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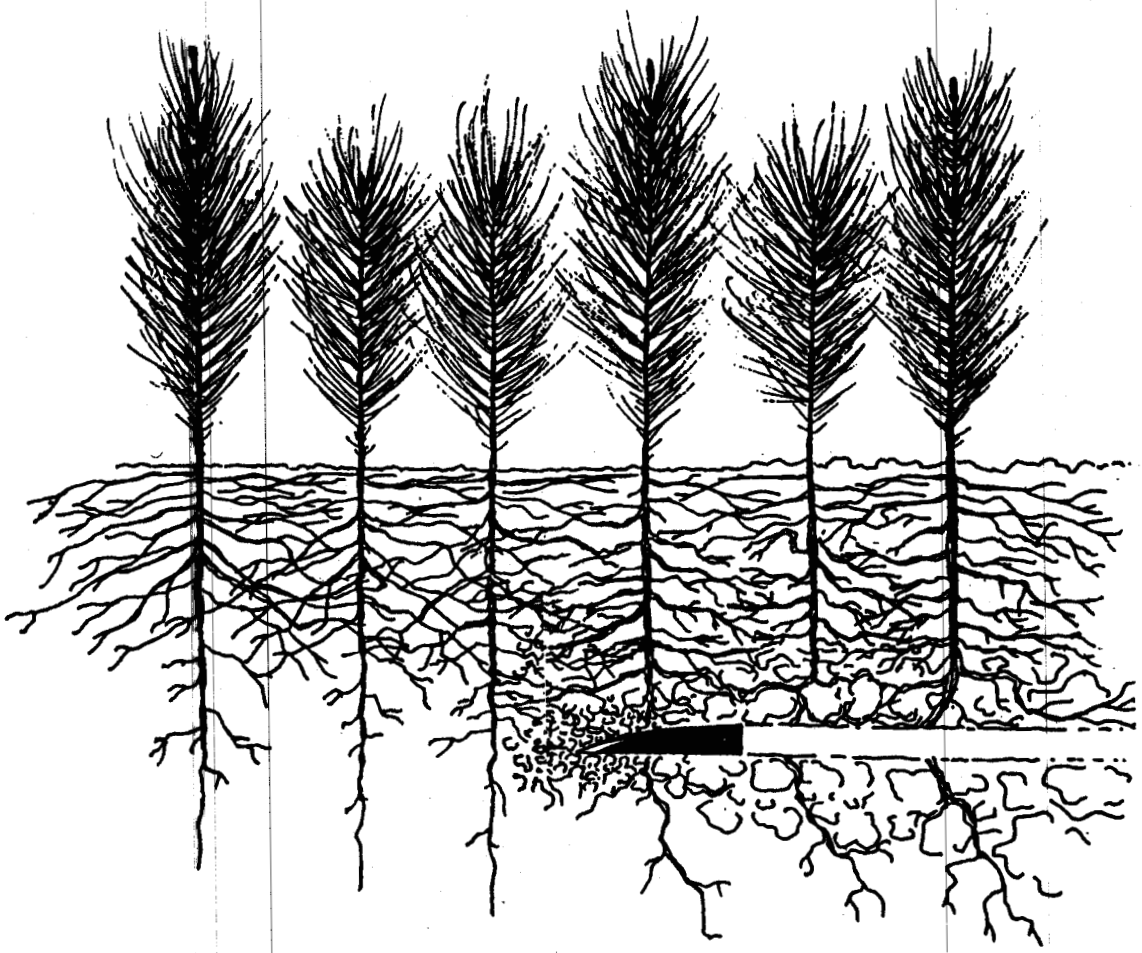

Virginia
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AN UNDERCUTTING STUDY IN LOBLOLLY PINE SEEDBEDS

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ABSTRACT

Seedbeds were undercut on July 20, August 19, and September 21. Three treatments involved undercutting on just one of these dates, two treatments involved undercutting on two of the dates, one treatment was undercut on all 3 dates, and one treatment was not undercut as a control. This study is similar to another installed 5 years earlier in 1977.

The undercutting treatments, with the exception of September 21 only, reduced root collar diameter in the seedbed. Seedlings undercut in both July and August were the smallest. Undercutting had only a slight effect on field survival (overall survival of the 6 undercutting treatments was only one percentage point better than the control), with none of the 6 treatments being significantly better than the control. Undercutting also had only a slight effect on height growth in the field (overall average height of the 6 undercutting treatments was only .1 feet greater than the control after 3 seasons in the field), with only one treatment significantly better than the control.

These results are remarkably similar to the results from the earlier study in 1977.

DESCRIPTION OF STUDY

A previous study was installed in 1977, and the results were reported in our Occasional Report #58, dated March, 1982. In this earlier study, undercutting reduced root collar diameter in the seedbeds, did not improve survival in the field, but did improve average height by approximately .4 feet after three seasons in the field.

This second study was installed at the New Kent nursery in Providence Forge, Virginia during the summer of 1982. The following undercutting treatments were replicated by 10-foot plots in three different seedbeds, each located in a separate nursery block.

1. Control- not undercut
2. Undercut 7/20
3. " 7/20 and 8/19
4. " 7/20, 8/19, and 9/21
5 " 8/19
6 " 8/19 and 9/21
7 " 9/21

We attempted to undercut at a depth of about 5 inches, although the actual undercutting depth varied between 4½ and 5½ inches, on all three dates. After the first undercutting, on July 20, there was a delay of ½ hour for one replication and 2½ hours for the other two replications before irrigation water was applied. In the two replications that went 2½ hours before irrigation, the taller seedlings wilted, and some seedlings were leaning as much as 90 degrees. For the later undercuttings, on August 19 and September 21, irrigation closely followed undercutting and no wilting occurred. Even after the visible wilting following the August 19 undercutting, no mortality was observed. The seedlings in all the plots were operationally top-clipped on August 11 and September 7, to an average height of about 8 inches.

SEEDBED RESULTS

On December 17, we lifted a 6-inch wide sample (2 square feet) across the bed in the center of each plot. Each sample was counted into three piles as it was lifted, so that seedlings from each drill row were evenly spread over the three piles. One pile was randomly selected for planting. The other two piles were put in storage until January, when root collar diameters were measured and seedlings separated into 1/32-inch diameter classes.

Undercutting reduced root collar diameter in most treatments, as shown in Table 1 and Figure 1. The single late undercutting on September 21, however, had no effect on diameter. The greatest diameter reductions resulted from Treatments 3 and 4, the only ones which included both of the earlier undercuttings on July 20 and August 19. The addition of the late undercutting in Treatment 4 produced no further reduction in diameter. Statistically, Treatments 3 and 4 (with both of the earlier undercuttings) are significantly different from Treatment 1 (the control) and Treatment 7 (the late undercutting only)./1 No visible differences in root morphology were apparent between treatments.

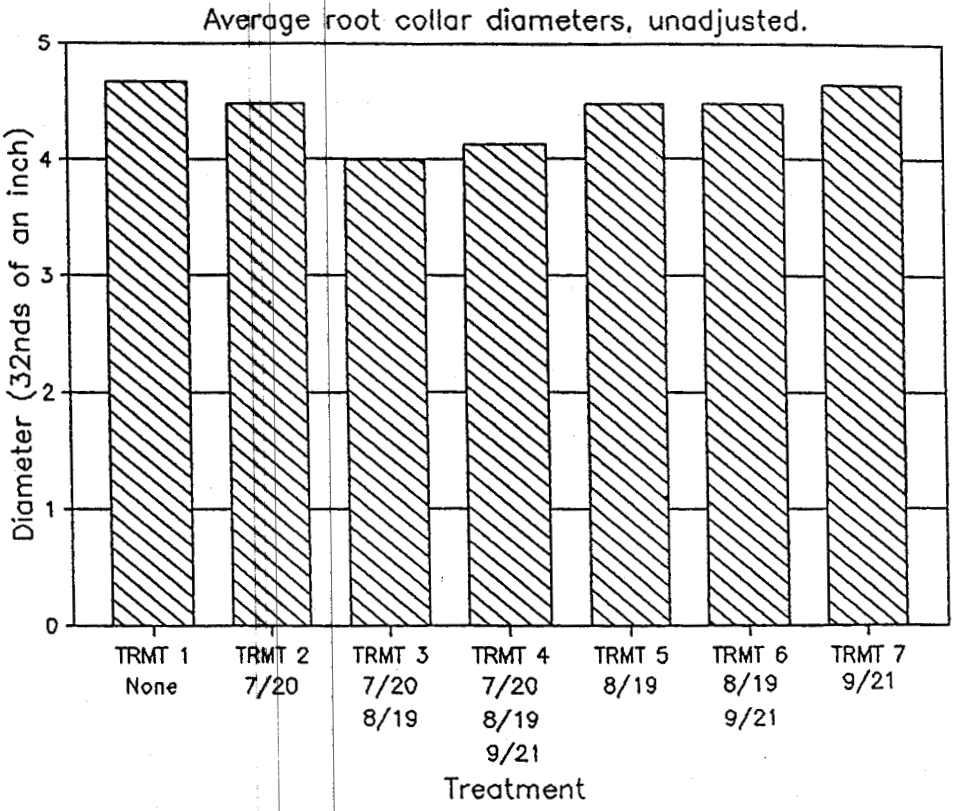
Seedbed density was not affected by the undercutting treatments. For the two-square-foot samples that were lifted and graded, average seedbed density varied from 37.0 to 48.8 seedlings per square foot for the 7 treatments. Two additional samples of the same size, taken 2 feet in from the ends of each plot, were counted but not lifted. This gave us three samples per plot from which to estimate average seedbed density. From this larger sample, the

1/ An analysis of variance revealed significant differences in root collar diameter among treatments (probability of a larger F = .016). Means in Table 1 not followed by the same letter are significantly different, using Duncan's New Multiple Range Test (p = .05).

Table 1. Average root collar diameters in 32nds of an inch, by treatment, unadjusted and adjusted to a common bed density.

Undercutting Treatment	Seedbed Density No./Ft.²	Root Collar Diameter Unadjusted	Adjusted
1. Not Undercut	43.5	4.67a	4.70
2. 7/20	44.0	4.49ab	4.50
3. 7/20, 8/19	48.5	3.99c	4.01
4. 7/20, 8/19, 9/21	39.5	4.13bc	4.06
5. 8/19	40.0	4.48ab	4.47
6. 8/19, 9/21	37.0	4.48ab	4.45
7. 9/21	48.8	4.64a	4.73
Means	43.0	4.42	4.42

Figure 1.



average number of seedlings per square foot was estimated to range from 40.3 to 45.2 for the 7 treatments. Statistical analysis based on all three samples showed no significant differences in seedbed density among treatments.2/

The variation in average seedbed density, among the samples lifted and measured from the seven treatments, would be expected to affect average root collar diameters, so an analysis of covariance was made to adjust average diameters to a common bed density. Adjusted mean diameters were only slightly different and, in fact, the differences among treatments actually increased (Table 1). The average seedbed densities presented in Table 1 only include the samples that were lifted and measured.

FIELD PLANTING

Procedure

Later in the afternoon of the day we lifted the seedlings, seedlings were selected for planting in the field. We had three lots of seedlings from each treatment, one from each seedbed replication (1/3 of the 2 foot square sample lifted from each plot). These three lots, for each treatment, were successively counted into four piles of 20+ seedlings each, which gave us the seedlings we needed for 4 replications in the field. This sorting procedure insured that we selected about the same number of seedlings from each seedbed replication for each field replication.

The study was planted on December 21, in four randomized blocks with a 20-seedling row of each treatment in each block. The site was a gentle upper slope on a typical well-drained soil in the central Piedmont.

The study was measured after one, two, and three growing seasons in the field. Survival was tallied and the height of each surviving seedling was measured.

Survival

Average survival dropped only one percentage point between the end of the first and third seasons. After three seasons, average survival for the six undercutting treatments was less than one percentage point higher than for the control (Table 2).3/ The only significant difference is between the July 20 only and the August 19 only undercutting treatments (Treatments 2 and 5).3/

2/ Concerning seedbed density, the overall F for treatments was not stastistically significant (probability of a larger F = .320), and there were no differences among individual treatments at the .05 level, using Duncan's New Multiple Range Test.

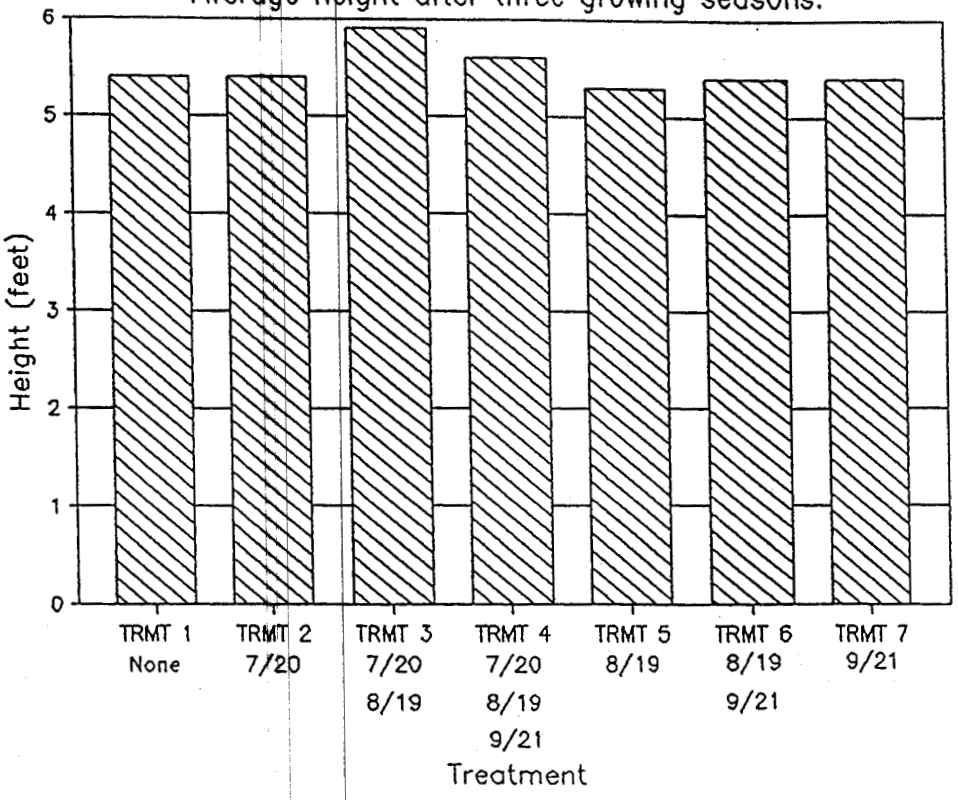
3/ Survival percents were transformed to arc sine and an analysis of variance was carried out. The overall F for treatments was not statistically significant (probability of a larger F= .355). Duncan's New Multiple Range Test was used to test for differences among individual treatments, and survival percents in Table 2 not followed by the same letter are significantly different at the .05 level.

Table 2. Average survival and height after 3 seasons in the field.

Treatment	Survival %	Height in Feet
1. Not Undercut	91 ab	5.4 b
2. 7/20	99 a	5.4 b
3. " , 8/19	94 ab	5.9 a
4. ", ", 9/21	89 ab	5.6 ab
5. 8/19	89 b	5.3 b
6. ", 9/21	91 ab	5.4 b
7. 9/21	91 ab	5.4 b
Means	92	5.5

Figure 2.

Average height after three growing seasons.



Height Growth

After three seasons in the field, seedlings from the 6 undercutting treatments averaged .1 feet taller than seedlings that were not undercut (Table 2 and Figure 2). The July 20 and August 19 undercutting (Treatment 3) is significantly taller than all but the July 20, August 19, and September 21 undercutting (Treatment 4). 4/

DISCUSSION

The reduction in root collar diameter as a result of undercutting in this study was very similar to the earlier study we did in 1977. The 1977 study included the same combination of undercutting treatments, but the undercuttings were generally done about 2 weeks later in the season. In the present 1982 study, the July 20 plus August 19, and the July 20, August 19, and September 21 undercutting treatments reduced average root collar diameter by .68/32 and .54/32 of an inch respectively, compared to seedlings not undercut. In the 1977 study, the comparable two undercutting treatments reduced average root collar diameter by .72/32 and .58/32 of an inch respectively.

This much of a reduction in root collar diameter can be cause for real concern, because of its effect on the cull factor. We presently cull at 3.5/32 of an inch. In the present study the number of seedlings smaller than 3.5/32 of an inch in diameter was almost three times as great in the two most severe treatments as in the control (28%, 28%, and 10% respectively). These same two undercutting treatments, while causing the greatest reduction in root collar diameter, were also the ones which gave the best height growth in the field. However, improvements in height were not large, only .5 and .2 feet after 3 seasons. It is questionable whether such small increases in height growth in the field would compensate for the considerable reduction in root collar diameter and the accompanying increase in the cull factor.

4/ Average third-year heights were subjected to an analysis of variance. The overall F for treatments was not statistically significant (probability of a larger F = .093). Duncan's New Multiple Range Test was used to test for differences among individual treatments, and heights in Table 2 not followed by the same letter are significantly different at the 0.5 level.