COMPARISON OF SURVIVAL AND GROWTH OF 1-0 AND 2-0 WHITE PINE

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At TVA's Clinton, Tenn., Nursery, and at other nurseries in the region, white pine is the only species held in the beds for two growing seasons. Except for scattered individuals, 1-0 seedlings are not considered plantable because they do not meet commonly accepted requirements: Well-developed terminal buds, secondary needles, and a minimum top length of 3 inches. One-year-old seedlings rarely have secondary needles, and usually they are less than 3 inches tall. However, these criteria developed from judgments rather than experimentation.

If tests showed that 1-year-old white pine was plantable, considerable saving could be realized. For example, in 1960 the cost of producing 2-0 white pine seedlings at the Clinton Nursery was $9 per thousand, and $4 of this total was incurred the second year. To test the practicability of planting 1-0 stock, TVA initiated a series of small controlled tests in 1957 to compare the survival and growth of 1- and 2-year-old white pine seedlings. These tests, with 25 trees per plot, were set up in three areas of eastern Tennessee during a 5-year period. Additional comparisons of 1-0 seedlings, involving size of seedling and development of terminal buds, were also made in some of the tests. All the tests were designed to permit statistical evaluation of the results. In 1958, 1959, and 1960 the U.S. Forest Service used 174,000 1-year-old seedlings in routing planting operations on the Chattahoochee National Forest in Georgia and the Cumberland National Forest in Kentucky. Survival counts and height measurements, made annually in most cases, were discontinued in 1962, when the plantings were 2 to 5 years old.

Results

Survival and height growth of 1-year-old white pine seedlings were satisfactory in nearly all test plantings. The larger seedlings--those at least 3 inches tall when planted--developed about as well as 2-year-old seedlings. Unfortunately, only about 15 percent of the 1-0 white pine in the Clinton Nursery attains this size.

Survival of the 2-year-old seedlings was greater than that of the 1-year-olds, but many of the differences were not significant (tables 1 and 2). For example, the average

TABLE 1.--Average survival of white pine in eastern Tennessee planting tests

Year planted	No. plots	Planting stock	Survival after				
			1 year	2 years	3 years	4 years	5 years
			Percent	*Percent*	*Percent*	*Percent*	*Percent*
1957.....	56	1-0	80	74	73	73	73
		2-0	84	81	79	78	78
1958.....	30	1-0	95	86	84	--	80
		2-0	98	96	96	--	94
1959.....	15	1-0	94	92	91	90	--
		2-0	98	97	97	96	--
1960.....	15	1-0	98	97	96	--	--
		2-0	99	99	98	--	--
1961.....	15	1-0	95	91	--	--	--
		2-0	98	97	--	--	--
Total.....	131	1-0	92	88	--	--	--
		2-0	95	94	--	--	--

TABLE 2.--Effect of seedling age, seedling height, and bud size on survival of white pine in eastern Tennessee planting tests

Year planted and location	Planting stock	Seedling height	Bud size	Survival after			5-year height growth
				1 year	2 years	5 years	
		Inches		*Percent*	*Percent*	*Percent*	*Feet*
1957:							
Anderson County..	1-0	Under 3	Small	70	55	55	2.9
	1-0	Do.	Large	68	60	56	3.6
	1-0	Over 3	Small	80	80	77	4.4
	1-0	Do.	Large	77	77	77	4.2
	2-0	(1)	(1)	75	75	70	3.8
Carter County....	1-0	(1)	(1)	85	79	76	4.5
	2-0	(1)	(1)	94	88	86	5.1
Morgan County....	1-0	Under 3	Small	66	57	56	3.8
	1-0	Do.	Large	76	74	72	4.3
	1-0	Over 3	Small	92	90	90	5.2
	1-0	Do.	Large	88	84	84	5.8
	2-0	(1)	(1)	84	79	78	4.8
1958:							
Anderson County..	1-0	Under 3	(1)	89	78	70	2.4
	1-0	Over 3	(1)	94	87	84	4.1
	2-0	(1)	(1)	97	94	92	4.6
Morgan County....	1-0	Under 3	(1)	97	82	72	3.4
	1-0	Over 3	(1)	98	96	94	5.6
	2-0	(1)	(1)	99	98	95	6.8
1959:							
Anderson County..	1-0	Under 3	(1)	94	93	--	--
	1-0	Over 3	(1)	94	92	--	--
	2-0	(1)	(1)	98	97	--	--
1960:							
Anderson County..	1-0	Under 3	(1)	96	95	--	--
	1-0	Over 3	(1)	99	99	--	--
	2-0	(1)	(1)	99	99	--	--
1961:							
Anderson County..	1-0	Under 3	(1)	94	89	--	--
	1-0	Over 3	(1)	96	93	--	--
	2-0	(1)	(1)	98	97	--	--

[1] Ungraded.

survival of all plantings after 2 years was 88 percent for 1-0 stock and 94 percent for 2-0 stock. Mortality losses after the second year were minor for both classes. After 3 years, the pilot-scale plantings of 1-0 stock on the Chattahoochee National Forest verified these test results (table 3).

Height growth of the 2-0 stock was also generally greater than that of the 1-0 stock (tables 2 and 3), and for this factor many of the differences were statistically significant. After 5 years, 1-0 seedlings taller than 3 inches at planting time outgrew the smaller 1-0 seedlings. The average annual growth of the taller seedlings was about 1 foot, which is quite satisfactory. It almost equaled the average growth of 2-year-old seedlings. In the 1957 plantings in Tennessee's Anderson and Morgan Counties, 1-0 seedlings actually outgrew 2-0 seedlings. The reported growth of 4-year-old plantations on the Cumberland National Forest indicated satisfactory growth of all 1-0 planting stock. The Chattahoochee plantings performed about the same as those used in the Tennessee tests.

TABLE 3.--Survival and growth of white pine in pilot-scale plantings on the Chattahoochee and Cumberland National Forests, 1959 and 1960

National Forest	Location	Planting stock	Survival after		Height after	
			3 years	4 years	3 years	4 years
			Percent	*Percent*	*Feet*	*Feet*
Chattahoochee (1960).	Bald Mountain..	1-0	69	--	0.8	--
	Do.....	2-0	80	--	1.4	--
	East Cowpen....	1-0	59	--	.7	--
	Do.....	2-0	74	--	1.3	--
	Jacks River....	1-0	37	--	1.0	--
	Rich Knob.....	1-0	50	--	.8	--
	Do.....	2-0	66	--	1.2	--
Cumberland (1959)....	London.....	1-0	--	85	--	3.0
	Morehead.....	1-0	--	75	--	2.5
	Somerset.....	1-0	--	([1])	--	1.5

[1] Poor.

In the 1-0 tests of seedling size and terminal bud size, size of bud proved less significant than seedling size as a factor in survival (table 2). Mortality was less among seedlings taller than 3 inches at planting time than among those less than 3 inches tall. After 5 years more than 75 percent of the taller 1-0 stock had survived.

Use of bed-run 1-0 seedlings, especially those less than 3 inches tall, presents some planting problems. They are harder to plant at the proper depth, and this could be a major problem in machine planting. The somewhat variable results on the pilot-scale tests indicate problems that might not be encountered on smaller test plots. For example, the larger areas may contain various soil and ground cover conditions, whereas such factors can be carefully controlled on small test plots. More test planting of 1-0 stock on large areas is needed.

Conclusion

Nurseries in the Tennessee Valley States produce 40 to 45 million 2-0 white pine seedlings a year. If it were possible to satisfactorily plant 1-0 stock, annual nursery costs could be reduced by an estimated $160,000. In addition, production could be increased.

The tests reported here indicate that 1-0 seedlings at least 3 inches tall survive and grow just as well as 2-0 seedlings. The height of the average 1-0 seedling at the Clinton Nursery is now slightly over 2 inches; therefore, stimulating first-year growth by just 1 inch would make them plantable.

So far, artificial lighting, fertilization, and other cultural treatments have failed to produce an average 3-inch seedling the first year. But tests are still in progress, and it is hoped that the results reported above will stimulate more research among nurserymen.