GROWTH AND SURVIVAL OF THREE HARDWOOD SPECIES AS AFFECTED BY ARTIFICIAL REGENERATION METHOD

G. W. Wendel
Research Forester, Forest Service,
U.S. Department of Agriculture,
Northeastern Forest Experiment Station,
Broomall, Pa.

The survival and growth of 1—0 bare-rooted seedlings, container-grown seedlings, and direct-seeded seedlings were compared on cutover sites in West Virginia.

A major problem with barerooted hardwood seedlings is that much of the root system is often damaged during the lifting operation. The root system is further reduced by severe root pruning, particularly if the species has a tap root.

To determine whether slow early growth is associated with root pruning and damage to seedlings during lifting and transplanting, the growth and survival of 1—0 bare-rooted seedlings were compared with those of seedlings established by direct seeding and container-grown seedlings. Northern red oak (*Quercus rubra* L.), black cherry (*Prunus serotina* Ehrh.), and yellow-poplar (*Liriodendron tulipifera* L.) were compared at the end of 7 years.

The Study

The study was installed in the spring and summer of 1970 on the Fernow Experimental Forest near Parsons, W. Va. Two areas were used. The red oak and black cherry study area was relatively level and had been cutover in August 1969. The yellow-poplar area had been cutover about 2 years earlier. All merchantable stems down to 5 inches dbh were cut. The smaller stems and tops were carefully removed from the area with a crawler tractor. To reduce stump sprouting, the red oak and black cherry area was treated with 2,4,5-T applied with a mistblower (fig. 1). A heavy grass cover on the yellow-poplar area was controlled with an herbicide.

Before cutting, the red oak and black cherry area supported a stand of red oak, black cherry, beech (*Fagus grandifolia* Ehrh.), hickory (*Carya* sp.), and sugar maple (*Acer saccharum* Marsh.). The stand on the yellow-poplar area was composed of yellow-poplar, white ash (*Fraxinus americana* L.), black cherry, red oak, and slippery elm (*Ulmus rubra* mühl.). Oak site index was 70 on the red oak and black cherry area; it was 80 on the yellow-poplar site.

On the yellow-poplar area the soil was a Belmont silt loam; on the other area it was Calvin channery silt loam.

On each species plot, 300 planting locations were laid out at 6- by 8-foot spacing. One hundred locations in each plot were randomly designated for each of the artificial regeneration methods.

All bare-rooted seedlings were 1—0 stock; they were planted with a shovel in early April. Red oak

Figure 1.—*General view of red oak/black cherry area before planting.*

acorns were collected in the fall of 1969 and stratified in moist sand for 3 months. Two acorns were planted about 1-inch deep in each spot during March 1970. Black cherry seeds were stratified in moist sand for 100 days. Five to seven seeds were sown ½-inch deep in each designated spot. Yellow-poplar seeds were handled similarly.

Tubed seedlings were grown in 1½-inch diameter by 10-inch long kraft cardboard tubes. The tubes were filled with topsoil obtained from a forested area. Stratified acorns and yellow-poplar and black cherry seeds were planted in the tubes. Although 300 black cherry tubelings were prepared, only 32 were outplanted. Mice and chipmunks entered the tubeling growing area and destroyed the young seedlings by eating the remains of cotyledons attached to the seedlings. The seedlings were grown for 5 to 6 weeks and outplanted at the randomly designated locations in each of the plots. Red oak tubelings were outplanted in the latter part of May and the black cherry and yellow-poplar were planted in mid-June (figs. 2, 3, and 4).

All of the 1—0 seedlings and tubelings were mulched with 30-inch squares of black plastic at planting time. When seedlings emerged in the seedspots, they were also mulched.

Results

Mulching. Mulching controlled the development of herbaceous vegetation close to the seedlings. The mulched area was too small to have an effect on the development of blackberries and sprouts that soon dominated the area and partially shaded many seedlings.

Red oak. Seventy-seven percent of the red oak seedlings were still alive at the end of seven growing seasons. In contrast, 31 percent of the tubelings and 4 percent of the seedspot seedlings survived (table 1). The low survival of tubelings and seedlings in seedspots was due to chipmunks and mice. Frequent examination of the area during the first growing season revealed that rodents had eaten the remains of the cotyledons and in doing so cut off the emerging seedlings.

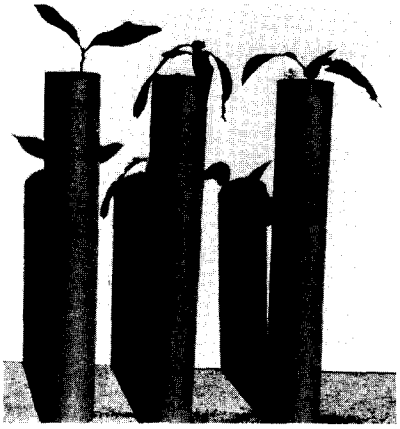

Figure 3.—*Black cherry tubelings.*

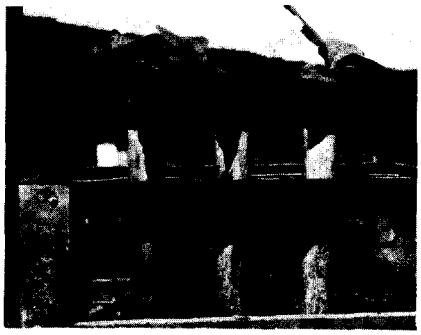

Figure 2.—*Red oak tubelings.*

Figure 4.—*Yellow-poplar tubelings.*

Table 1.—*Survival and height growth of three hardwood species at the end of seven growing seasons*

Species	Regeneration method	Survival	Average height (and number) by dominance classes			
			Dominant	Intermediate	Overtopped	All
		(percent)	*(feet (no.))*			
Red oak	1-0 seedlings	77	13.5 (18)	10.5 (18)	2.9 (41)	7.1
	Tubelings	31	0 (0)	7.7 (2)	1.6 (29)	2.0
	Seed spots	4	10.5 (2)	7.5 (1)	0.4 (1)	4.6
Yellow-poplar	1-0 seedlings	82	16.2 (57)	11.8 (13)	7.3 (12)	14.2
	Tubelings [1]	---	---	---	---	---
	Seed spots	9	2.3 (4)	4.8 (1)	2.5 (4)	2.6
Black cherry	1-0 seedlings	76	17.5 (24)	14.8 (12)	5.2 (40)	10.6
	Tubelings [1]	---	---	---	---	---
	Seed spots	19	0 (0)	11.7 (1)	5.6 (18)	5.9

[1]No survivors.

Although the tubelings and seedspots were planted at random, rodents seemed to have no difficulty finding them.

Trees planted as 1—0 seedlings averaged 7.1 feet tall at the end of 7 years, compared to 4.6 feet for seedspot seedlings and 2.0 feet for tubelings (table 1). More than half of the surviving 1—0 seedlings were overtopped by other vegetation; 23 percent were in the intermediate class, and 23 percent were in the dominant and codominant crown classes. Dominant and codominant seedlings averaged 13.5 feet tall compared to 10.5 and 2.9 feet for intermediate and overtopped trees, respectively. Most of the surviving containerized seedlings were overtopped by other vegetation.

Yellow-poplar. Eighty-two percent of the yellow-poplar seedlings, and 9 percent of the seedspot seedlings were still alive at the end of seven growing seasons (table 1). No tubelings survived.

Trees planted as 1—0 seedlings averaged 14.2 feet tall and seedspot seedlings averaged 2.6 feet tall (table 1). About 70 percent of the surviving 1—0 seedlings were classified as dominant or codominant and these trees averaged 16.2 feet tall. Of the nine surviving seedspot seedlings, four were classified as dominant/codominant stems with an average height of 2.3 feet.

Black cherry. Seventy-six percent of the black cherry 1—0 seedlings, and 19 percent of the seedspot seedlings were still alive at the end of seven growing seasons (table 1).

Those planted as 1—0 seedlings averaged 10.6 feet tall and seedspot seedlings averaged 5.9 feet tall. About 32 percent of the surviving 1—0 seedlings were classified as dominant or codominant with an average height of 17.5 feet (table 1). Over half of the surviving 1—0 seedlings were overtopped; these averaged 5.2 feet tall.

Seedspot seedlings averaged 5.9 feet at the end of 7 years; almost all of these stems were overtopped by other vegetation.

Summary and Discussion

A majority of the surviving 1—0 yellow-poplar seedlings grew well. More than half of these seedlings were in the dominant/codominant crown position at the end of 7 years. About a third of the black cherry 1—0 seedlings were dominant/codominant. Red oak 1-0 seedlings have not grown as well as the yellow-poplar and black cherry. More than half of the surviving red oak seedlings were overtopped, and about one-fourth were classified as dominant or codominant.

Survival of the seedspot and containerized seedlings was poor. Few of these seedlings occupy dominant or codominant crown positions. Chipmunks and mice destroyed most of the red oak and black cherry seedlings that emerged from the seedspots and tubelings. The yellow-poplar containerized and seedspot seedlings did not survive better because they were shaded out by the dense stand of grass and herbaceous material that became established on the area. The attempt to control the grass on the yellow-poplar area with herbicide was ineffective.

This study has shown that planting bare-rooted stock is the best way to artificially regenerate black cherry, red oak, and yellow-poplar on cutover sites. Until some method for controlling rodents or protecting hardwood seeds and seedlings from them is found, direct seeding and planting of containerized seedlings, as used in this study, will be of limited value. In addition, economical methods for controlling competing vegetation will have to be found if these relatively small seedlings are to survive.