

SEEDLING SIZE AND SOIL MOISTURE AFFECT SURVIVAL OF LOBLOLLY PINE SPROUTS

John L. Thames
Southern Forest Experiment Station, U.S. Forest Service
Oxford, Miss.

Rabbits and cattle often severely damage newly planted loblolly pine plantations in north Mississippi by clipping the seedling stems above the root collar. The study reported here was made to determine the influence of seedling size, height of clipping, and soil moisture condition on the ability of loblolly pine to sprout and survive through the first growing season.

Methods

One-year-old nursery seedlings of two size classes corresponding to morphological grades I and III (2) were planted February 2, 1958, on sandy soil near Oxford.

To simulate browsing damage, some seedlings were clipped on February 8 at 4 inches above the soil surface and some at 1 inch. Check seedlings were unclipped. All clipping was below lateral branches.

Three soil moisture conditions were maintained for the period February 8 through July 6 on separate 15- by 18-foot areas 10 feet apart. Rain was excluded from one area (dry) by a framework of wood covered with clear plastic; on the second area (wet) the soil was watered periodically to keep the upper 18 inches well above the wilting point; and the third (natural) was not treated. Trenches 2 feet deep were dug around the dry and wet areas, and the inside walls were lined with roofing felt to eliminate subsurface flow.

Three blocks were established within each area. Each block contained 6 plots representing all combinations of grades of stock and clipping treatments. Twenty seedlings were planted on each plot at a spacing of 1- by 3/4-foot.

Moisture content of the 0- to 18-inch soil layer was measured every 2 weeks, beginning May 8. The moisture remained above the wilting point on all three areas through most of the early growing season, but in early June dropped to the wilting point on the dry area and remained there for 33 days. After May 8 watering maintained moisture on the wet area at 2 to 5 percent above the natural area. Moisture measurements were discontinued on July 6, when a storm destroyed the plastic shelter and a 2.3-inch rain wet all areas to near field capacity. Seedlings were examined for survival and sprouting on July 29 and on the following January 27.

Results

Four months after clipping, sprouts had appeared on 90 percent of the seedlings clipped at 4 inches above the soil surface and on 70 percent of those clipped at 1 inch (table 1). Heavy infestation by tip moth subsequently killed some seedlings on all plots, but survival differences related to soil moisture conditions, height of clipping, and seedling grade persisted to the end of the growing season.

Final survival of seedlings clipped 1 inch above ground averaged 18 percent, as compared with 52 percent for those clipped at 4 inches and 83 percent for unclipped seedlings. Differences were significant at the 0.01 level. Seedlings clipped at 4 inches averaged 2.7 sprouts per stem, with the longest sprouts averaging 3.2 inches; those clipped at 1 inch had 2.1 sprouts averaging 2.8 inches.

TABLE 1.--Seedling survival at end of drought test, and at end of first growing season

Grade and clipping treatment	Wet area		Natural area		Dry area	
	July	Jan.	July	Jan.	July	Jan.
Grade I:	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Clipped at 4 inches.....	70	67	73	55	47	43
Clipped at 1 inch.....	67	48	43	20	25	10
Not clipped.....	95	92	83	82	87	80
Grade III:						
Clipped at 4 inches.....	60	48	78	63	40	33
Clipped at 1 inch.....	58	23	37	3	7	3
Not clipped.....	93	92	93	88	67	62

The differences between grades, though not large, were very consistent. They were significant at the 0.05 level. After 1 year, average survival of grade I seedlings in all treatments was 55 percent; of grade III, 46 percent. Grade I seedlings averaged 2.7 sprouts and grade III, 2.0. The longest sprouts for the two grades averaged 3.29 and 2.33 inches.

Survivals at each inventory were related to moisture condition, differences for both clipped and unclipped seedlings being significant at the 0.01 level. Final survival of clipped seedlings averaged 22 percent on the dry area, 35 percent on the natural, and 46 percent on the wet. Comparable percents for unclipped seedlings were 71, 85, and 92.

Clipping height and morphological grade largely determined the type of sprout formed. Most grade I seedlings were clipped near or below the lowest needle fascicle, but nearly all grade III seedlings had some fascicles remaining. Most sprouts on grade I seedlings originated in the axils of primary leaves. Where needle fascicles were retained, as on most grade III seedlings, sprouts usually originated within the fascicle (fig. 1). Buds within fascicles near the injury began swelling several days to 2 weeks before any auxiliary sprouts appeared.

Shoots of both types developed in the same way. As the bud grew upward, it pushed aside the withered stub and became the new terminal. Where several sprouts developed on an injured seedling, one usually dominated--forking was rare and only small evidence of injury was found after two growing seasons.

Much of the mortality of clipped seedlings between July 29 and the end of the growing season is attributable to tip-moth injury. Most unclipped seedlings retained enough foliage to maintain photosynthesis and replace damaged tips with new sprouts. On clipped seedlings tip moths frequently destroyed all green parts, and food reserves were evidently insufficient for resprouting.

Results indicate that a large proportion of heavily browsed loblolly seedlings can recover by sprouting and develop normally. Larger seedlings and those clipped at higher levels above the ground are most likely to sprout, and their sprouts are generally more vigorous. Drought during the growing season greatly reduces the survival of sprouted seedlings. Seedlings whose foliage is limited to sprouts are more vulnerable to tip moths than are normal seedlings.

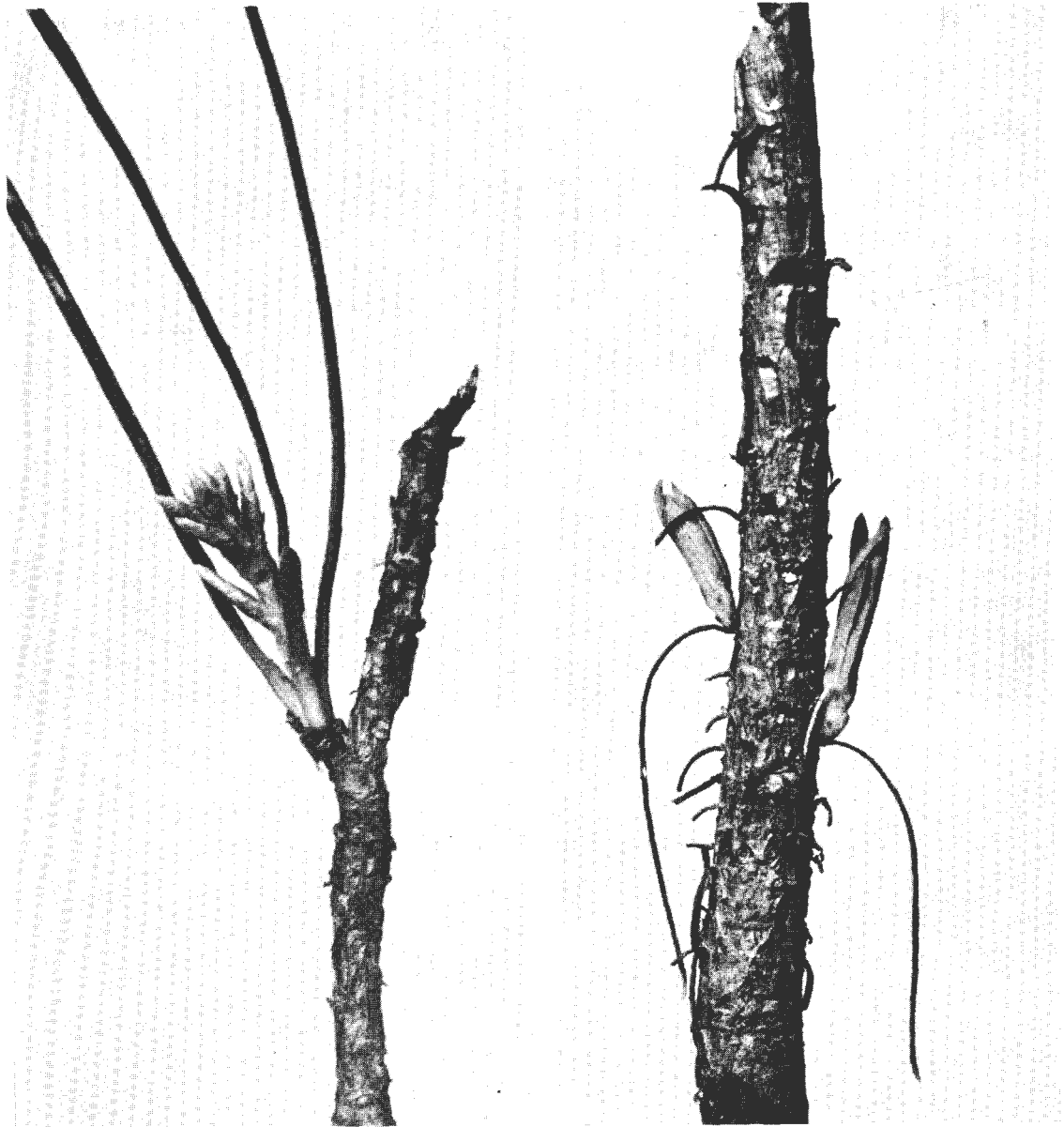


Figure 1.--Left: On most grade III seedlings, sprouts originated in needle fascicles that were below the point of clipping; Right: Clipping removed most needle fascicles from grade I seedlings, but sprouts formed in the axils of primary leaves.

Literature Cited

1. Little, S., and Somes, H. A. 1960. Sprouting of loblolly pine. Jour. Forestry 58: 195-197.
2. Wakeley, P. C. 1954. Planting the southern pines. U.S. Dept. Agr. Agr. Monog. 18, 233 pp.