

DIRECT SEEDING OF CONIFERS IN RHODE ISLAND

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Most of Rhode Island's forested area is stocked with low-quality hardwoods. Oak forests (50 percent or more oak) occupy almost 75 percent of the commercial timberland and furnish 70 percent of the timber volume (1).

One of the major goals of Rhode Island foresters is to increase the proportion of conifers in these stands. Planting has provided, some conifers, but not enough.

In the fall of 1959, the Rhode Island Agricultural Experiment Station and the Rhode Island Division of Forests began a cooperative project to evaluate the feasibility of direct seeding of native conifers. Because of the recent development of seemingly effective rodent repellents and deterrents, it was felt that direct seeding might be practical for establishing conifers on some sites.

Study Methods

Tests were conducted on the Arcadia State Forest in western Rhode Island. The study area was on a well-drained soil- -Merramac fine sandy loam, --in an area which had burned in 1951. It supported a young stand consisting primarily of scrub oak (Quercus ilicifolia Wangerh.), white oak (Quercus alba L.), pitch pine (Pinus rigida Mill.), and gray birch (Betula populifolia Marsh.). The understory consisted of low sweet blueberry (Vaccinium angustifolium), early sweet blueberry (Vaccinium vacillans Kalm.), sheep laurel (Kalmia angustifolia L.), poverty grass (Danthonia spicata (L.) Beauv.), and some sweet fern (Comptonia peregrina Coult.) and princess pine (Lycopodium clavatum L.).

In early December 1959, 2 . acres were prepared for seeding by bulldozing and rootraking strips 15 feet wide and 350 feet long separated by 10-foot unbulldozed strips. The strips were oriented north and south.

A seed mixture of 6 pounds of white pine, 2 pounds of pitch pine, and 2 pounds of hemlock was sown per acre, using a "cyclone" seeder. Seed was treated prior to sowing with endrin and Arasan-75; the method described by Derr and Mann (2) was employed. One acre was seeded on December 17, 1959, and 1 acre on May 2, 1960. Seed was mixed with a little rye to facilitate spreading.

Tests of untreated seed showed 45 percent germination of hemlock, 73 percent of white pine, and 80 percent of pitch pine. The hemlock seed was collected in the fall of 1958 from the Cockaponset State Forest in Connecticut. The white pine was collected in September 1959 in Litchfield County, Conn. The pitch pine seed was from Clarion County, Pa., and was collected in the fall of 1959.

This seed mixture was chosen because naturally occurring combinations of pitch pine and white pine make a good mixture on certain sites such as the one chosen for this study. White pine, which apparently receives little weevil damage in such stands, is above average quality. Pitch pine yields a crop of pulpwood and in some cases sawlogs. Hemlock was included in the seed mixture despite the belief that its chance of success would be slim. However, it was felt that its inclusion in the species mixture might result in few stems and that its presence would be desirable from forestry, wildlife, and esthetic viewpoints.

¹The soil was typed by M. A. Puchalski. Soil Conservation Service, U.S. Department of Agriculture.

For both the fall-sown and spring-sown areas, records of germination and survival were made periodically from a total of 51 permanently marked 1-meter-square plots located randomly in the treated areas.

Results

Well-stocked stands of conifer seedlings were obtained on all study areas. In October 1961, the fall-sown area contained a stand of 14,140 conifer seedlings, consisting of 3,284 white pine, 9,428 pitch pine, and 1,428 hemlock seedlings (table 1). The spring-sown area contained a stand of 8,800 seedlings per acre, with 2,600 white pine, 6,000 pitch pine, and 200 hemlock seedlings (table 1).

To properly evaluate data, tree percent was calculated for each species where tree percent = $\frac{\text{number of seedlings}}{\text{number of viable seed sown}_2} \times 100$. This calculation permitted a more accurate analysis of the success of each species.

The difference between numbers of pitch pine and hemlock seedlings was significant, but the differences between white pine and pitch pine and between white pine and hemlock were not.

Although there were more seedlings of each species on fall-sown strips than on spring-sown strips, the differences were not significant. The stocking of conifer seedlings was essentially the same in the center and edges of the bulldozed strips.

TABLE 1.--Number of seedlings per acre of white pine, pitch pine, and hemlock, by month sown

Species	June 1960		September 1960		June 1961		October 1961	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Pitch pine.....	7,284	1,200	9,144	5,600	¹ 9,284	6,000	9,428	6,000
White pine.....	2,856	0	3,000	2,000	3,144	2,800	3,284	2,600
Hemlock.....	1,428	0	1,284	200	1,712	200	1,428	200
Total.....	11,568	1,200	13,428	7,800	14,140	9,000	14,140	8,800

¹ Increases in number of seedlings after the first growing season are due to delayed germination.

Mortality

Since periodic counts were made on permanently marked sample plots, seedling losses during the study period could be recorded (table 2). The losses ranged from 50 percent for hemlock to 7 percent for spring-sown white pine. All the causes of the losses were not known. However, insolation apparently accounted for many of the summer losses, and frost heaving for the winter losses. All of the mortality of spring-sown white pine seedlings (7 percent) occurred during the second (1961) summer. In contrast, all of the fall-sown white pine seedlings mortality (22 percent) occurred during the first (1960) summer.

² The number of viable seed sown of each species is based on number of seeds per pound and germination tests. Any effect that seed treatment with repellent might have on seed germination is not considered.

TABLE 2.--Total seedlings,¹ and number and percent loss of white pine, pitch pine, and hemlock seedlings on the plots examined by month sown

Date	Fall-sown									
	White pine			Pitch pine			Hemlock			
	Total seedlings	Loss		Total seedlings	Loss		Total seedlings	Loss		
		Number	Percent		Number	Percent		Number	Percent	
September 1960...	27	6	22	72	8	11	16	7	44	
June 1961.....	22	0	0	68	3	4	12	0	0	
October 1961.....	23	0	0	67	1	1	13	3	23	
Summary.....	29	6	21	78	12	15	20	10	50	
	Spring-sown									
	September 1960...	10	0	0	30	2	7	1	0	0
	June 1961.....	14	0	0	31	1	3	1	0	0
	October 1961.....	14	1	7	33	3	9	2	1	50
	Summary.....	14	1	7	36	6	17	2	1	50

¹ Increases in total seedlings after the first growing season are due to delayed germination.

Pitch pine losses, which occurred during both summer and winter, were usually greater during the summers. By October 1961, 15 percent of the pitch pine seedlings were lost on the fall-sown area, and 17 percent on the spring-sown area. Losses of hemlock seedlings were high (50 percent) on both fall- and spring-sown areas.

Discussion

In general, the well-stocked stand of seedlings obtained indicates that much less seed could have provided satisfactory results at less cost. The poor overall showing of hemlock plus the high cost of hemlock seed indicates that it should be excluded from any seed mixture where seed is to be sown under conditions similar to those in this study.

Derr and Mann (2) declare that the goal for broadcast seeding of longleaf pine should be at least 2,000 initial seedlings per acre. Based on the relatively open characteristics of longleaf pine stands, initial stocking of pitch pine and white pine apparently should equal or exceed 2,000 seedlings per acre. After two growing seasons, seedlings-per-acre totals for pitch pine plus white pine were 12,712 and 11,400 for fall-sown and spring-sown areas, respectively. Ratios of pitch pine to white pine were about 3 to 1 on the fall-sown area and 2.5 to 1 on the spring-sown area. This effectiveness of the pitch pine-white pine mixture suggests that adequate stocking of these species could probably be obtained with less seed. Tests using less seed are planned.

The pitch pine seedlings almost always grew more rapidly than the white pine seedlings; in some cases pitch pine was as much as 3 to 4 times as high as the white pine. The development of these seedlings on the area will be observed to evaluate the effects

of such a large difference in height on the future of white pine in the stand. This determination will, in turn, give a better idea as to the desirability of white pine-pitch pine seedings.

Based on viable seed sown, there should have been more white pine seedlings than pitch pine seedlings. Actually, pitch pine outnumbered white pine on both fall- and spring-sown areas. Apparently, much of the white pine seed was lost before it had a chance to germinate. There was some seed loss to rodents despite treatment with repellents. In areas where consumption by rodents occurred, white pine seemed to be more affected than pitch pine or hemlock. This is another factor that needs further study before extensive seedings are made.

Summary

A mixture of white pine, pitch pine, and hemlock seed treated with Arasan-75 and endrin was sown in the fall and spring at the rate of 6 pounds of white pine, 2 pounds of pitch pine, and 2 pounds of hemlock per acre on a bulldozed site in western Rhode Island.

At the end of two growing seasons the fall-sown area contained a stand of 14,140 seedlings, including 3,284 white pine, 9,428 pitch pine, and 1,428 hemlock seedlings. The spring-sown area contained a stand of 8,800 seedlings per acre, with 2,600 white pine, 6,000 pitch pine, and 200 hemlock seedlings. Although there were more seedlings of each species on fall-sown strips, the differences were insignificant.

Because of the success of the pitch pine and white pine, studies with these species using less seed will be continued. Also, the future development of the pitch pine-white pine seedings will be observed to evaluate the possibilities in a mixture containing these two species.

Literature Cited

- (1) Ferguson, R. H., and McGuire, J. R. 1957. The timber resources of Rhode Island. U.S. Forest Service, Northeastern Forest Expt. Sta.
- (2) Derr, H. S., and Mann, W. F., Jr. 1959. Guidelines for direct-seeding longleaf pine. U.S. Forest Service Southern Forest Expt. Sta., Occasional Paper 171.