TOP PRUNING AND NEEDLE CLIPPING OF CONTAINER-GROWN SOUTHERN PINE SEEDLINGS

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Abstract. Early and severe clipping of longleaf pine (*Pinus palustris* Mill.) needles markedly slowed seedling development in containers and resulted in reduced growth in the field. A less severe clipping 3 weeks before outplanting improved seedling survival in a period of severe moisture stress. Some needle clipping of containerized longleaf may be justified to prevent matting of the needles, which can reduce seedling development. Top pruning of loblolly pine (P. *taeda* L.) and slash pine (P. *elliottii* Engelm. var. *elliottii*) seedlings did not affect field survival, but it did reduce height growth after outplanting. Top pruning of containerized slash and loblolly pines should be avoided by controlling height growth with other cultural regimes.

Additional keywords: Pinus *palustris*, P. *taeda*, P. *elliottii*, seedling development, field survival and growth

Top pruning of conifer seedlings is commonly used in bare-root nurseries to retard excessive top growth and keep the seedlings in better root-to-shoot ratios. Normally, tops are pruned while new growth is expanding rapidly and sufficient time is available for subsequent bud formation and normal development (Stoeckler and Jones 1957).

Clipping needles of longleaf pine (*Pinus palustris* Mill.) seedlings after lifting has been recommended for planting on adverse sites (Allen 1955). However, Derr (1963) reported some growth retardation resulting from clipping longleaf, and Langdon (1955) found no advantage to clipping South Florida slash pine needles (P. *elliottii* var. *densa* Little and Dorman). Shoulders (1967) found that late summer clipping of longleaf needles in the nursery did not adversely affect field survival or growth.

The general intent of top pruning or needle clipping of conifer seedlings has been to reduce transpiration and thus improve seedling survival under adverse conditions. Results from a number of studies show no conclusive advantage to this technique. The loss of photosynthetic production, which is necessary for root development, may account for these results.

Top pruning of container-grown seedlings is not practical on a regular basis. However, there may be some instances where it may be needed to obtain a desirable root-to-shoot ratio. More likely is the need to clip the needles of longleaf pine. Even at a low density, needle development in containers can

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be great enough to cause shading problems in these very intolerant seedlings. Clipping could allow more uniform light exposure to all seedlings in a container. The purpose of this study was to evaluate the effects of top pruning of container-grown loblolly pine (P. taeda L.) and slash pine (P. elliottii Engelm. var. elliottii) seedlings and needle clipping of longleaf pine seedlings on initial seedling development and field performance.

METHODS

Three sowing dates (late January, March, and May) were used for outplanting. Styroblock-4® [2/] containers were filled with a 1:1 peat-vermiculite mix. Thirty-day stratified loblolly and unstratified slash and longleaf seeds were sown in sufficient numbers so that extras could be transplanted into cavities that had no germinating seeds. Seedlings received fertilization (20-19-18 NPK) at 150 ppm N each week beginning at about 3 weeks. Loblolly and slash pine seedlings were grown for 16 weeks and were top pruned to a height of 12.5 cm at 10, 12, and 14 weeks. Longleaf needles in one treatment were maintained at 5 cm, regardless of age. Another treatment consisted of clipping to 5 cm at 10 weeks of age and then reclipping to 10 cm. The third treatment consisted of one clipping at 13 weeks to 10 cm. Unclipped seedlings grown for 16 weeks were used as controls.

Outplanting dates for each species were May 27, July 20, and September 14, 1981. These provided for both seasonal and stress comparisons.

For each planting date, there were four replications of each species-treatment combination. Each plot consisted of 25 seedling rows. Planting was at 1.2-meter intervals in rows 1.2 meters apart.

For each replication, five seedlings were characterized at the time of planting by determining top height (except longleaf), root-collar diameter, and stem and shoot dry weight. Percentage of survival was measured about 2 months after planting. Survival and heights (caliper for longleaf) were also measured in the fall and then again in March 1983.

A completely randomized design was used with the significance level set at 0.05. Duncan's multiple-range test was used to evaluate differences in amount of treatment means.

RESULTS

The effects of pruning and clipping treatments were evaluated on seedling characteristics at time of planting (table 1) and on field performance (table 2). Treatment regimes were different among species; therefore, effects on initial seedling characteristics differed.

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Initial seedling characteristics

Maintaining the length of longleaf pine needles at about 5 cm resulted in smaller stem diameters and top weights (table 1). Generally, whether the initial clipping was made at 10 or 13 weeks had no significant effect on seedling development. Root weights of seedlings with needles maintained at 5 cm were smaller than those of unclipped seedlings. In addition, root weights and diameters of seedlings grown for the July outplanting were generally smaller.

Stem heights and weights of loblolly seedlings decreased as pruning time was delayed from 10 to 14 weeks. This is logical because less time remained for the seedlings to recover from pruning. Loblolly diameters and root weights were more affected by seasonal effects than by pruning treatment (table 3).

Field performance

Planting date had the greatest effect on survival of longleaf pine seedlings (table 2). Needle clipping had little effect on survival when seedlings were planted in May or September; however, clipping affected survival in July when the seedlings were under considerable moisture stress. Two-month survival averaged 96 percent for the May planting, compared to 18 and 66 percent for the July and September plantings. In July, when seedlings were under greater stress, survival for the seedlings with needles clipped at 13 weeks was significantly greater than for those not clipped, those clipped early and maintained at 5 cm, or those clipped at 10 weeks and then kept at 10 cm length.

Root-collar diameters of longleaf were affected by planting date and clipping. Seedlings planted in September were smaller than those in earlier plantings (table 2), and seedlings with needles maintained at 5 cm were smaller after 1+ years in the field. This small size probably reflects the size of the seedlings when they were outplanted (table 1).

Survival of loblolly and slash pine seedlings was affected by planting date, but not by top pruning treatment. The July planting survival was significantly poorer than either the May or September plantings. In July, survival of seedlings clipped at 10 weeks to 12.5 cm was 14 percentage points higher than the control, but this difference was not statistically significant (tables 2 and 4).

Heights of both loblolly and slash pine seedlings were affected by planting date, pruning, and the interaction between the two factors (table 4). As with longleaf, loblolly and slash pine seedlings planted later in the year grew less (table 2). Control seedlings were taller in every instance, but the pruning treatment effects varied with planting date. Generally, there were greater differences in height due to pruning treatments in the May than in the September plantings.

Table 1.--Summary of initial seedling characteristics by species, planting date,[1/] and clipping treatment

Treatment	Height			Diameter			Top weight			Root weight		
	May	July	Sept.	May	July	Sept.	May	July	Sept.	May	July	Sept.
		mm			mm			mg			mg	
Needle clipping												
Longleaf pine												
Control	-	-	-	3.4	3.4	3.5	961	1216	1122	162	147	165
Constant 5 cm	-	-	-	2.9	2.7	3.2	439	410	329	116	108	143
5 cm @ 10 wk, then 10 cm	-	-	-	3.4	3.0	3.4	768	809	426	167	108	106
10 cm @ 13 wk	-	-	-	3.5	3.0	3.4	762	795	707	174	106	152
Top pruning												
Loblolly pine												
Control	233	225	229	2.6	2.7	2.6	918	1118	1031	202	155	206
Clip at 10 wk	171	178	178	2.8	2.8	2.4	766	795	675	214	187	208
Clip at 12 wk	145	146	133	2.8	2.6	2.6	628	516	667	178	138	233
Clip at 14 wk	130	134	135	3.0	2.6	2.6	490	490	518	202	148	190
Slash pine												
Control	279	253	294	3.1	3.0	2.8	1200	1124	1173	252	229	154
Clip at 10 wk	160	177	152	2.9	2.7	2.8	674	602	587	191	145	177
Clip at 12 wk.	139	138	130	3.0	3.1	3.0	636	562	571	202	234	202
Clip at 14 wk	132	130	130	2.9	2.8	2.7	598	367	406	172	164	201

[1/] All planting was done in 1981.

Table 2.--Summary of field performance by species, planting date,[1] and clipping treatment

Treatment	2-mo survival May	2-mo survival July	2-mo survival Sept.	3/83 Survival May	3/83 Survival July	3/83 Survival Sept.	3/83 Size May	3/83 Size July	3/83 Size Sept.
		percent			percent			cm	
Needle clipping									
Longleaf pine									
								Diameter	
Control	95	15	70	75	12	66	1.5	1.6	1.4
Constant 5 cm	93	10	66	87	4	54	1.4	1.0	1.1
5 cm @ 10 wk, then 10 cm	98	8	60	80	7	45	1.7	1.3	1.3
10 cm @ 13 wk	96	37	67	75	29	59	1.5	1.5	1.4
Top pruning									
Loblolly pine									
								Height	
Control	100	57	82	91	56	80	71.6	57.9	45.4
Clip at 10 wk	97	71	91	86	67	90	61.4	53.9	42.1
Clip at 12 wk	99	66	83	89	62	82	64.9	55.8	39.9
Clip at 14 wk	100	55	96	88	52	92	64.3	43.9	39.3
Slash pine									
								Height	
Control	97	57	76	90	55	74	83.2	61.6	43.3
Clip at 10 wk	100	71	81	88	69	76	71.0	57.6	37.5
Clip at 12 wk	99	66	85	93	65	84	73.5	57.9	37.8
Clip at 14 wk	100	63	85	83	60	83	63.4	54.9	38.4

[1]All planting was done in 1981.

Table 3.--Summary of statistical analyses of the initial seedling characteristics as affected by clipping treatments and seasonal development[1]

Source of variation	Longleaf Dia	Longleaf Top weight	Longleaf Root weight	Loblolly Ht	Loblolly Dia	Loblolly Top weight	Loblolly Root weight	Slash Ht	Slash Dia	Slash Top weight	Slash Root weight
Planting date (A)	S	S	S	-	S	-	S	-	-	S	-
Clipping (B)	S	S	S	S	-	S	-	S	S	S	S
A x B	-	S	-	S	S	S	-	S	-	-	S

[1] "S" indicates statistical significance at the 0.05 level.

Table 4.--Summary of statistical analyses of seedling field performance[1] as affected by clipping treatments and planting dates[2]

Source of variation	Longleaf 2-mo surv	Longleaf '83 surv	Longleaf Dia	Loblolly 2-mo surv	Loblolly '83 surv	Loblolly Ht	Slash 2-mo surv	Slash '83 surv	Slash Ht
Planting date (A)	S	S	S	S	S	S	S	-	S
Clipping (B)	S	S	S	-	-	S	-	-	S
A x B	S	S	S	-	-	S	-	-	S

[1]Field performance reflects percentage of survival and height for loblolly and slash pine and diameter for longleaf pine.

[2]"S" indicates statistical significance at the 0.05 level.

Table 4.--Summary of statistical analyses of seedling field performance[1] as affected by clipping treatments and planting dates[2]

Source of variation	Longleaf			Loblolly			Slash		
	2-mo surv	'83 surv	Dia	2-mo surv	'83 surv	Ht	2-mo surv	'83 surv	Ht
Planting date (A)	S	S	S	S	S	S	S	-	S
Clipping (B)	S	S	S	-	-	S	-	-	S
A x B	S	S	S	-	-	S	-	-	S

[1]Field performance reflects percentage of survival and height for loblolly and slash pine and diameter for longleaf pine.

[2]"S" indicates statistical significance at the 0.05 level.

DISCUSSION

The effects of needle clipping of longleaf differed from the top pruning of loblolly and slash pine. Clipping longleaf needles shortly before outplanting improved survival when seedlings were exposed to significant moisture stress following planting. Clipping during this late phase of growth was less detrimental to seedling quality than earlier clipping. Survival of longleaf seedlings was closely related to root weights at the time of outplanting (table 5). Root-collar diameter after 1+ years was also correlated with initial seedling diameters and top dry weights. Therefore, clipping treatments that reduced seedling development in the greenhouse cultural period also reduced field survival and growth.

Earlier observations and unpublished studies have shown that even with the possible reduction in field performance due to some clipping treatments, clipping of longleaf needles may be helpful in increasing seedling uniformity. Longleaf grown in containers under high fertility regimes produce mats of extremely long needles. Some clipping of these needles should result in greater seedling uniformity because longleaf is very sensitive to competition. The key is to develop clipping regimes that have the least impact on seedling development.

The need for top pruning of loblolly and slash pine should be less than for needle clipping of longleaf pine. Height growth can usually be controlled by cultural treatments such as reduced fertility and moisture stress. Even under conditions of severe moisture stress in the field, there was no statistically significant advantage to top pruning container-grown loblolly or slash pine seedlings.

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Table 5.--Correlations for initial seedling characteristics and field performance

Initial characteristics	Correlation coefficients[1] 2-mo survival	3/83 survival	3/83 size[2]
Needle clipping			
Longleaf pine			
Diameter	0.505	0.473	0.589*
Top weight	-.084	-.060	.678*
Root weight	.634*	.581*	.423
Top pruning			
Loblolly pine			
Height	-.075	-.039	.295
Diameter	.213	.043	.597*
Top weight	-.151	-.107	.213
Root weight	.688*	.752*	-.107
Slash pine			
Height	-.151	-.129	.251
Diameter	-.151	.147	.543
Top weight	-.017	-.015	.358
Root weight	.081	.135	.418

1/Coefficients followed by an asterisk are statistically significant at the 0.05 level.

2/Size reflects stem diameters for longleaf pine and heights for loblolly and slash pine.