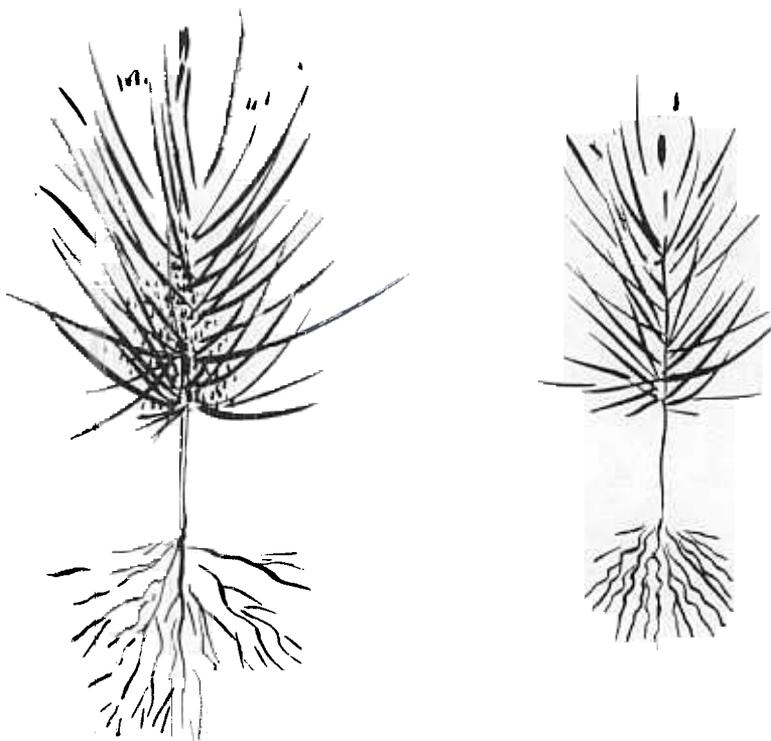
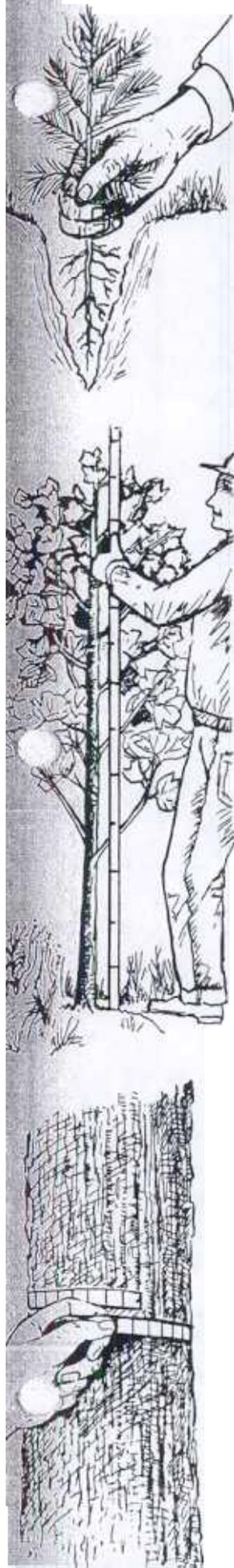


ROOT PRUNING



EFFECT ON SURVIVAL

Root Pruning Loblolly Pine Seedlings
Effect on Survival and Growth

T. A. Dierauf and J. W. Garner

ABSTRACT

In a three year study, moderate and severe root pruning just before planting was compared to no root pruning, on two size classes of seedlings (smaller and larger than average). Seedlings were bar planted in holes the full depth of the planting bar blade.

For the smaller seedlings, survival was 1.0 percentage point higher for moderate pruning and 5.6 points lower for severe pruning compared to unpruned seedlings. For the larger seedlings, survival was 3.8 points lower for moderate pruning and 7.9 points lower for severe pruning compared to unpruned seedlings. Shallow planting of severely pruned seedlings was also tested in the third year of the study and, compared to deep planting, shallow planting greatly reduced survival. Root pruning had little effect on the growth of surviving seedlings.

PROCEDURE

Moderate and severe root pruning were compared with no root pruning (see Figure 1) for three years during the 1971-72, 1972-73, and 1973-74 planting seasons. These three pruning treatments were applied to smaller and larger than average seedlings ($2\frac{1}{2}$ to $4/32$ inch and 5 to $6\frac{1}{2}/32$ inch root collar diameter), giving six treatments. Both large and small seedlings were tested, because pruning to a fixed length, such as 3 or 5 inches, removes proportionally more roots from large seedlings than from small seedlings.

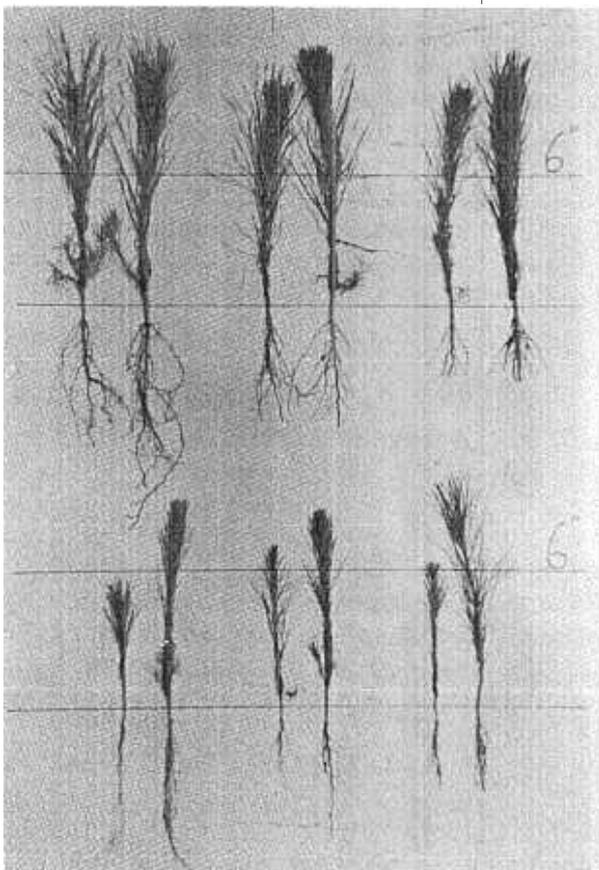


FIGURE 1. From left to right: Check (unpruned), moderately pruned (lateral roots smoothed down along the tap root and all roots cut 5 inches below the root collar), and severely pruned seedlings (same as for moderately pruned but cut 3 inches below the root collar). Large seedlings above and small seedlings below.

1971-72 Study

The seedlings were lifted from a single nursery bed. Root collar diameters were measured, and the seedlings that fit the small and large size classes of the study were picked out. The seedlings in each size class were then well mixed, and samples for each of the three pruning treatments were drawn. After pruning the roots with a sharp knife, the seedlings were packaged and placed in cold storage.

Treatments were replicated four times in randomized blocks, with a block consisting of a 25 seedling row for each of the six treatments. The planting site was a nearly level, well-drained, upland site on the Buckingham State Forest in the central Piedmont of Virginia. Blocks 1 and 2 were planted on January 27 and blocks 3 and 4 on January 31.

The seedlings were bar planted, and the bar was pushed all the way into the ground to make holes for the seedlings. Seedlings were planted by pushing the root system to the bottom of the hole and then raising the seedling enough to straighten the lateral roots and leave at least an inch of the stem above ground. All seedlings were planted at least an inch deeper than they grew in the nursery, but root pruned seedlings could be planted somewhat deeper than unpruned seedlings.

1972-73 Study

The seedlings were lifted by hand from 20 different nursery locations. Seedlings that fit the small and large size classes were picked out of the samples from each nursery location, and proportional samples were drawn from each location for the pruning treatments.

Treatments were replicated three times on two different planting sites using randomized blocks, with a block consisting of a 20 seedling row of each of the six treatments. One planting site was a sloping, well-drained, upland site on the Buckingham State Forest. The other planting site was a level, very sandy, excessively drained site in the central Coastal Plain of Virginia. The Coastal Plain site was planted on December 18 and the Piedmont site on December 19 and 20 (blocks 1 and 2 on the 19th and block 3 on the 20th). The seedlings were bar planted in the same manner as in the 1971-72 study.

1973-74 Study

The seedlings were lifted by hand from 20 different nursery locations and handled in the same manner as in the 1972-73 study.

Treatments were replicated three times on two different planting sites using randomized blocks, with a block consisting of a 20 seedling row of each treatment. One planting site was a gently sloping, well-drained, upland site on the Buckingham State Forest. The other planting site was a level, sandy, excessively drained site in the lower Coastal Plain of Virginia. The Piedmont site was planted on January 8 and the Coastal Plain site on January 10.

Two additional treatments involving severely pruned seedlings were added to the study on the Coastal Plain site. Severely pruned seedlings, small and large, were planted both "deep" in holes made the full depth of the planting bar (as in

the other studies), and "shallow" in holes only four inches deep. Severely pruned seedlings planted "shallow" were planted only one inch deeper than they grew in the nursery, while severely pruned seedlings planted "deep" were planted as deep as possible as long as at least one inch of the top remained above ground.

RESULTS

Survival after three growing seasons is given in Table 1.^{1/} Root pruning reduced survival more with large seedlings than small seedlings. On the Coastal Plain tract in 1973-74, where both deep and shallow planting of severely pruned seedlings were tested, shallow planting drastically reduced survival. Compared to deep planting, shallow planting reduced survival another 25.0 and 28.4 percentage points for small and large seedlings respectively.

Table 1. Survival percent after three growing seasons

<u>Seedling Size</u>	<u>Year and Planting Site*</u>	<u>Pruning Treatment</u>		
		<u>None</u>	<u>Moderate</u>	<u>Severe</u>
Small	1971-72	77.0 a	85.0 ab	80.0 a
	1972-73, C.P.	64.3 a	78.3 b	61.7 a
	1972-73, P.	71.7 ab	73.3 ab	70.0 a
	1973-74, C.P.	90.0 b	83.3 ab	85.0 ab (60.0 a)
	1973-74, P.	<u>95.0 bc</u>	<u>83.3 ab</u>	<u>73.3 a</u>
	Means	79.6	80.6	74.0
Large	1971-72	95.0 c	94.0 c	90.0 bc
	1972-73, C.P.	95.0 c	95.0 c	86.7 b
	1972-73, P.	93.3 c	90.0 abc	91.7 bc
	1973-74, C.P.	93.3 b	85.0 ab	86.7 b (58.3 a)
	1973-74, P.	<u>100.0 c</u>	<u>93.3 bc</u>	<u>81.7 ab</u>
	Means	95.3	91.5	87.4

* C.P. = Coastal Plain and P. = Piedmont

Note: Figures in parentheses under severe pruning for 1973-74, C.P. are for shallow planting

Seedling Size

The larger diameter seedlings survived better than the smaller diameter seedlings.^{2/} The overall difference (averaging pruning treatments, years, and planting sites) was 13.3 percentage points. Seedling size, therefore, had a greater effect on survival than root pruning.

^{1/} A separate analysis of variance was made for each planting site of each year. Survival percents were first transformed to arc sin. Differences between treatment means were tested using Duncan's New Multiple Range Test. In Table 1, means not followed by the same letter are significantly different at the .05 level of significance.

^{2/} The effect of seedling size on survival was significant at the .005 level in the 1971-72 and 1972-73 studies, and at the .05 level in the 1973-74 test on the Piedmont site, but was not significant for the 1973-74 test on the Coastal Plain site.

Height Growth

After three seasons in the field, there are no consistent height differences related to root pruning. In general, unpruned seedlings are slightly taller, as shown in Table 2. The only consistent height difference is between small and large seedlings, with large seedlings averaging .87 feet taller (21 percent).

Table 2. Average seedling height (in feet) after three growing seasons

<u>Seedling Size</u>	<u>Year and Planting Site*</u>	<u>Pruning Treatment</u>		
		<u>None</u>	<u>Moderate</u>	<u>Severe</u>
Small	1971-72	5.34	5.30	5.20
	1972-73, C.P.	2.39	2.84	2.76
	1972-73, P.	4.39	4.31	4.03
	1973-74, C.P.	3.50	3.05	3.48
	1973-74, P.	<u>5.07</u>	<u>5.03</u>	<u>4.94</u>
	Means	4.14	4.11	4.08
Large	1971-72	6.13	6.30	5.90
	1972-73, C.P.	3.91	3.77	3.78
	1972-73, P.	5.63	5.48	5.19
	1973-74, C.P.	4.36	3.97	3.39
	1973-74, P.	6.04	<u>5.74</u>	<u>5.15</u>
	Means	5.21	5.05	4.68

* C.P. = Coastal Plain and P. = Piedmont

DISCUSSION

Moderate root pruning, as done in this study, may not be such a bad practice considering the slight effect it had on survival. Seedlings with unpruned root systems are often difficult to plant properly. Our experience in these tests was that pruned seedlings were easier to plant: we could plant them faster and do a better job of getting the roots in the ground. In these tests we took the time to plant all seedlings properly, but the average tree planter would not do as good a job with unpruned seedlings as with pruned seedlings (assuming, of course, that seedlings are planted in holes the full depth of the planting bar).

Severe root pruning, as done in this study, should probably be discouraged. With deep planting the average reduction in survival over the three years of the study was 5.6 and 7.9 percentage points for the small and large seedlings respectively, but added to these moderate losses is the danger of much greater losses if the tree planter makes shallow planting holes. For the average tree planter, the temptation might be great to make the job easier by making holes just deep enough to accommodate the pruned root system.