

EFFECTIVENESS OF AN UNDERGROUND STORAGE UNIT FOR LOBLOLLY PINE SEEDLINGS

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An underground seedling storage unit was constructed on the Cumberland State Forest in the summer of 1965. A study was made in 1966 and 1967 to evaluate the effectiveness of this unit compared to an unheated open shed for storing loblolly pine seedlings.

Description of Storage Facilities

The underground storage unit (referred to hereafter, as the "unit") was constructed of cinder blocks in an excavation in the side of an embankment (fig. 1). The floor and roof were poured concrete. Soil was piled against the sides of the unit, and also over the roof to a depth of 1/2 feet. A door in the front end opened to the north and there were vents in the door, and in each end of the roof. The dimensions of the unit were: length-20 feet, width-12 feet, and height 8 feet. The capacity was 300,000 to 400,000 loblolly pine seedlings.

The open shed storage facility" (referred to hereafter as the "shed")- was an equipment shed enclosed on three sides and open to the north. It was located about 200 yards from the underground storage unit.

Description of Study

Identical studies were made in 1966 and 1967. Fully dormant seedlings were lifted on February 15 and stored for periods of 2, 4, 6, 8, and 10 weeks before planting. Nondormant seedlings that had already started to grow in the nursery beds were lifted on April 14 in 1966 and April 13 in 1967, and stored for periods of 2, 4, and 6 weeks before planting.

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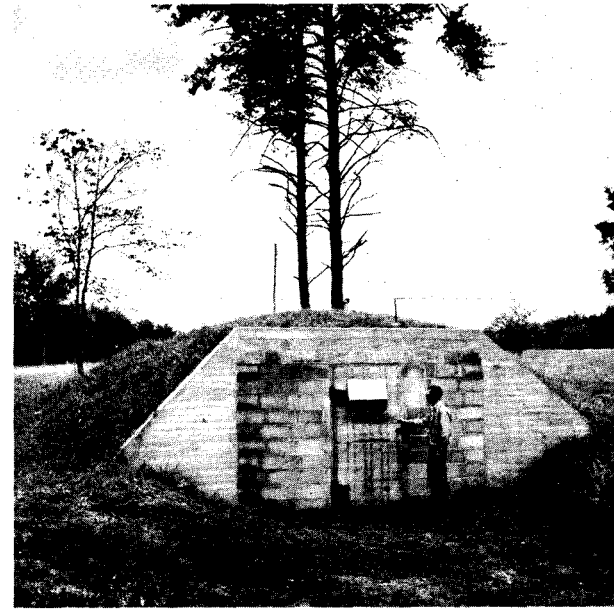


Figure 1.—Underground Storage Unit

The planting schedule (every 2 weeks) was followed fairly closely. Only two plantings were not made within 3 days of the target date. In 1966, nondormant seedlings scheduled for 4 weeks' storage were actually stored an extra 7 days before planting; and in 1967, dormant seedlings scheduled for 2 weeks' storage were actually stored an extra 8 days before planting.

Each year, a uniform portion of a seedbed was reserved for the study, and both dormant and nondormant seedlings were lifted from it. Seedlings were bundled in packages of 1,000.

Maximum-minimum thermometers were placed in both the unit and the shed, and temperatures were recorded daily except on weekends. The underground unit was quite effective in reducing daily temperature fluctuations. Compared to those in the shed, maximum daily temperatures were lower and minimum temperatures higher in the unit.

Molding was not a problem in the storage unit. Seedling packages were examined each day, and if mold appeared on the outsides of the packages

TABLE 1.—*Survival rates after three growing seasons and differences between unit and shed stored seedling survival.*¹

Storage period	1966 study			1967 study			
	Unit	Shed	Diff.	Unit	Shed	Diff.	
	Percent	Percent	Percent	Percent	Percent	Percent	
Dormant seedlings	2 weeks (3 wks. in 1967)	99	99	0	91	94	3
	4 weeks	97	98	1	93	91	2
	6 weeks	94	98	4	96	78	18*
	8 weeks	95	92	3	89	57	32**
	10 weeks	88	67	21**	85	32	53**
Nondormant seedlings	2 weeks	95	89	6	67	61	6
	4 weeks (5 wks. in 1966)	92	87	5	69	60	9
	6 weeks	62	67	5	54	22	32**

¹Survival percentages were transformed to arc sin and analyses of variance were made. Differences between treatments were tested using Duncan's New Multiple Range Test.

NOTE: Asterisks denote differences that are statistically significant at the 5 percent (*) and 1 percent (**) levels.

more ventilation was provided. In this way, growth of mold was effectively checked.

Each of the 16 treatments (an early lifting with five storage periods and a late lifting with three storage periods, for both storage facilities) were replicated five times in randomized blocks. Seedlings were planted (on the same day they were removed from cold storage) in rows of 20, so that a total of 100 seedlings were planted for each treatment. Spacing was 3 by 3 feet.

The planting sites were cutover woodland prepared by light bulldozing for the 1966 study and by chopping and burning for the 1967 study. Both areas were fairly level.

The soil on the 1966 area was Altavista fine sandy loam; a moderately well drained terrace soil. The soil on the 1967 area was Tatum very fine sandy loam, a well drained upland soil.

Hardwood sprouts were chopped off during the second growing season to reduce the effect of hardwood competition on survival and growth.

Measurement

Survival rates and heights were measured each fall, through , the third. season. Survival rates changed very little after the first season. The results which follow are based on the third year measurement.

Seedling Survival

Survival data are summarized in table 1.

Comparison of Storage

Facilities

In 1966, there was little difference in survival rates between seedlings stored in the unit and the shed. The only important difference in favor of the storage unit was for dormant seedlings stored 10 weeks.

In 1967, the open shed was less effective. Starting with 6 weeks storage, there were considerable differences in survival rates of dormant seedlings, with those in storage unit faring better. Nondormant seedlings stored 6 weeks in the unit also survived considerably better.

Abrupt Survival Rate Decrease for Nondormant Seedlings

Survival rate of nondormant seedlings was as good after 4 as after 2 weeks' storage, but fell sharply between 4 and 6 weeks' storage. This occurred in both 1966 and 1967, for seedlings stored in the unit as well as the shed. Differences in survival between 4 and 6 weeks' storage are statistically significant at the 1 percent level for both unit and shed stored seedlings in 1966, and for shed stored seedlings in 1967. The difference for unit stored seedlings in 1967 was not statistically significant.

TABLE 2.—Comparison of dormant and nondormant seedling survival after three growing seasons.

Unit		1966 study			1967 study		
		Weeks' storage			Weeks' storage		
		2	4	6	2	4	6
		Percent	Percent	Percent	Percent	Percent	Percent
Unit	Dormant	99	97	94	91	93	96
	Nondormant	95	92	62	67	69	54
	Difference	4	5	32**	24**	24*	42**
Shed	Dormant	99	98	98	94	91	78
	Nondormant	89	87	67	61	60	22
	Difference	10*	11*	31**	33**	31**	56**

NOTE: Asterisks denote differences which are statistically significant at the 5 percent (*) and 1 percent (**) levels.

TABLE 3.—Differences between unit and shed stored seedling heights after three growing seasons.

Storage period	Unit	Shed	Diff.	1966 study		1967 study	
				Unit	Shed	Unit	Shed
				Feet	Feet	Feet	Feet
Dormant seedlings	2 weeks (3 wks. in 1967)	5.0	4.6	.4	5.6	5.5	.1
	4 weeks	4.8	4.6	.2	5.5	5.7	.2
	6 weeks	4.5	4.6	.1	5.5	4.8	.7
	8 weeks	4.9	4.7	.2	5.2	4.5	.7
	10 weeks	4.3	3.5	.8*	4.9	3.5	1.4**
Nondormant seedlings	2 weeks	5.2	4.	.9**	4.1	4.3	.2
	4 weeks (5 wks. in 1966)	4.5	4.	.1	4.2	3.9	.3
	6 weeks	3.5	3.9	.4	4.0	3.6	.4

NOTE: Asterisks denote differences which are statistically significant percent (*) and 1 percent (**) levels.

Comparison of Dormant and Nondormant Seedlings

Comparisons between dormant and nondormant seedlings should be made with caution, since nondormant seedlings *must* be lifted later than dormant seedlings. In this study, they were lifted 2 months later. Consequently, if dormant and nondormant seedlings are compared for storage periods of 2, 4, and 6 weeks, the nondormant seedlings were planted about 8 weeks later. It is also possible to compare dormant and nondormant seedlings on a common planting date—April 25 in 1966, and April 27 in 1967—but on this date dormant seedlings had been stored 10 weeks and nondormant seedlings only 2 weeks. Such comparisons, therefore, indicate the effect not only

of seedling dormancy, but also storage period or planting date.

Table 2 compares dormant and nondormant seedlings for storage periods of 2, 4, and 6 weeks. For these storage periods, dormant seedlings were planted in March and nondormant in late April and May, so the differences in the table may be due to planting date as well as seedling dormancy.

Height Growth

Third year average seedling heights are given in Table 3.3 Height growth of *dormant* seedlings

3 Analyses of variance were made of mean heights of surviving seedlings. Differences between treatments were tested using Duncan's New Multiple Range Test.

was affected by type of storage facility and length of storage in the same way as was survival. Height growth of nondormant seedlings, however, did not closely follow the pattern of

survival; for the 1966 study, there was a noticeable decrease in height between 4 and 6 weeks storage, but the decrease for the 1967 study was slight.