Protecting Ponderosa Pine From Mule Deer With Plastic Tubes

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Plastic protectors reduced deer browsing damage to ponderosa pine seedlings during a 5-year study in central Oregon. Seventy-seven percent of unprotected seedlings were damaged, but none of the seedlings in tubes were damaged. Protection also improved seedling survival and height growth.

Browsing by mule deer (*Odocoileus hemionus hemionus*) suppresses growth and can affect survival of conifer seedlings (*1, 4*). Chemical repellants are used to alleviate browse damage, but their short-term persistence limits their effectiveness.

This was the problem that confronted foresters responsible for protecting ponderosa pine (*Pinus ponderosa*) seedlings on a plantation in central Oregon. Many seedlings had been browsed the first winter after planting despite application of a 5-percent solution of ZIP (zinc dimethyidithiocarbamate cyclohexylamine) animal repellant. Vexar plastic seedling protectors were placed over the seedlings the next year. Although these tubes had effectively reduced damage to Douglas-fir (*Pseudotsuga menziesii*) by black-tailed deer (*O. h. columbianus*) in western Oregon and Washington (*3*), their effectiveness during long-term exposure to wintering mule deer was unknown.

Method

The plantation is 7.2 kilometers south of Sisters, Oreg., in a ponderosa pine/bitterbrush (Purshia tridentata)/fescue (Festuca idahoensis) community (*7*). The site was burned by wildfire in 1969 and planted with ponderosa pine seedlings in spring 1974. ZIP animal repellant was sprayed on individual seedlings in fall 1974, but heavy deer browsing occurred during winter 1974. In 1975, seedlings were individually enclosed in 76-centimeter-tall, 5-centimeter-diameter Vexar seedling protectors (DuPont, ID #60-PDP-27, translucent green); two straight, 20-centimeter-long, 9-gauge wires with hooks were used to anchor each protector to the ground (fig. 1).

From 1975 through 1980, data was collected on damage, survival, and height growth on seedlings in four treatment categories:

1. Browsed-control--a seedlings browsed in winter 1974 and left unprotected.
2. Unbrowsed-controls—seedlings not browsed in winter 1974 and left unprotected.

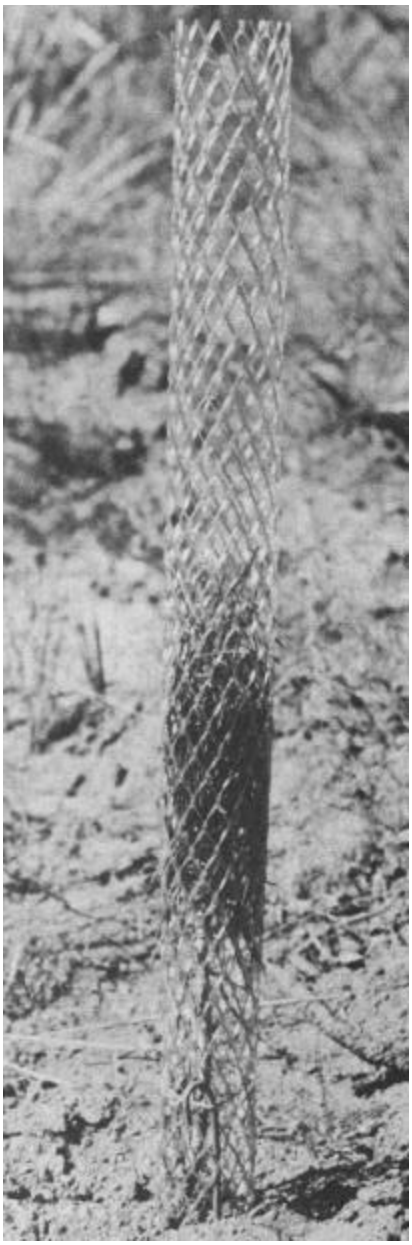

Figure 1.—*Undamaged ponderosa pine seedling enclosed by a plastic protector at the beginning of the study.*

3. Browsed-protected—seedlings browsed in winter 1974 and then protected.
4. Unbrowsed-protected—seedlings not browsed in winter 1974 and then protected.

Within the plantation, five 0.5-hectare areas heavily used by deer during winter 1974 were chosen for sampling. Within each area, four rows of seedlings were randomly selected and assigned one of the four treatments. Within each row, 10 seedlings fitting the assigned treatment were individually marked with numbered stakes. Thus, there were 10 seedlings per treatment per area for a total of 200 seedlings (50 seedlings per treatment).

Plots were visited in spring and fall of each year to determine the vitality of seedlings, condition of tubes, and damage to the terminal stems of seedlings. Vitality was evaluated on a scale ranging from zero (representing a healthy condition) to five (indicating death). When plots were installed, seedling heights were measured to the highest whorl to establish height at planting and then each fall to the highest green needles to determine annual height gains or losses.

Student's t-test was used to analyze height data. Chi-square test of independence was used for damage and survival data. All differences and similarities discussed were tested for significance at the 5-percent probability level.

Results

Browsing by deer accounted for 95 percent of all animal damage to seedlings; pocket gophers (*Thomomys talpoides*) accounted for the other 5 percent. Seedlings were not browsed while enclosed by protectors, but 20 percent were damaged in 1980 when the protectors began to disintegrate. Seventy-seven percent of all surviving unprotected seedlings were damaged by deer (fig. 2). Thus, while protectors remained intact, they eliminated damage by deer.

Survival was better for protected than for unprotected seedlings (table 1). Of 100 unprotected seedlings, 48 died during the study. Browsing caused the death of 12 and abiotic factors the other 36. Survival of unprotected seedlings that were damaged before the study began was poorer than survival of those that were not browsed before the study began. Drought or frost injured 25 (48%) of the 52 surviving unprotected seedlings, compared with only 7 (8%) of the 93 surviving seedlings that were protected.

Figure 2.—*Deer-browsed ponderosa pine seedling 6 years after planting.*

At the beginning of the study, average heights of protected and unprotected seedlings were similar. However, at last measurement in fall 1980, protected seedlings were more than twice as tall as unprotected seedlings (figs. 3 and 4). Also, both protected and unprotected seedlings that were browsed before the study began were shorter in 1980 than those that were

Table 1.—*Unprotected and protected ponderosa pine seedlings: percentage that were damaged[1] and percentage that survived each year, 1976-80*

	Control				Protected			
	Browsed		Unbrowsed		Browsed		Unbrowsed	
Year	Damaged	Survived	Damaged	Survived	Damaged	Survived	Damaged	Survived
1976	6	96	32	100	0	96	0	98
1977	2	78	10	90	0	96	0	94
1978	51	58	51	78	0	96	0	92
1979	17	54	15	68	4[2]	96	2[4]	92
1980	29	44	17	60	26[3]	94	13[3]	92

[1]Damage is defined as browsing of terminal stem of seedling.

[2]Seedling protectors were missing from seedlings.

[3]Seedling protectors had decomposed.

[4]Seedling had grown above protector.

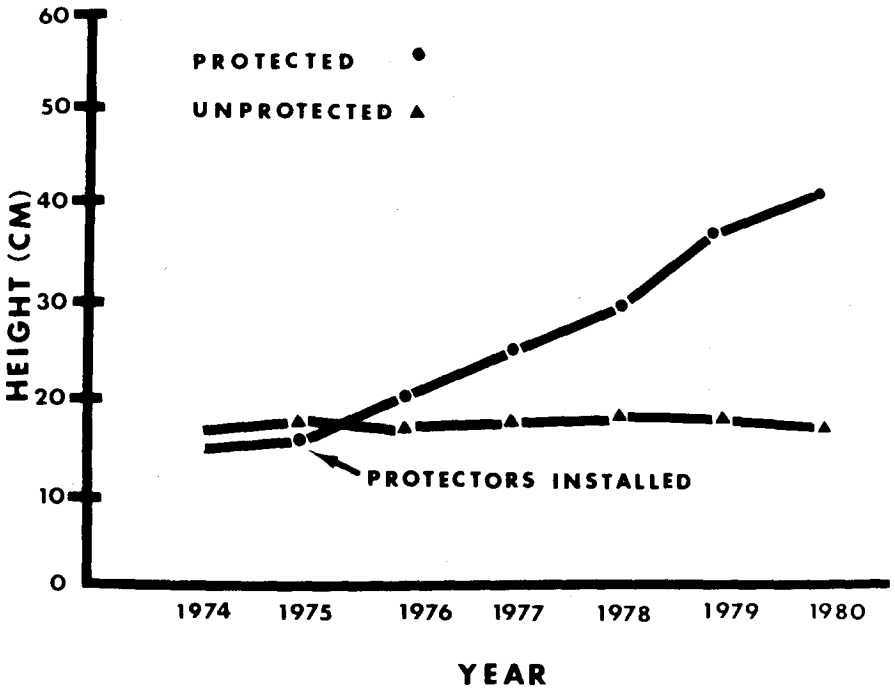

Figure 3.—*Mean annual heights of protected and unprotected seedlings that were browsed in winter 1974.*

treated similarly, but were not browsed initially (figs. 3 and 4).

The only adverse effect that the tubes had on seedlings occurred when terminal shoots protruded through or were caught in the plastic mesh. This resulted in bent main stems (fig. 5) of 69 percent of the unbrowsed group and 30 percent of the browsed group.

Discussion

Despite the sustained use of the plantation by wintering deer, seedling protectors effectively reduced browsing, resulting in better survival and greater height of protected than of unprotected seedlings. These benefits were probably because of an improved microenvironment around the seedlings, as well as reduced animal damage. Borrecco (*2*) observed that protected, undamaged Douglas-fir seedlings were 24 percent taller than unprotected, undamaged seedlings when grown under nursery conditions. Marquis (*6*) suggested that filtered light within the protector could improve seedling growth during the 1st year. Furthermore, in this study, survival data and observations of seedling vitality indicated that protected seedlings were more vigorous and less susceptible to damage by frost and drought than unprotected seedlings.

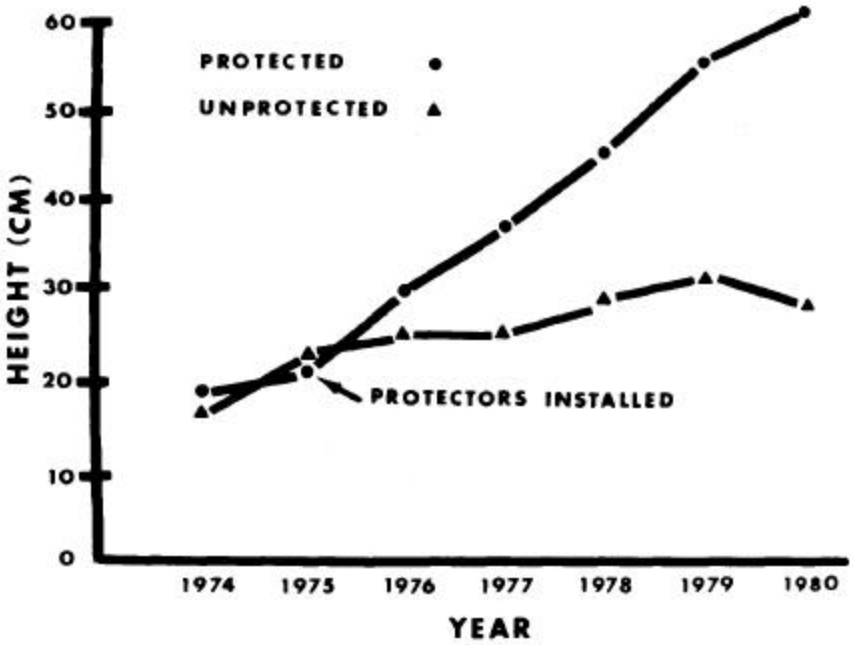

Figure 4.—*Mean annual heights of protected and unprotected seedlings that were not browsed in winter 1974.*

Browsing during the 1st year after planting has the greatest adverse effect on growth and survival of seedlings. The height difference (figs. 3 and 4) between the two groups of protected and unprotected seedlings is greater than can be explained by loss of 1 year's growth to browsing. Also, survival of browsed controls was poorer than that of unbrowsed controls, even though damage during the study was similar. Therefore, because browsing during the 1st year has a lasting effect on growth and survival, it is important to identify potential damage situations and provide protection immediately after planting.

Protectors should persist until seedling terminals have outgrown the upper limits of the "browse damage zone." This zone is about 100 centimeters above ground- or snow-level, according to Campbell and Evans (*3*). It is not always possible to predict seedling growth rates accurately. Therefore, it will usually be better to use tall protectors with a long life.

More terminal shoot protrusion and hangup was found in this study than was reported by Campbell and Evans (*3*) for Douglas-fir in the same type of

Figure 5.—*Undamaged ponderosa pine seedling with plastic protector removed 6 years after planting. Growth and spiral form are typical of seedlings that were affected by protectors.*

tube. A partial explanation may be the difficulty of anchoring the tubes in the rocky soil of the test plantation and strong prevailing winds, which caused many tubes to lean excessively. This occurrence could be reduced by following the suggestions for anchoring seedling protectors by Larson and

others. (*5*). However, another experiment (R. M. Anthony, unpublished data) indicates that ponderosa pine is more susceptible to hangup than Douglas-fir, given the same mesh design.

Despite the problem of deformed terminal shoots, seedling protectors effectively reduce browsing and enhance growth and survival of ponderosa pine seedlings. Because of the high cost of fencing (*5*) and the lack of effective, long-term repellants, seedling protectors represent the best currently available method for reducing seedling browsing on mule deer winter range.

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