UNIVERSITY of IDAHO-College of Forestry, Wildlife and Range Sciences

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A Direct Seeding Experiment With Four Tree Species Native to Northern Idaho

by

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The acreage needing forestation in the United States is tremendous, but current or projected planting programs do not begin to cope with the challenge. To many foresters, direct seeding has long seemed the obvious recourse. In the northern Rockies, however, this technique has generally proved fruitless. The dearth of applicable technical information concerning direct seeding undoubtedly is largely responsible for the many failures reported within the region. The experiment described below represents one part of a new attempt to determine the synthesis of species, site preparation and time of seeding necessary for maximum success under conditions commonly encountered in the field.

SITE

Plots were located on a northwest slope near the town of Blanchard in Bonner County. The study area probably supported climax vegetation typical of the *Thuja plicata/Pachistima myrsinites* association. About 20 years ago a wildfire devastated the site, and a heavy brush invasion followed. Inland Empire Paper Company, owners of the property, sprayed the brush with 2,4,5,T in the spring of 1960 and carried out a controlled burn the following fall. The company attempted to restock the area by means of aerial seeding after the burn. A mixture of Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco.), grand fir (*Abies grandis* (Dougl.) Lindl.) and western red cedar *Larix occidentalis* Nutt.) seed was employed in this operation, at the rate of 40,000 viable seeds per acre. Results were generally disappointing, with adequate germination and survival achieved on only a small fraction of the acreage involved. Because of the past history of direct seeding failures throughout the entire region, a small portion of the area had been reserved for experimental work and was purposely left out of the direct seeding trial. This portion became the site of the study reported herein (Figure 1).

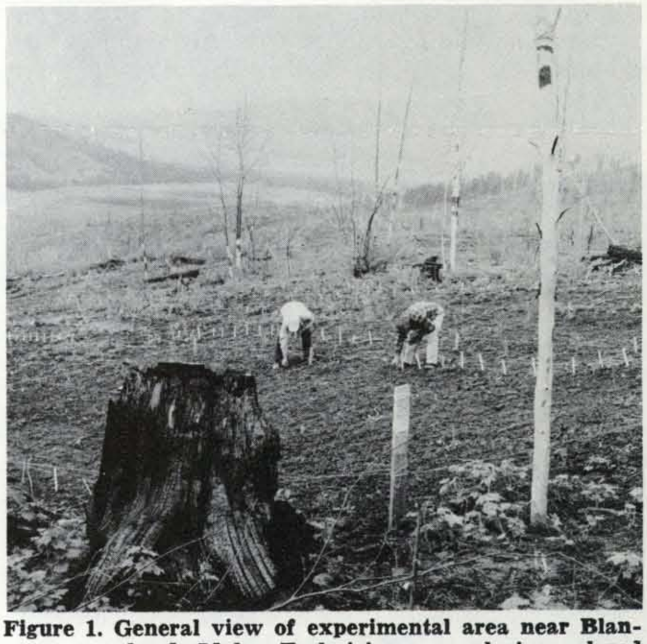

Figure 1. General view of experimental area near Blanchard, Idaho. Technicians are placing colored toothpicks next to newly emerged seedlings.

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The cooperation of the Inland Empire Paper Company, Millwood, Wash., and James Anderson, their Chief Forester, is gratefully acknowledged.

Soil texture of the plot area was silt loam, 1/3 atmosphere water holding capacity 24.3%, and 15 atmosphere water holding capacity 12.3%. The pH of the surface horizon was 6.5, and organic matter content 2.73%.

At the time the experiment was initiated (one year afer the controlled burn mentioned above) little natural revegetation had occurred on the site.

METHOD

An area of approximately 1/4 acre was divided in half, one subdivision to be used for fall seeding in 1961, the other to be seeded in the spring of 1962. Those two sections were then halved again. One portion of the fall division and one of the spring division received no treatment other than the controlled burn cited previously. The remaining parts of both sections were cultivated shortly before the fall seeding operation.

Planting of seed, species used, and number of replications were same on each of the four subdivisions of the experimental area. Eight hundred seeds each (8 replicates, 100 seeds per replicate) of ponderosa pine (*Pinus ponderosa* Laws.), Douglas fir, grand fir, and western red cedar were drilled in 25 foot rows on each section. Fall plots were sown November 7, 1961, and spring plots on May 3, 1962.

Throughout the experimental period, soil moisture (3 and 8 inch depth) and surface temperature data were monitored for all plot conditions. Precipitation and air temperature records of the site were also maintained.

RESULTS AND DISCUSSION

Whereas moisture was adequate throughout the spring germination period, during July and August (the critical months for seedling survival) only 0.69 of an inch of precipitation was recorded. Of this total, 0.53 of an inch occurred in the week ending August 7th. Air temperature exceeded 90° F on eight days in July and three in August.

On May 17, 31, June 14 and 24 examinations were made of seedling emergence. Those seedlings newly appearing on each date were staked with different colored toothpicks. Counts of seedlings surviving at the end of the growing season were made on September 26. Emergence and survival both by week and in total were tallied on the basis of species, season of seeding, site treatment and combinations of these variables. A separate statistical evaluation was made for germination and survival data.

Emergence was practically nil before May 17 (Table 1). On fall seeded plots, without exception, by far the greatest emergence occurred during the period of May 17 to 31 and tapered off sharply thereafter. This pattern was not unexpected. Chemical effects on the overwintering seed would doubtlessly promote early emergence. In contrast, many spring seeded plots had notably higher emergence during the period May 31-June 14 than during the preceding two weeks. One important exception to this trend can be noted in the data for ponderosa pine seeded in the spring on burned and cultivated soil. Here twice as many seeds emerged during May 17 to 31 than from May 31 to June 14.

Table 1. Cronological trends in seed emergence. Results given as per cent of total emergence of the particular species for the entire season.

Seeding Date & Ground Prep.*		5/7	5/31	6/14	6/24
		Douglas-Fir			
Fall Seeded	Burned only	6	32.4	2.2	0
	Burned, Cult.	0	21.9	5.1	0.3
Spring Seeded	Burned only	0	9.2	10.7	2.9
	Burned, Cult.	0	8.0	6.8	0.5
		Ponderosa Pine			
Fall Seeded	Burned only	0.2	20.6	6.0	0
	Burned, Cult.	0.2	15.3	3.7	0.7
Spring Seeded	Burned only	0	3.3	5.5	3.5
	Burned, Cult.	0	25.9	13.9	1.2
		Grand Fir			
Fall Seeded	Burned only	0	30.9	4.5	0.9
	Burned, Cult.	0	16.4	6.3	0
Spring Seeded	Burned only	0	2.8	7.2	8.2
	Burned, Cult.	0.9	6.4	10.0	5.5
		Western Red Cedar			
Fall Seeded	Burned only	0	23.8	0	0
	Burned, Cult.	0	28.6	7.9	1.6
Spring Seeded	Burned only	0	25.4	3.2	3.2
	Burned, Cult.	0	1.5	4.8	0

* Experimental area burned one year prior to the fall seeding, and all cultivated plots prepared immediately prior to fall seeding.

The time of emergence may have influenced the fate of seedlings. Within a particular species, those treatments producing relatively high seed emergence percentages by May 31 generally showed higher seedling survival at the end of the growing season. Evidently the earlier emerging seedlings were able to produce a more extensive root system before the onset of summer drought than were the later emerging plants.

The analysis of variance for both emergence and survival data revealed that many significant or highly significant differences occurred. Duncan's New Multiple Range Test was utilized to determine where these significant differences lay.

A comparison of overall species performance, without regard to season of planting or method of ground preparation, may first be made. From the standpoint of emergence, there was no significant difference between Douglas fir and ponderosa pine. However, both of these species produced significantly better emergence than grand fir, which in turn significantly out-performed cedar. Survival results differed from those found for emergence in that ponderosa pine was significantly better than Douglas fir. Seventy-four per cent of emerged ponderosa pine seedlings survived the first growing season, compared to 50% of the Douglas fir.

Season of seeding markedly affected results. Method of ground preparation is not a factor in these particular comparisons. The best emergence was achieved with fall sown Douglas fir. Spring seeded Douglas fir ranked fourth, behind both spring and fall seeded ponderosa pine. When survival is considered, however, the spring seeded ponderosa pine was significantly superior to fall seeded pine, as well as to all other species—season of seeding treatments. Actual survival percentages ranged for 77% for the spring seeded ponderosa pine to only 8% for spring seeded cedar.

The data concerning effect of ground preparation on emergence and survival of the four species, regardless of season of seeding, indicate that best results in both emergence and survival occurred where the previously burned plots were cultivated and seeded with ponderosa pine. No significant difference in survival was found among seedlings on uncultivated ponderosa pine, uncultivated Douglas fir, and cultivated Douglas fir plots.

The most critical comparisons can be observed in figure 2, a graphical presentation of interactions involving all three variables. In order to ascertain clearly where significant differences among the 8 most successful treatments occurred, reference to Table 2 should be made. Treatments not joined by the same line differ significantly from each other, whereas those which are joined by the same line do not.

No significant difference was found between emergence of spring seeded ponderosa pine on burned and cultivated land and fall seeded Douglas fir on land which was burned only. However, it should be stressed that *survival* of seedlings from this particular ponderosa pine treatment was significantly better than that found for the Douglas fir treatment and superior survival is, of course, the ultimate goal.

Several factors contributed to the superior performance of the spring seeded ponderosa pine. Of the species investigated, the seed of the ponderosa pin is most preferred by rodents. Thus, more seed loss of the species might be expected where seed was available for many months rather than for a short time in the spring. As a result, less seed would be available for germination on fall seeded ponderosa pine plots than on spring seeded plots. Movement of seed off fall seeded plots can probably be rejected as an influence in this experiment because the seed was drilled into the soil, rather than being placed on the surface. Then too, the superior emergence of fall seeded Douglas fir, grand fir, and cedar indicates that rodent feeding preferences, rather than washing, was a dominant effect.

Soil moisture content in relation to growth habit of ponderosa pine seedlings undoubtedly strongly affected results. By late August water content of the soil had reached the wilting point at the 3 inch depth on all plots without exception, but remained well above this at the 8 inch depth on plots which had received cultivation. The well known ability of ponderosa pine to rapidly extend a tap root enabled the seedlings to utilize this source of moisture, with consequent benefit to survival. In contrast, the other species with more of their roots concentrated in the surface soil, were more prone to succumb to moisture stress.

Temperature of the soil surface ranged between 125° and 138° F every week during the summer. Ponderosa pine is usually thought to be more resistant to heat damage than the other species utilized. Thus, although direct evidence is lacking, this insolation effect cannot be discounted in assessing results.

Table 2. Significance of emergence and survival differences. Treatments are listed in order of decreasing effectiveness, and only the eight best in each category are shown. These treatments NOT joined by the same line differ significantly from one another; those which are joined by the same line do not present significant differences.

Species	Season of Seeding	Site Prep.	Significance of differences (5% level)
	2. Emergence		
P. Pine	Spring	Burn, Cult.	
Dougl. Fir	Fall	Burn	
Dougl. Fir	Fall	Burn, Cult.	
P. Pine	Fall	Burn	
Dougl. Fir	Spring	Burn	
P. Pine	Fall	Burn, Cult.	
Dougl. Fir	Spring	Burn, Cult.	
P. Pine	Spring	Burn	
	1. Survival		
P. Pine	Spring	Burn, Cult.	
Dougl. Fir	Fall	Burn	
P. Pine	Fall	Burn	
Dougl. Fir	Fall	Burn, Cult.	
P. Pine	Fall	Burn, Cult.	
Dougl. Fir	Spring	Burn, Cult.	
P. Pine	Spring	Burn	
Grand Fir	Fall	Burn	

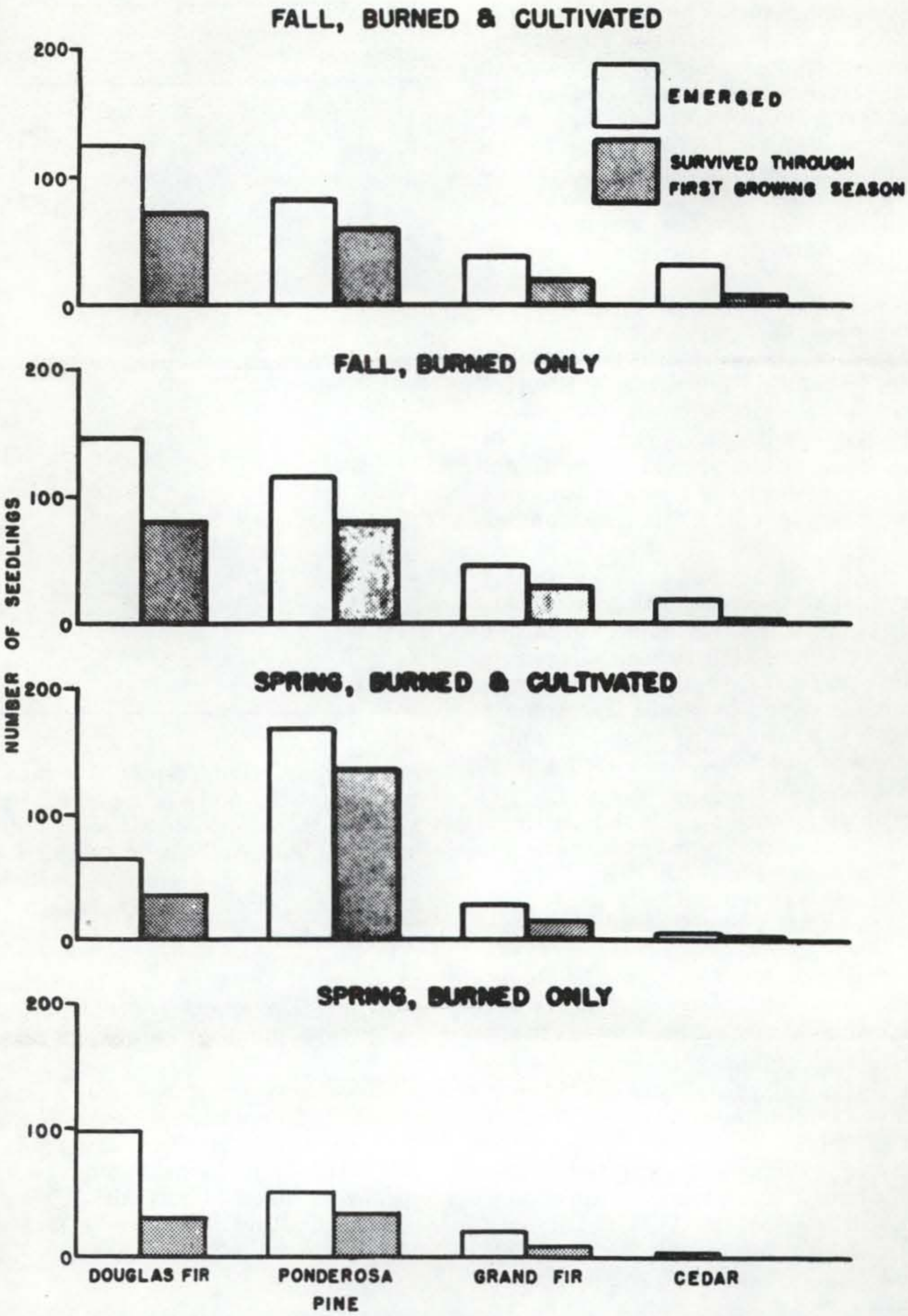

Figure 2. Interactions of species, season of seeding and ground preparation on emergence and subsequent survival of seedlings.