

LOBLOLLY PINE COLD- STORAGE PLANTING STUDY



Virginia Division of Forestry



Department of Conservation and Economic Development

LOBLOLLY PINE COLD-STORAGE PLANTING STUDY

By

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SUMMARY

Loblolly pine seedlings were lifted on January 25, February 18 and March 18, 1965 and placed in cold storage for periods of approximately 40, 70 and 100 days prior to planting on March 1, April 1, May 3, June 1 and July 1. Half of the seedlings were clay treated before packaging and half were not.

After three growing seasons it was found that, in general, both survival and height growth decreased with increasing time in cold storage. Also, survival and height growth were better for earlier plantings than later plantings of comparable storage period. There were no consistent differences between clay treated and undipped seedlings.

DESCRIPTION OF STUDY

Loblolly pine seedlings were lifted in 1965 on three different dates, and placed in cold storage prior to planting as shown in the tabulation below:

<u>Planting Date</u>	<u>Lifting Date</u>		
	<u>Jan.25</u>	<u>Feb.18</u>	<u>March 18</u>
	<u>storage period (days)</u>		
March 1	36		
April 1	66	42	
May 3	98	74	46
June 1		104	76
July 1			106

Two types of packaging were tested. Half the seedlings had their roots dipped in a suspension of kaolin clay (applied at an approximate rate of

three pounds per 1,000 seedlings) and then were packaged in waterproof paper. The other half were not dipped and were packed bare rooted in a mixture of spagnum moss and pine excelsior.

The study was installed on the Appomattox and Pocahontas State Forests. Seedlings were planted in rows of 40, at a spacing of two feet within rows and three feet between rows. Each treatment (i.e. combination of lifting date, planting date, and packaging method) was replicated four times on each forest in a randomized block design, for a total of 160 seedlings per treatment on each forest. There were 2,880 seedlings planted on each forest with a total of 5,760 seedlings planted on both.

The Appomattox State Forest is in the central piedmont, and the soils on the plots are in the Tatum and Nason series. The Pocahontas State Forest is on the eastern edge of the piedmont, and the soils on the plots are in the Appling series. These soils are well-drained and occur on upland positions. The plots were prepared for planting by light bulldozing.

The seedlings for the study were grown at the Virginia Division of Forestry Nursery at New Kent and came from a portion of a single bed which was selected for uniformity of seedling size and appearance. Seedling tops were still dormant on March 18 when the final lifting was made.

While the seedlings were in the cold-storage unit the temperature was maintained between 33 and 37 degrees Fahrenheit. Relative humidity was high and the storage room kept unlighted.

Seedlings were planted soon after being removed from cold storage. They were planted on the Pocahontas State Forest the same day they were removed. On the Appomattox State Forest they were planted the same day for the April 1 and May 3 plantings, and on the day after for the March 1, June 1 and July 1 plantings (planting was actually done, therefore, on March 2, June 2 and July 2). Seedlings were carefully handled when planted so that there was practically no exposure of the roots.

Hardwood sprouts and brush were cut down twice during the three years following planting to reduce competition as a factor affecting survival and growth.

MEASUREMENT

Survival counts were made at the end of the first and third growing seasons, and seedling heights were measured at the end of the third growing season.

RESULTS

Survival decreased between the end of the first and the end of the third growing season, as shown in Table 1. The decrease was related to planting date, being constant for March 1, April 1 and May 3 plantings, but greater for June 1 and much greater for July 1 plantings.

Table 1. Decrease in survival percent between end of first and end of third growing season (lifting dates and packaging methods combined).

	Planting Date				
	March 1	April 1	May 3	June 1	July 1
			(Percent)		
Appomattox S.F.	2.2	1.8	2.6	6.1	13.2
Pocahontas S.F.	5.4	5.2	5.3	7.6	15.9

Survival and height were affected by both length of time in cold storage and time of planting. In general, both survival and height decreased with increased storage time, and the decreases in survival and height were greater for later plantings. The data (survival and height at the end of the third season) were analysed separately for each forest and each lifting date. A total

of 12 analyses were made: for both survival and height, for each of the three lifting dates, for each of the two forests.^{1/}

^{1/}

Analyses of variance were made. Survival percents were transformed to arc sin, and analyses of height were based on mean heights of surviving seedlings. The following planned orthogonal comparisons tested the effects of packaging method and length of storage, and their interaction:

1. packaging method
2. linear relationship with length of storage
3. non-linear relationship with length of storage
4. interaction of packaging method and linear relationship
5. interaction of packaging method and non-linear relationship

The results of these tests are given in the table below:

Forest	Lifting Date		Comparisons				
			1	2	3	4	5
Appomattox	Jan. 25	Survival	NS	.005	NS	NS	NS
		Height	NS	.01	NS	NS	NS
	Feb. 18	Survival	NS	.005	NS	NS	NS
		Height	NS	.005	NS	.05	.05
	March 18	Survival	NS	.005	.025	NS	.05
		Height	NS	.005	.025	NS	NS
Pocahontas	Jan. 25	Survival	.01	NS	.05	NS	NS
		Height	.025	NS	NS	NS	NS
	Feb. 18	Survival	NS	.005	NS	NS	NS
		Height	NS	.005	NS	NS	NS
	March 18	Survival	.005	.005	NS	NS	NS
		Height	NS	.005	NS	NS	NS

NS means not significant.

Table 2, which follows, summarizes survival percent and height growth after three growing seasons for both forests. Figures 1, 2 and 3 depict this same data graphically.

Table 2. Survival percent and height related to cold storage period (days) and planting date for clay-dipped and bare-rooted seedlings after three growing seasons.

Appomattox State Forest

Planting Date	Packaging Method	Lifting Date					
		Jan. 25		Feb. 18		Mar. 18	
		Surv. %	Ht. (Ft.)	Surv. %	Ht. (Ft.)	Surv. %	Ht. (Ft.)
Mar. 1	(Days in Storage)	(36)					
	Bare	92	5.1				
	Clay	90	5.1				
April 1	(Days in Storage)	(66)		(42)			
	Bare	88	4.8	89	5.0		
	Clay	82	4.8	95	5.2		
May 3	(Days in Storage)	(98)		(74)		(46)	
	Bare	51	3.8	71	4.1	71	4.6
	Clay	74	4.6	79	4.7	87	4.8
June 1	(Days in Storage)			(104)		(76)	
	Bare			44	4.0	56	3.4
	Clay			31	3.2	34	3.6
July 1	(Days in Storage)					(106)	
	Bare					52	3.4
	Clay					51	3.2

Pocahontas State Forest

Planting Date	Packaging Method	Lifting Date					
		Jan. 25		Feb. 18		Mar. 18	
		Surv. %	Ht. (Ft.)	Surv. %	Ht. (Ft.)	Surv. %	Ht. (Ft.)
Mar. 1	(Days in Storage)	(36)					
	Bare	78	4.1				
	Clay	96	4.7				
April 1	(Days in Storage)	(66)		(42)			
	Bare	91	4.6	91	4.5		
	Clay	91	4.6	91	4.6		
May 3	(Days in Storage)	(98)		(74)		(46)	
	Bare	70	4.3	75	4.3	92	4.7
	Clay	85	4.6	82	4.3	80	4.5
June 1	(Days in Storage)			(104)		(76)	
	Bare			61	3.7	81	4.1
	Clay			80	4.0	75	4.4
July 1	(Days in Storage)					(106)	
	Bare					78	3.7
	Clay					67	3.3

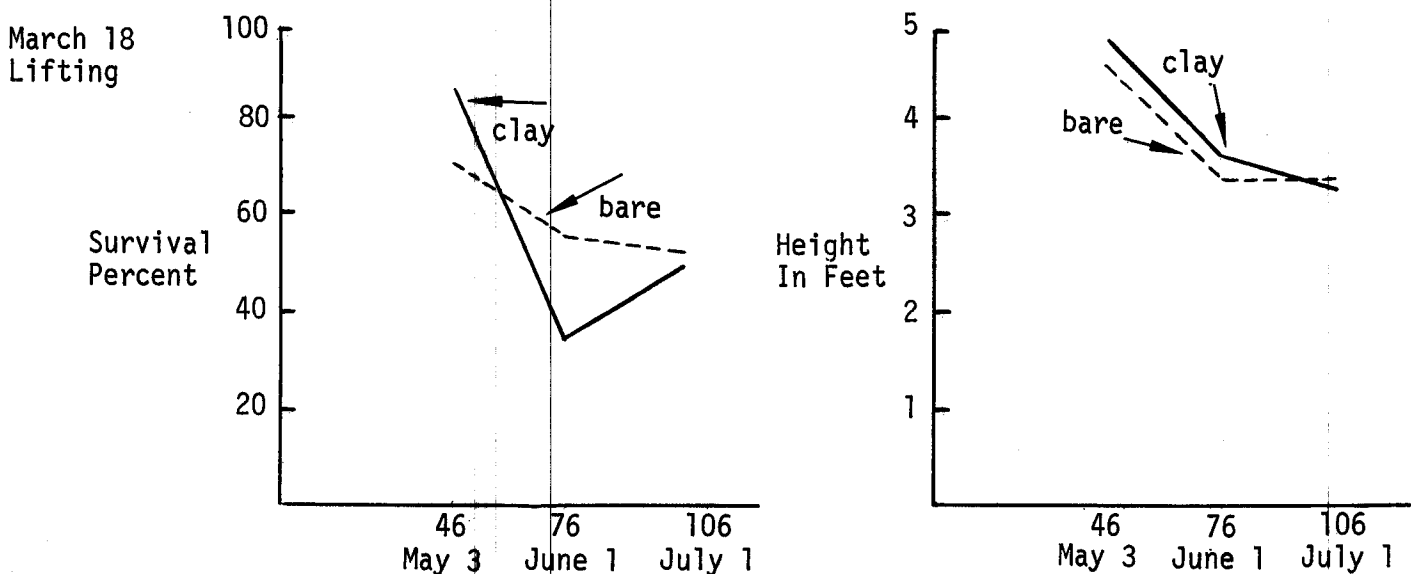
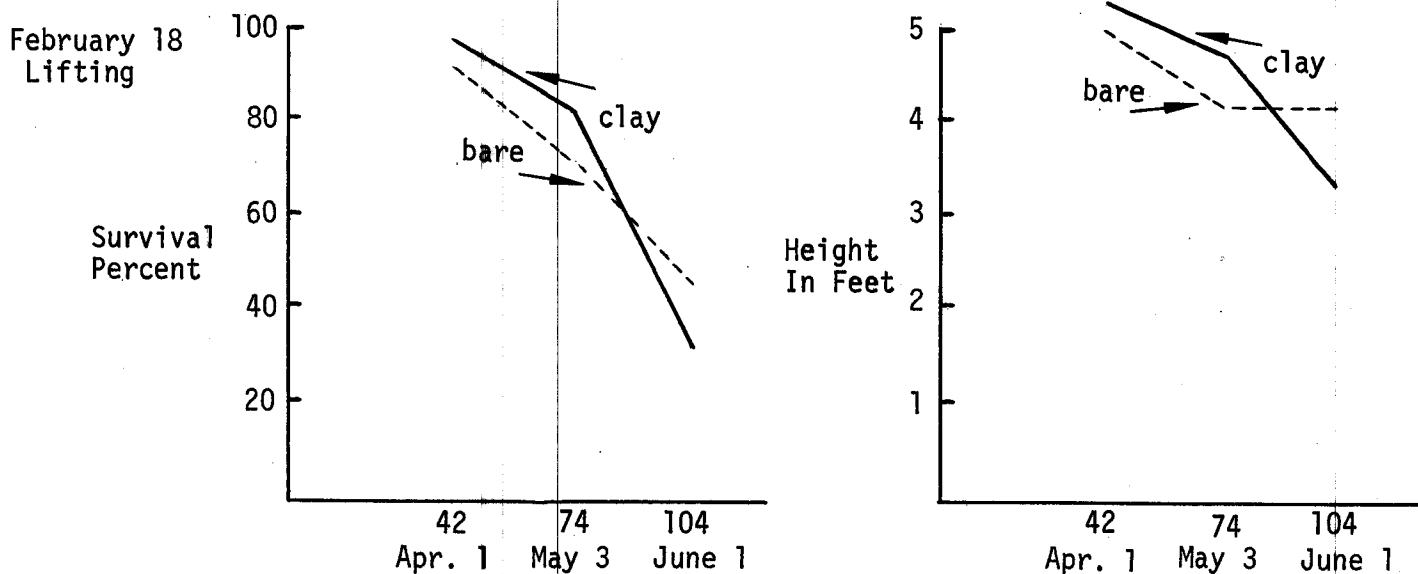
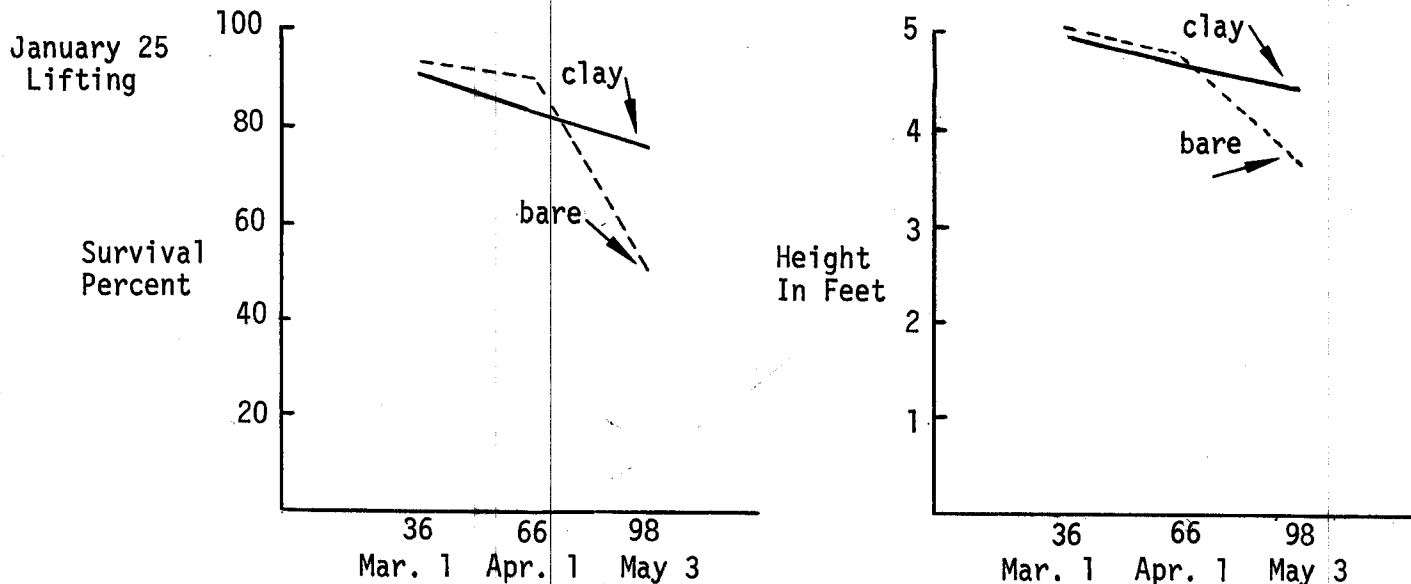
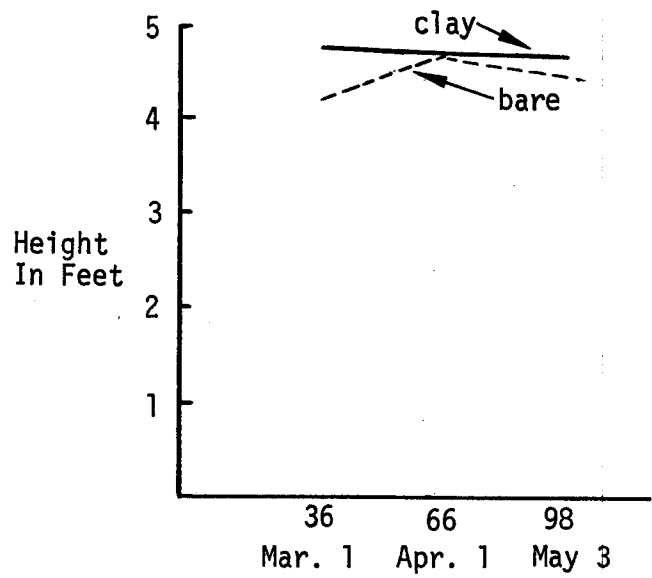
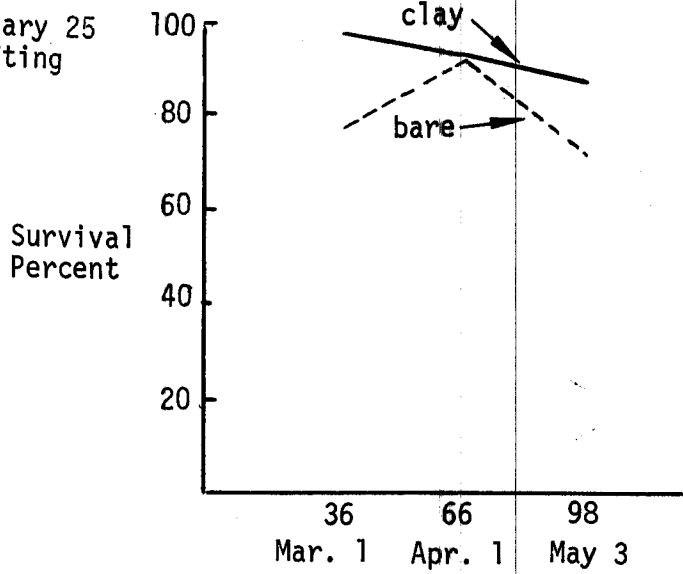
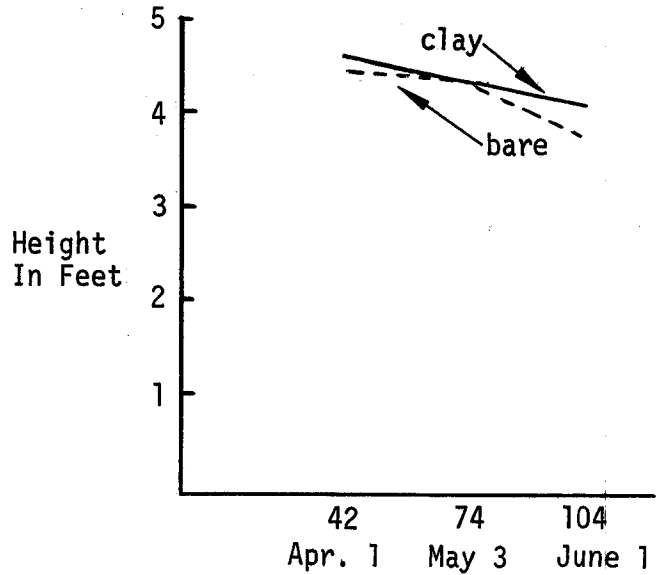
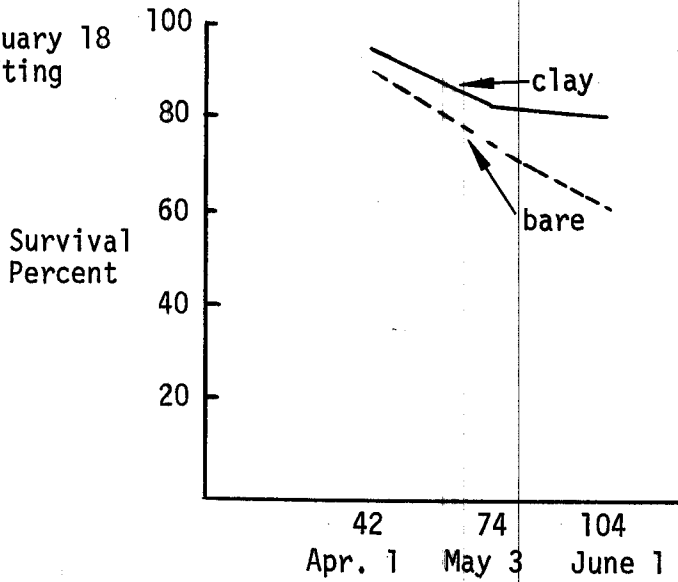


Figure 1. Appomattox State Forest - Survival percent and height after three growing seasons related to cold-storage period (in days) and planting date, for clay-dipped and bare-rooted seedlings.

January 25
Lifting



February 18
Lifting



March 18
Lifting

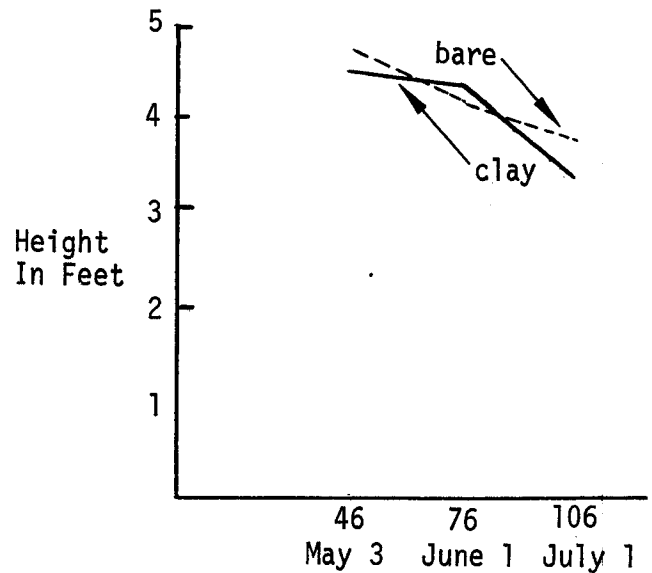
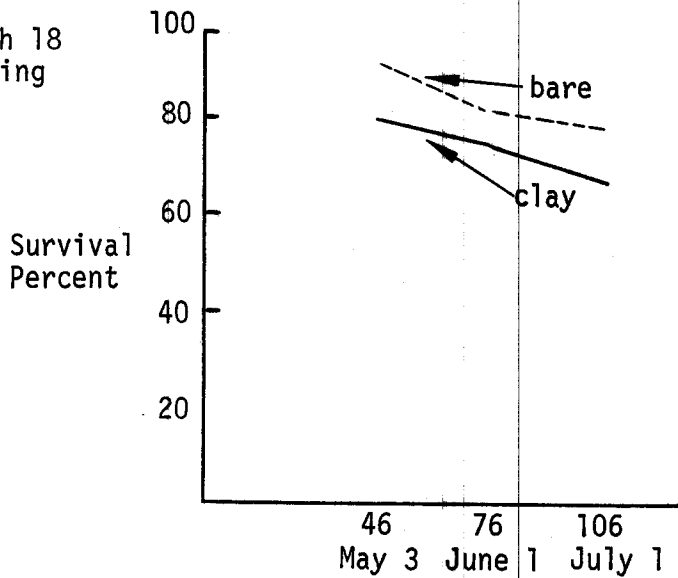
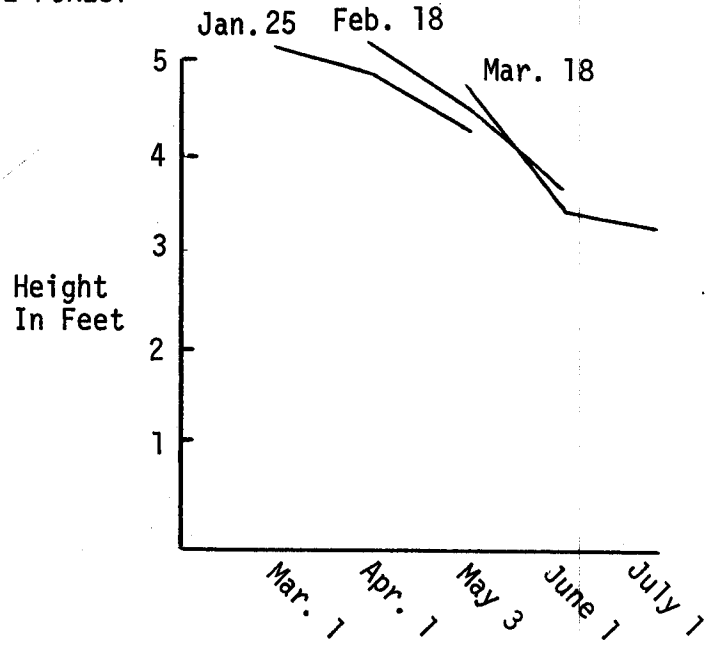
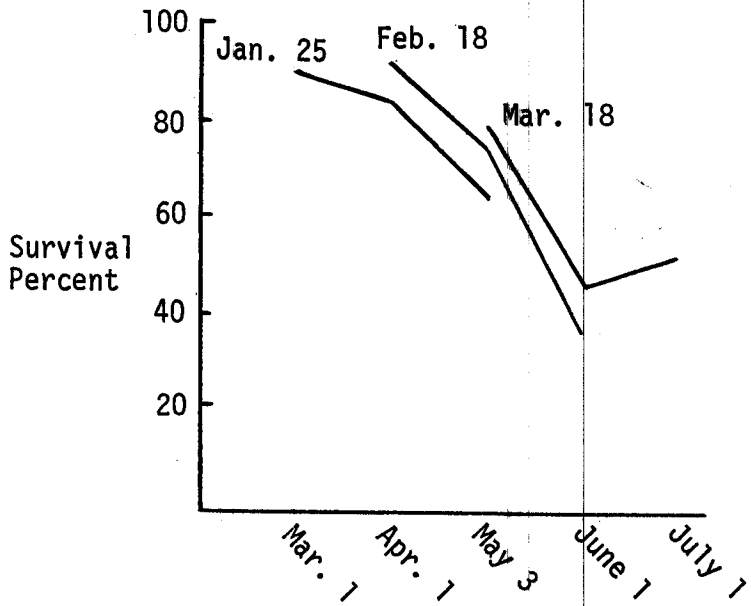


Figure 2. Pocahontas State Forest - Survival percent and height after three growing seasons related to cold-storage period (days) and planting date, for clay-dipped and bare-rooted seedlings.

APPOMATTOX STATE FOREST



POCAHONTAS STATE FOREST

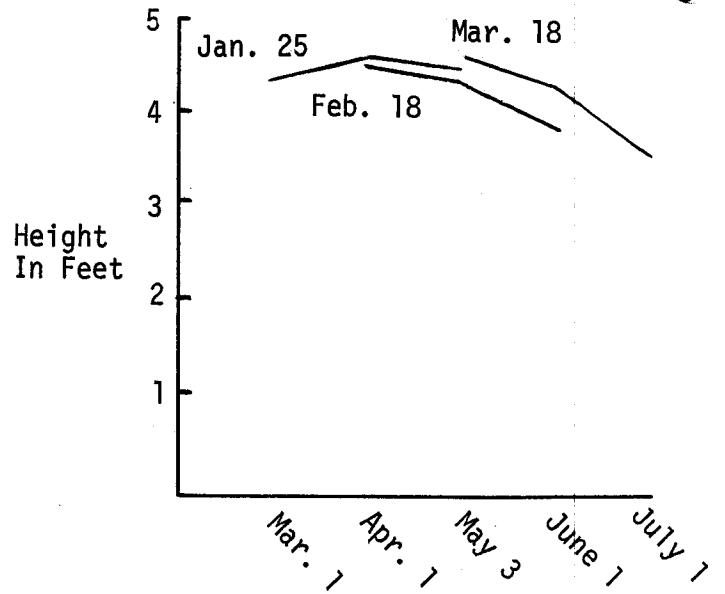
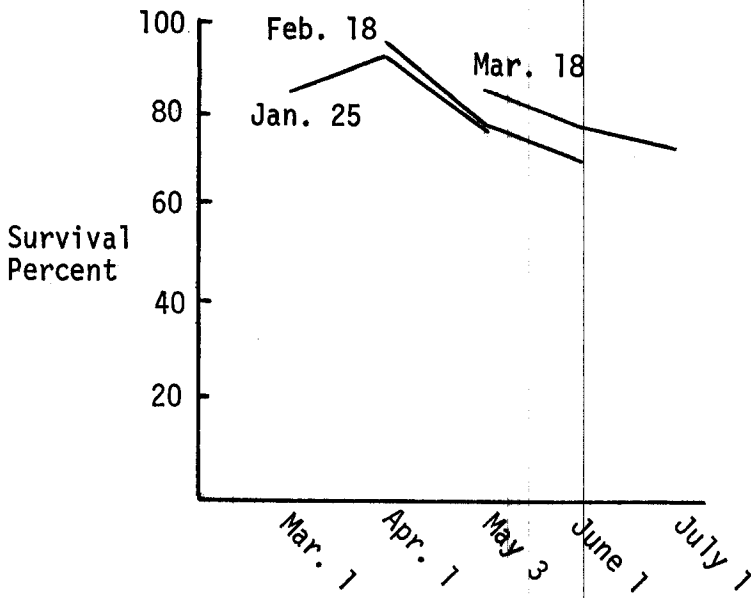


Figure 3. Survival and height after three growing seasons related to planting date for each lifting date (clay-dipped and bare-rooted seedlings combined).

WEATHER

1965 was a dry year with a 12 inch rainfall deficit recorded for the Appomattox State Forest area and a 14 1/2 inch rainfall deficit recorded for the Pocahontas State Forest (Chesterfield County) area.

DISCUSSION

1. In most cases longer storage periods reduced both survival and height growth. The only exception was the January lifting on the Pocahontas State Forest where the linear relationship with time in storage was not statistically significant for either survival or height.
2. The study was not designed to make statistical comparisons among the five planting dates. Figure 3, however, suggests that planting date had an important effect on both survival and height growth. In general, earlier plantings survived and grew better than later plantings of a comparable storage period. This was especially noticeable on the Appomattox State Forest where June and July plantings averaged only 45 percent survival and marked decreases in height growth occurred.
3. In most cases when comparing clay dipped with bare rooted seedlings no statistically significant differences were found for either survival or growth. The only exceptions were on the Pocahontas State Forest where clay treated seedlings survived better (.01 level) and were taller (.025 level) for the January lifting; but did not survive as well (.005 level) for the March 18 lifting. It should be remembered that during time of planting, seedlings were carefully handled in order to minimize exposure.

4. Considerable delayed mortality occurred after the first growing season for July 1 plantings, and even June 1 plantings had more delayed mortality than earlier plantings. Apparently, the seedlings planted on June 1 and July 1 were not as well established at the end of the first growing season as seedlings planted earlier, and fewer of them had the vigor necessary for survival.