HERBICIDE AIDS SURVIVAL OF DOUGLAS-FIR SEEDLINGS PLANTED ON DRY SITES IN OREGON; ROOT WRAPPING HAS LITTLE EFFECT

MONROE BICKFORD [1] and RICHARD K. HERMANN [2]

Planting seedlings in containers or wrappers has often resulted in satisfactory survival on sites where planting of bare-rooted stock has been unsuccessful. No "container planting" method, however, is suitable for all sites, and modifications of the original technique may be necessary for different conditions. The aim of the present study was to determine if planting root-wrapped seedlings, as now done on rocky sites in the Gifford Pinchot National Forest, would be advantageous for reforesting droughty areas in the Coast range of Oregon. Seedlings are wrapped by placing roots and soil on paper, which is rolled into a tube by a machine constructed on the principle of a cigarette roller. Pitcher (3) described the machine and methods of production. S. Miller (2) advocated planting of t-wrapped seedlings for reforesting the Tillaok burn in Oregon, and the technique was later used experimentally in Indiana (1). The U. S. Forest Service has successfully rehabilitated more than 1,000 acres of extremely stony soils on the Yacolt burn in Washington with root-wrapped seedlings (4).

Methods

The following combinations of treatments were employed in the study. (1) Three ways of preparing seedlings for planting (in solid wrapper, perforated wrapper, no wrapper) ; (2) four rates of Atrazine application (0, 12/s, 31/s, and 5 pounds to an acre) ; and (3) five lifting dates (November 1963, December 1963, January 1964, February 1964, and March 1964). In all instances, seedlings were planted the day after lifting. Each of the 60 combinations of treatment was applied to 15 seedlings, which were again separated into three groups of five seedlings for planting in three different blocks.

Seedlings were 2-0 Douglas-firs obtained at the Oregon State Nursery near Corvallis. Roots were wrapped in paper towels filled with a 1:1 mixture of moist topsoil and peat moss. The machine rolling resulted in cylindrical packages about 2 inches in diameter and 12 inches long. The bottom of the cylinder remained open. Wrappers were perforated by cutting from 30 to 40 slits about 1/4 inch in length. Seedlings were planted with a planting bar.

The planting area was a gentle south-facing slope that was once timbered and later cleared for grazing. Most of the present vegetation consists of annual and perennial grasses and forbs. The soil is a Dixonville clay loam underlain by partially decomposed basalt. This soil is very sticky when wet and cracks badly when dry.

The three planting blocks were laid out perpendicular to the fall line of the slope. Depth of soil decreased from 30 inches in the block at the bottom of the slope to 8 inches in the block at the upper part of the slope. Atrazine was sprayed at the end of March 1964. A 10-foot-wide buffer strip was left between plots that received different amounts of herbicide. Application of Atrazine at the rate of 1 2/3 pounds per acre killed about 60 percent of grasses and herbs; application at rates of 3 1/3 and 5 pounds per acre eliminated nearly 85 percent of the vegetative cover.

Results

Application of Atrazine, the block in which seedlings were planted, and date of lifting all had significant influence on survival of seedlings (5 percent level of significance in the statistical analysis of data). Root wrapping was inconsequential to survival, but significant interactions of root wrapping with effects of Atrazine and with date of lifting were noted.

Root wrapping.-Wrapping roots did not increase survival of seedlings (table 1) or have any noticeable effect on their growth in height. Examination of excavated seedlings showed that the

1 Forester, Mapleton District, Siuslaw National Forest, Oregon.
2 Ecologist, Forest Research Laboratory, Oregon State University, Corvallis, Oregon.

TABLE 1.—*First-and-second-year survival of Douglas-firs with and without root wrappers. (Data for 1964 are based on 300 seedlings, and data for 1965 on 200 seedlings for each treatment.)*

Treatment	Live seedlings	
	1964	1965
	Pct.	*Pct.*
Solid wrapper	38	14
Perforated wrapper	43	15
No wrapper	42	14

paper wrapper had almost completely disintegrated at the close of the first growing season, though the cylinder of peat moss and soil mixture was still intact. Apparently this mixture had been compressed enough in wrapping to retain its shape until after the second growing season. Development of new roots was not restricted by the hardened filler (fig. 1) and equaled that of seedlings without wrappers.

The interaction of root wrapping and date of lifting noted in the analysis of first-year survival may reflect the sharp drop in survival of unwrapped seedlings lifted in March (fig. 2). The supply of moisture within the wrapper probably gave packaged seedlings enough advantage over unwrapped seedlings to become established in a soil that started to dry soon after planting.

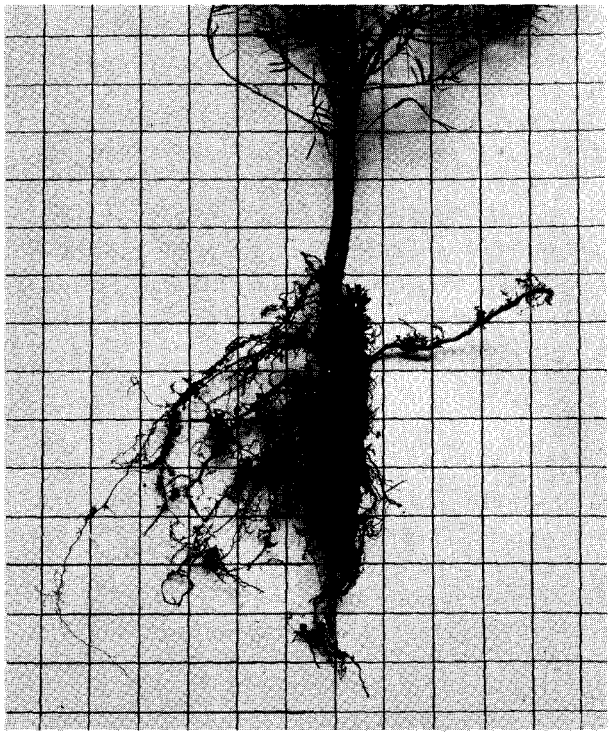

Figure 1.—Root system of root-wrapped Douglas-fir 2 years after planting. Paper of the wrapper has disintegrated; cylinder of mixture of peat moss and top soil is still recognizable. (Each division on paper equals 1 inch.)

Another interaction noted was that of root wrapping and rate of application of Atrazine. Seedlings with wrappers had a lower survival rate with a low rate of application, or with none, than seedlings without wrappers (fig. 3). The reasons for this interaction are not clear.

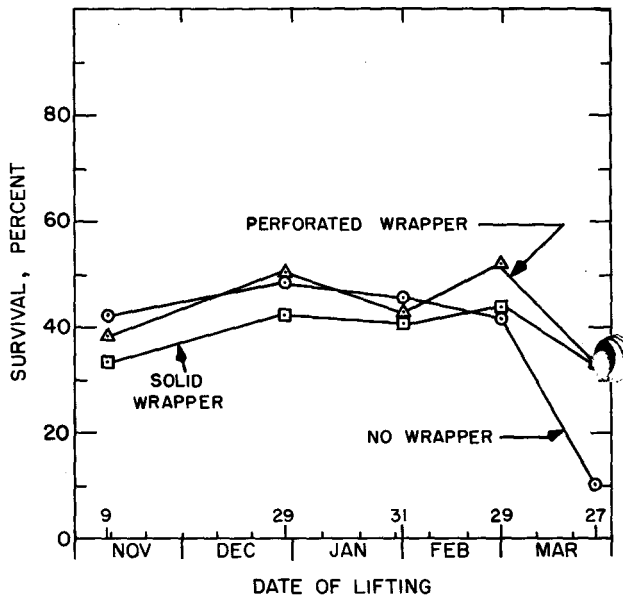

Figure 2.—First-year survival of seedlings with and without root wrappers lifted at 5 different dates. (Each percentage point is based on 60 trees.)

Date of lifting- The effect of date of lifting on survival was evident as early as the beginning of the first growing season. Twice as many seedlings lifted in November failed to open buds and died in spring as at any other data of lifting (table 2) . By the end of the first growing season, seedlings lifted in November and March showed a significantly lower rate of survival than those lifted in the months between (table 2).

Application of Atrazine.-Reducing competing vegetation with Atrazine was the most important aid in establishing seedlings. Applying Atrazine at, the rate of 1 2/3 pounds per acre increased survival, twofold and at rates of 3 1/3 and 5 pounds per acre acre increased survival nearly fivefold. Atrazine was

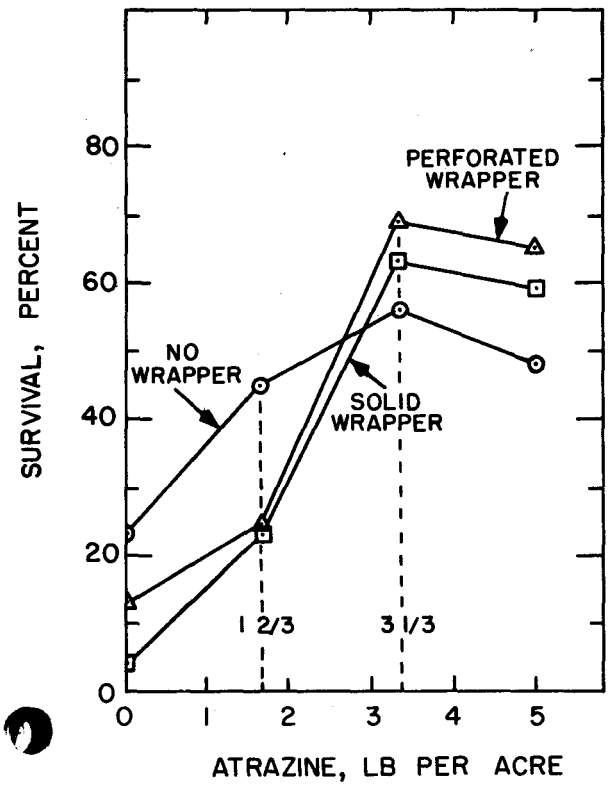

Figure 3.—First-year survival of seedlings with and without root wrappers with different rates of application of Atrazine. (Each percentage point is based on 75 trees.)

TABLE 2.—*Bud burst in spring 1964 and first-year survival of seedlings lifted at 5 different dates. (Each percentage is based on 180 trees.)*

Date of lifting	Trees failing to open buds	Survival
	Pct.	*Pct.*
November 29	8	38
December 29	4	47
January 31	2	44
February 29	2	51
March 27	3	25

most effective on the upper part of the slope where supply of available moisture was most limited. This effect is shown clearly by the proportionately greater increase in survival with increase in rate of Atrazine on the upper slope compared with data on survival of seedlings on the lower slope (table 3).

Treatment with Atrazine was not repeated, and the area was reinvaded in spring 1965 by herbac

TABLE 3.—*First-year survival of seedlings in 3 different blocks, with different rates of application of Atrazine within blocks.*

Atrazine	Block I, lower slope	Block II, middle slope	Block III, upper slope
Lbs per acre	*Pct.*	*Pct.*	*Pct.*
0	33	1	5
1⅔	33	33	17
3⅓	75	61	52
5	67	51	64

eous vegetation. The resulting competition for moisture was reflected by high second-year mortality in the remaining two blocks on the middle and upper parts of the slope. Survival in fall 1965, combined for both blocks, was 3, 7, 33, and 20 percent where Atrazine had been applied in spring 1964 at rates of 0, 1⅔, 3⅓, and 5 pounds per acre, respectively.

Growth in height of seedlings in the first growing season did not indicate a relation to the rate of application of Atrazine, but a response to the Atrazine treatments in spring 1964 was shown by growth in height during the second year (fig. 4).

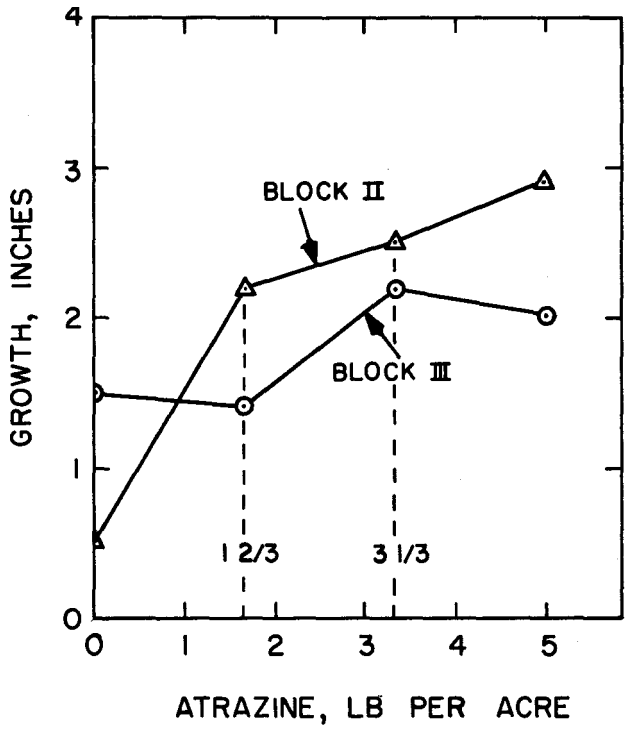

Figure 4.—Second-year growth of seedlings in Blocks II (middle slope) and III (upper slope). Seedlings in Block I were excavated in fall 1964.

Discussion

A major concern in planting trees with packaged roots is the possibility of restriction of root growth because of slow disintegration of wrapping material. Paper towels as wrappers eliminate this problem. Toweling paper deteriorates rapidly in the soil and does not form a mechanical barrier to spread of roots. However, this study indicates that little will be gained by planting root-wrapped seedlings on similar sites. The technique benefits seedlings planted on rocky sites by providing an initial supply of soil not needed by seedlings planted in ordinary soil.

Perhaps advantages from root-wrappings may be realized with seedlings planted at the beginning of the dry period when the mixture of wet peat moss and soil within the wrapper provides a reservoir of moisture for a short term. This study also indicates (fig. 3) that the wrapper may protect roots from a possibly adverse effect of high concentrations of Atrazine in the soil.

Root-wrapped seedlings show the same adverse effect of lifting in fall and spring if placed under environmental stress as do seedlings that are planted with bare roots. Unless benefits, such as those to trees planted in rocky soils, can be demonstrated, the added expense of root wrapping before planting is not justifiable.

Literature Cited

1. Miller, C. I.
   1955. Root-rolled seedlings. Tree Planters' Notes 20: 9-10.
2. Miller, S.
   1946. No squat, no stoop with mechanical tree planter. Popular Science Monthly 148 (May): 98-99.
3. Pitcher, J. A.
   1965. Rolled tree seedlings. Tree Planters' Notes 72: 23-25.
4. U. S. Forest Service.
   N.D. The Yacolt burn. U. S. Dept. Agr., Gifford Pinchot National Forest, Vancouver, Wash. 4 pp.