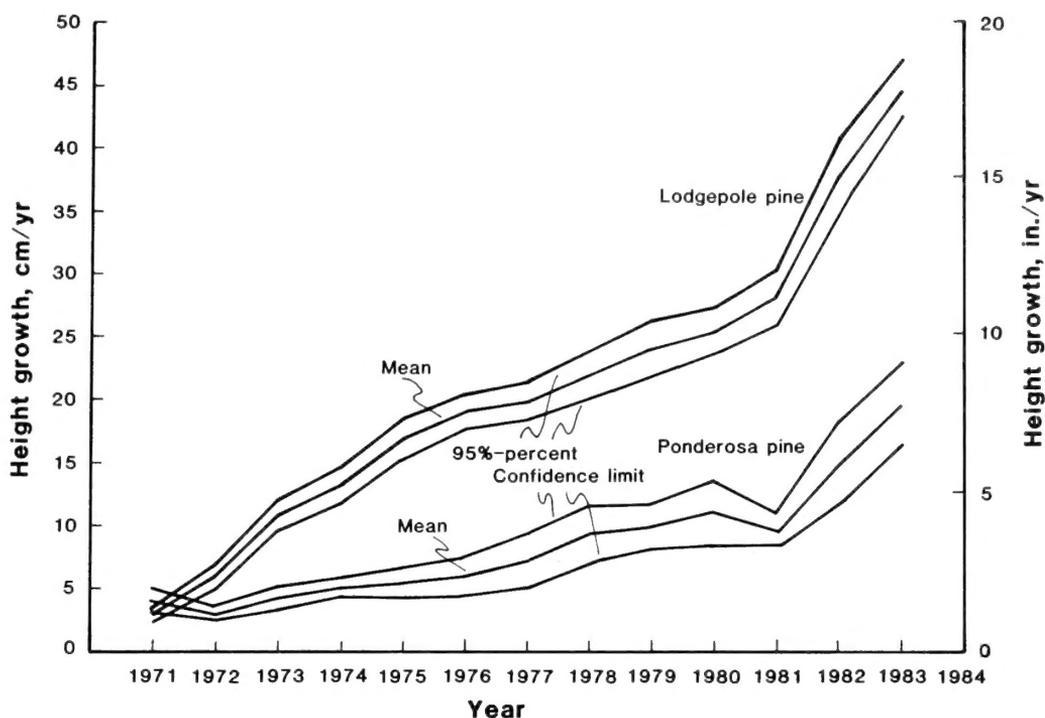


Figure 1.--Height growth per year for lodgepole and ponderosa pine seedlings planted in April 1971.

The 3-0 ponderosa pine stock was raised in the Bend Pine Nursery of the USDA Forest Service, 28 air miles from the planting site; seed had been collected at the 4,000-foot elevation within 18 miles of the planting site. Lodgepole pine seedlings were obtained from roadsides within 10 miles of the planting site because nursery seedlings were not available. The planting was done over a 2-day period in April 1971. Average height growth for the first growing season (fig. 1) was slightly greater for ponderosa pine, possibly because of the nursery fertilization program. From 1972 through 1983, however, height growth of lodgepole pine was superior. At the end of 1983, the 60 surviving lodgepole pines averaged 9 feet in height, significantly¹ taller than the 3.9-foot average for the 27 surviving ponderosa pines. Of the surviving ponderosa pine trees, none was taller than the average height of the lodgepole pine trees. Height growth rates, however, have accelerated with time: 11 of the 27 ponderosa pine trees grew more than 8 inches in 1983, although the best height growth of ponderosa pine was not equal to the average height growth of the lodgepole pine.

¹Use of the word "significantly" in this note means that a *t* test has been applied using a 5-percent level of probability to accept or reject differences as real.

Conclusions

Ponderosa pine planted on flats and basins in the pumice soil region of south-central Oregon will suffer varying degrees of radiation frost damage. Some of the trees will be so severely damaged they will not grow to salable size in a reasonable length of time. Most ponderosa pine trees will exhibit reduced growth rates because of repeated frost damage, but some of the trees may grow normally.

The data and observations presented here indicate that pumice-mantled flats and basins should be managed for lodgepole pine. Because a small percentage of ponderosa pine seems to be resistant to radiation frost, some seedlings could be planted on flats and basins. The scattered ponderosa pine trees existing in some of the flats might provide a seed source for the planting stock. These plantings could establish a potential future source of seed for geneticists to use in developing ponderosa pine that is more resistant to low temperatures.

Metric Equivalents

1 inch = 2.54 centimeters
1 foot = 0.30 meter
1 mile = 1.61 kilometers
 $^{\circ}\text{F} = 1.8 (^{\circ}\text{C}) + 32$

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