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First Season Survival and Growth of Douglas-fir Planted in North Idaho Shrubfields

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ABSTRACT

Douglas-fir seedlings planted under dense shrub competition conditions and on adjacent cleared areas were compared for first year survival, growth, and animal damage. Survival was positively correlated with shrub density and was significantly related to aspect. Damage to the planted seedlings by hares was extensive both in shrub fields and in the cleared strips and was significantly associated with first-year growth. First-season growth also was related to initial height and to the study area. During the study period, a year of above-average precipitation, seedling growth under shrubs was not significantly different from seedling growth in the cleared strips.

INTRODUCTION

Tree regeneration on warm, dry southerly exposures in northern Idaho frequently poses some difficulty. If successful reforestation is not promptly carried out following wildfire or site preparation, shrubs and forbs will occupy these harsh sites. This vegetation competes with tree seedlings for moisture, light, and nutrients, and provides habitat for small mammals that can damage young trees. In the absence of adequate coniferous cover these sites often develop into mature shrubfields, preventing establishment of commercial stands.

To reclaim mature shrubfields for artificial reforestation, Stewart (1978) and Gratkowski (1974) recommended using mechanical or chemical site preparation, prescribed burning, or a combination of the three methods to eliminate

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or reduce competition. Selection of site preparation method depends on steepness of slope, soil erodibility, herbicide effectiveness, fuel level, degree of disturbance desired and other interrelated site factors. Under some conditions these methods create microsite changes that may be detrimental to seedling establishment and development. In addition, site preparation may not achieve the desired results and may not be necessary.

Although there is little disagreement on the importance of eliminating grass competition, some investigators have questioned the assumption that shrub competition on harsh sites has detrimental effects on seedling growth (Coffman 1975, Ryker and Potter 1970, Youngberg 1966). They have observed that much of the natural regeneration of various conifers on harsh environments in the western states has occurred within the shade of shrubs or trees. The implication is that the benefits of shade outweigh the effects of competition for soil moisture.

This note reports on the feasibility of planting Douglas-fir (*Pseudotsuga menziesii* var. *glauca* [Mirb.] Franco) under shrubs on harsh environments without extensive site preparation. Although this case-history study does not represent a wide range of habitats, it does yield trends which may prove useful in planning for shrub-field regeneration.

The objective of this study was to answer the following questions:

1. Is there a significant difference in first-year survival and growth between Douglas-fir planted under dense natural shade (shrub) and in the open?

2. To what degree does animal damage affect first-year survival and growth of Douglas-fir planted in dense shade and in adjacent open strips?

DESCRIPTION OF THE STUDY SITES

The sites selected for this study are located in the Walde and Cabin Creek drainages on the Lochsa Ranger District, Clearwater National Forest. They are approximately two air miles apart and are typical of north Idaho shrubfields that have developed on harsh sites following clearcutting, prescribed burning, and unsuccessful planting.

The Walde Creek site and the Cabin Creek site were clearcut and prescribed burned in the mid-1960s. They were planted with bareroot grand fir (*Abies grandis* [Dougl.] Lindl.) and Douglas-fir in 1964 and 1966, respectively. When these plantations failed, funding limitations prevented prompt replanting. Both sites consequently developed into dense shrubfields with only widely scattered conifers. The primary shrub species on these sites included Rocky mountain maple (*Acer glabrum* Torr.), serviceberry (*Amelanchier alnifolia* Nutt.), ninebark (*Physocarpus malvaceus* (Greene) Kuntze), oceanspray (*Holodiscus discolor* (Pursh) Maxim.), scouler willow (*Salix scouleriana* Barratt), Pachistima (*Pachistima myrsinites* (Pursh) Raf.), snowberry (*Symphoricarpos albus* (L.) Blake), redstem ceanothus (*Ceanothus sanguineus* Pursh), and evergreen ceanothus (*Ceanothus velutinus* Dougl.). The last species comprises approximately 80 percent of the shrub volume with heights of 4 to 7 feet.

The Walde Creek study site primarily maintains a south aspect with slope angles of 37 to 45 percent. The Cabin Creek site includes aspects ranging from south to west and slope angles of 24 to 50 percent.

The soil association for both sites was identified as the Jughandle Series (Webb et al. 1971). This soil series has highly productive deep soils that are excessively drained. They have a thin organic layer underlain by brown and light-yellowish-brown sandy loam. Below is pale to very pale brown coarse sand. These soils range from strongly acidic to slightly acidic.

Walde Creek study site elevation is 4,300 feet (1310 m), and Cabin Creek, 4,400 feet (1341 m). Both are identified as grand fir/pachistima (*Abies grandis/Pachistima myrsinites*) habitat type (Daubenmire and Daubenmire 1968). Annual average rainfall is approximately 36 inches (91.5 cm), with a growing season of 70 to 90 days.

METHODS AND PROCEDURES

To compare open-planted trees with trees planted under shrubs, we cleared and planted 8- to 10-foot-wide strips in each shrubfield in May 1981. These strips were grouped into four areas with similar aspects and slopes.

Experienced planters placed bareroot 2-0 Douglas-fir in each area. They planted trees in the middle of the open strips at 8-foot intervals, after first scalping an 18-inch section of ground. Bark, a rock or branch was placed to shade the lower part of the seedling from direct solar radiation. The spacing for trees planted under shrubs varied with shrub density. Planters also required a safe area for swinging their planting tool. Each planting site was scalped, but the stems of the seedlings were not shaded. Each tree planter was assigned to plant a cleared strip and an adjacent shrubfield area. Planting dates were May 21 through May 28.

Half of the trees in the open and under shrubs were protected from animal damage through the use of plastic mesh tubes, each secured with two spiral pins.

Individual tree and site data were recorded immediately after planting and again in October, after the end of the first growing season. Data collected included seedling survival, first-year tree height growth, tree planter, aspect, area, animal protection, treatment (under shrubs vs. open), slope angle, spring shrub volume, fall shrub volume, initial tree height, and animal damage.

RESULTS

Animal Damage

Sixty-nine percent of all trees planted without animal protection were damaged (Table 1). Without the plastic mesh protection, 75 percent of the seedlings in the open strips and 63 percent of those under the shrubs were damaged. Only 6 percent of all trees covered with the mesh tubes were damaged. Most of this damage occurred on new growth when the terminal leader grew out of the tube and was exposed to feeding injury.

Growth

First-season growth was not significantly (0.05 level) related to treatment (shade vs. open), although there was a slight trend toward increased growth for trees planted in the open (2.60 inches as compared with 2.46 inches for undamaged trees planted under the shrubs). Other variables not significantly associated with first season growth included tree planter, aspect, slope angle, spring shrub volume and fall shrub volume. A trend toward greater height growth on the southwest to west aspects was noted, but was not statistically significant (all possible aspects were not represented).

First-season growth was significantly (0.05 level) related to animal damage, initial height, animal protection and area (Figure 1). Animal damage consisted primarily of rabbits feeding on the terminal leaders and reducing tree height. Larger stock grew better than smaller stock as shown by the significance of initial height in predicting height growth. This was not unexpected since Emmingham and Waring (1973) found a similar initial height to growth relationship. The plastic mesh tubes not only did an excellent job of protecting the seedlings from first growing season animal damage, but also were related to growth of those trees not damaged by animals (Figure 1). Light that is high in far-red is known to stimulate stem elongation, and this may explain the slightly greater growth of seedlings protected by the yellow tubes the first year (Marquis 1977).

The differences in growth by area can only be explained by the variable intensity of animal damage (Table 2). For example, the highest incidence of animal damage (47 percent) occurred on area 4. Other areas had less damage and greater net height growth. The reason for the difference in animal damage is not clear since animal habitat on all areas appeared to be unifom. The variance within sites is equally perplexing. Area 3, with 15 percent animal damage, is only 1400 feet from area 2, which received 40 percent animal damage.

Table 1. Animal damage to live trees with different planting and protection treatments.

Tree protection	Planting treatment	Type of animal damage				
		No damage	Terminal damage	Stem partially missing	Animal pushover	Total damage
		%	%	%	%	%
No animal protection	shrub	25	60	14	1	75
	open	37	54	8	1	63
	weighted treatment totals	31	57	11	1	69
Animal protection	shrub	93	7	0	0	7
	open	95	3	0	2	5
	weighted treatment totals	94	5	0	1	6

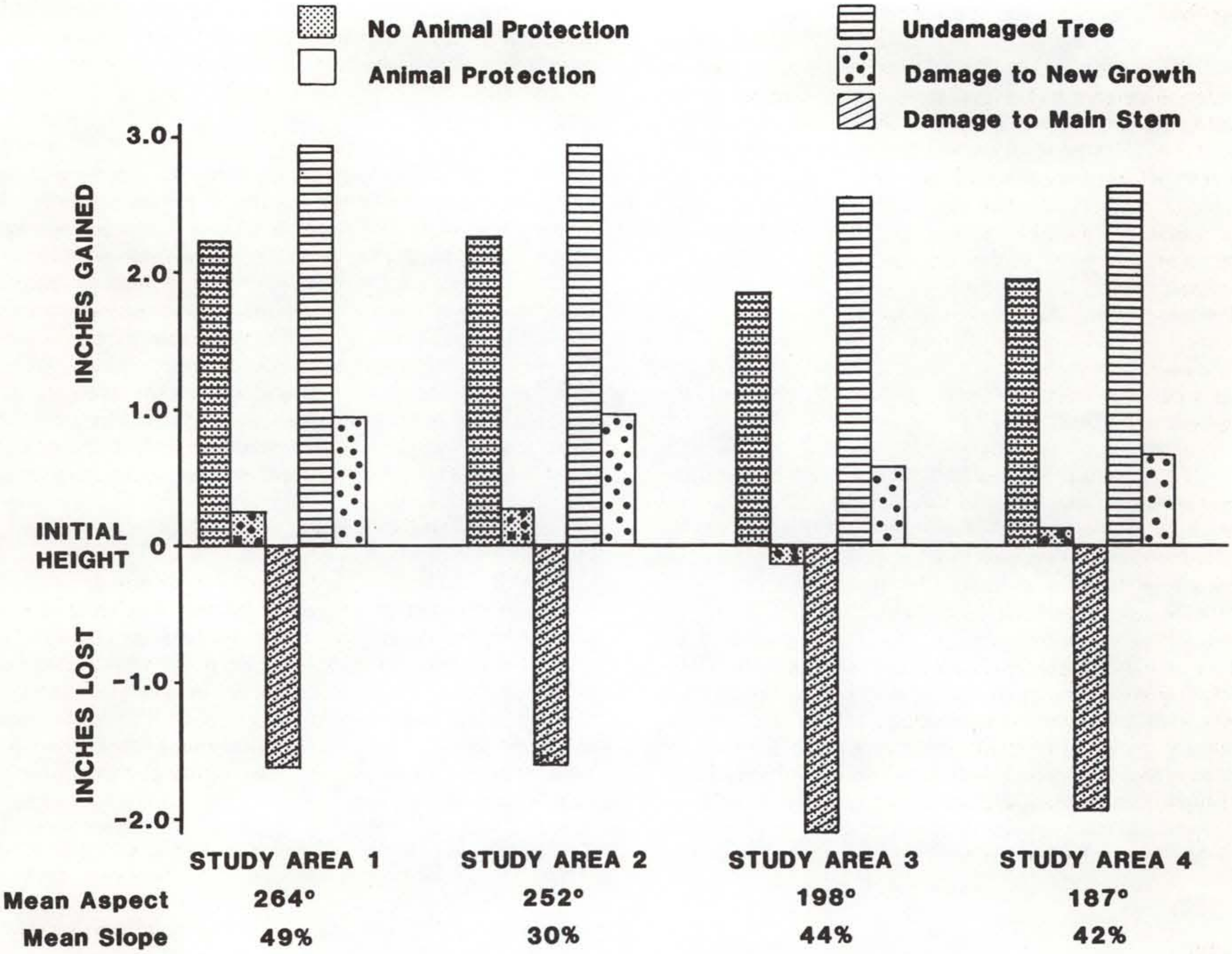

Figure 1. Mean first season height differences by area, animal protection and animal damage. Shading indicates no protection from animals. Clear backgrounds show areas which had barriers to protect trees from animals.

Table 2. Mean height growth for all live trees and percent total animal damage by area.

Area	Type animal damage			Total animal damage	Mean height growth
	terminal	stem	pushover		
	%	%	%	%	inches
1	34	2	0	36	1.83
2	30	10	0	40	1.67
3	15	0	0	15	1.87
4	36	9	2	47	1.20

Survival

Average survival on all areas was 89.8 percent, approximately 6 percent higher than other 1981 plantings on the Lochsa Ranger District on similar aspects, slopes and habitat types. However, it is nearly equal to the 88 percent survival of combined plantings during 1981. Good survival can probably be attributed to the above-average growing season precipitation. During the critical months (May-September) of the growing season, weather stations at Kooskia, Idaho (62-year record) and Pierce, Idaho (19-year record) recorded above average precipitation of 2.11 inches (5.4 cm) and 4.73 inches (12.0 cm), respectively. Most of this above normal precipitation came during June and July, with August and September slightly drier than average.

Fifty-one of the 500 study trees died during the first growing season. Pocket gophers accounted for the loss of only two trees, corresponding to the light pocket gopher activity observed. However, pocket gopher damage is often heaviest in the winter (Barnes 1973), and this study does not include winter 1981/1982 mortality data. Four trees were killed by elk trampling. Elk used several of the open strips as travel routes, hence 75 percent of the elk-related mortality and tree damage occurred in the open strips. Two trees were not found. The remaining 43 trees died of what appeared to be moisture stress, or from poor tree planting or handling. Thirteen of these 43 trees sustained other mammal damage prior to death.

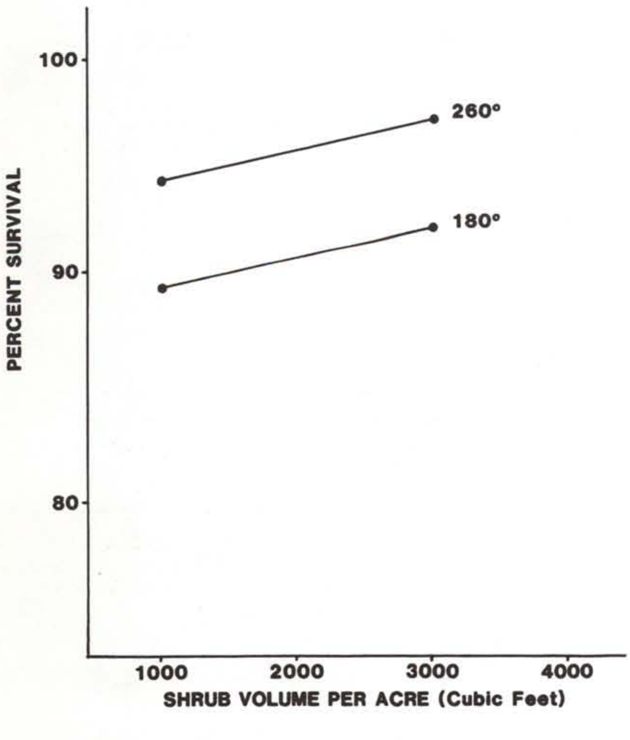

Figure 2. Percent survival by aspect and fall shrub volume.

Animal damage did not significantly affect (0.05 level) individual seedling mortality. Other factors that did not significantly affect survival included tree planter, area, animal protection, treatment, slope, spring shrub volume and initial height.

Factors significantly associated with tree survival were aspect and fall shrub volume. As expected, survival was lower on south to southwest aspects. Fall shrub volume has a positive relationship with survival even on west aspects (Figure 2). Trees planted in areas with greater shrub volumes had better survival. It is not clear why treatment (shrub clearing) was not significantly associated with survival while increasing shrub volumes were related to increased survival. It is possible that the seedlings in the cleared strips benefited from the shade provided by the rapidly resprouting shrub in the strips (resprouts were 2 to 3 feet high at the end of the first growing season).

CONCLUSIONS AND RECOMMENDATIONS

This case-history study has provided a small portion of the information needed to determine the feasibility of planting Douglas-fir under shrubs on harsh environments. Conclusions that are warranted for the first-year growing season include:

1. Douglas-fir seedlings planted under shrubs can be expected to survive as well as those planted in clearings.

2. Damage to seedlings by rodents and hares is extensive and significantly associated with first-year growth but not to survival. Animal protection for individual seedlings or control of animal populations is necessary to assure success of planting trees in shrubfields.

3. Plastic mesh tubes provide excellent protection from animal damage and have a positive relationship with first-year growth. However, better methods of securing and supporting these tubes need to be explored.

4. Animal populations vary by area; methods for predicting animal damage and/or population levels need to be developed.

5. Larger planting stock grows better on south and west aspects.

6. During years of above average precipitation, shrub volume is not related to first-year seedling growth.

7. Shrub density appears to be positively correlated with first-year seedling survival.

8. First-year mortality is greater on south aspects than on the more favorable west aspects.

9. Browsing of planted Douglas-fir seedlings by deer and elk is not a severe problem in these north Idaho shrubfields.

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