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Ten-Year Growth of PLANTED PAPER BIRCH in Old Fields in Maine

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EARLY RESULTS of planting paper birch in old fields in Maine have not been very encouraging. Observations of seven plantations in a study established in 1959 by the Northeastern Forest Experiment Station showed low survival and slow growth over the first five growing seasons *(1)*. Removing the sod in advance of planting gave better results than planting directly in the sod.

During the next five growing seasons, the number of survivors continued to decline, but at a much slower rate. Despite improved growth in this period, most of the surviving trees were relatively small. One-half to two-thirds of the stems fell below the 1-inch diameter class, and 60 to 78 percent were less than 10 feet tall. And since the crowns had not closed, natural pruning was at a minimum.

STUDY METHODS

The plantations in this study were established in the spring of 1959 by the Northeastern Forest Experiment Station in cooperation with the Maine Hardwood Association. Seven planting sites were selected in old fields in western Maine. These sites were either level or sloped gently to the south. Elevations ranged from 400 feet to 1,000 feet. Soils were mostly well-drained sandy loams. Three of the planting sites were actively used for haying or pasturing until planted. The other sites had been abandoned from agricultural use for a varying number of years.

Each plantation was about ½ acre in area. Planting was done at 6x6 spacing. The planting stock was 2-0 seedling stock of fair quality.

Four treatments were tested, each representing a different combination of site preparation, planting method, and planting position. These treatments were:

1. **Furrow slice.**—A plowed double furrow with the second slice turned over into the first furrow, trees hand-planted on the second slice (fig. 1).
2. **Furrow bottom.**—A plowed single furrow, trees hand-planted in the bottom of the furrow.

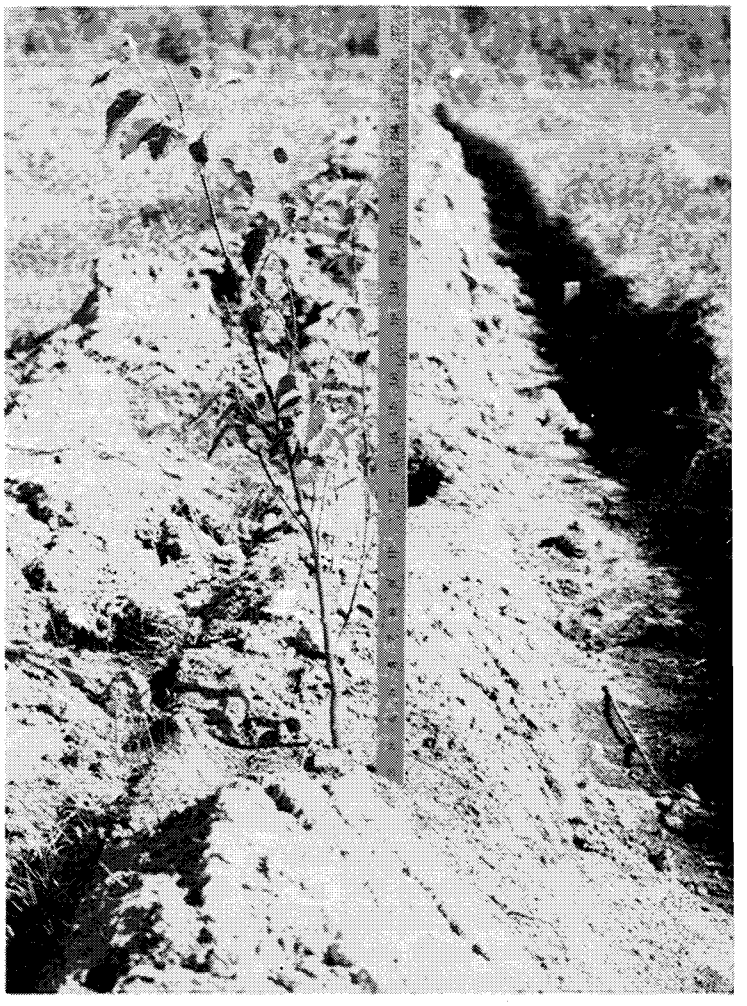


Figure 1.—In the furrow slice treatment, seedlings were hand planted on top of the second overturned slice of a double furrow.

3. **Scalp.**—Scalps 16 inches wide made with attachments to a Lowther planting machine, trees machine-planted in the center of the scalped strip. In practice, the scalps were not always full width because the blades fouled with debris.
4. **Sod.**—No sod removal, trees machine-planted directly in the sod.

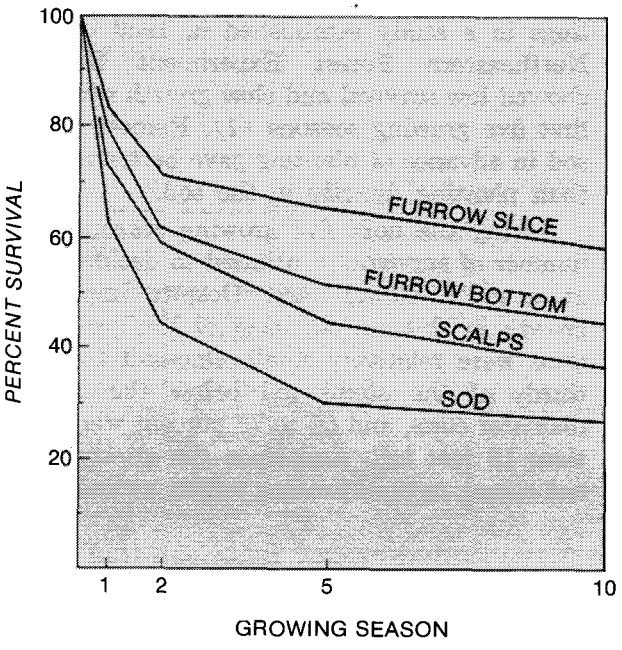
Since hardwood plantings are subject to animal damage, a test of repellents that protect seedlings from damage by deer, rabbits, hares, and mice was incorporated in the main study. These repellents were applied in spring and fall. However, they were ineffective because of the long intervals between applications and because of the relatively high animal pressure at the time the plantations were established.

Repellents were not used after the spring of 1960. Instead, a mouse-control program using

poisoned baits was carried out in the fall of 1960 and 1961 by the Division of Wildlife Services of the U. S. Department of the Interior. Since this program was set up to protect the seedlings rather than as a study of mouse control, the degree of control could not be evaluated. Also, seedling mortality and damage had already begun to decrease by the time of the 1960 treatment, and mouse populations were already low before treatment in 1960.

In September 1968, ten growing seasons after planting, the surviving trees in these seven plantations were remeasured to find out what changes in survival occurred and how well the survivors grew. Survival was based on an actual count of live trees remaining. Growth was based on height measured to the nearest ½ foot and diameter measured in 1-inch classes.

Figure 2.—Survival of planted paper birch seedlings, by treatment, for the first ten growing seasons.



RESULTS

Survival

After ten growing seasons, survival ranged from a low of 27 percent for seedlings planted in the sod to a high of 58 percent for those planted on the furrow slice. For all plantations combined, survival was best on the furrow slice, followed by survival in furrow bottoms, in scalps, and in sod, in that order (table 1).

In individual plantations, survival was consistently and significantly (at the 5-percent level) lower where the sod was left intact than where it was removed. However, differences among the furrow slice, furrow bottom, and scalp treatments varied from one plantation to another, indicating that the effects of site were greater than the effects of treatment.

Survival showed a continuous decline over the ten growing seasons (fig. 2). Most of the mortality occurred in the first 2 years.

Table 1.—*Ten-year survival of planted paper birch seedlings, by treatment and plantation, September 1968*

Plantation	Treatment			
	Furrow slice	Furrow bottom	Scalp	Sod
	Pct.	*Pct.*	*Pct.*	*Pct.*
1	89	65	53	43
2	88	70	55	46
3	59	52	50	28
4	48	7	19	3
5	43	42	34	29
6	64	72	43	33
7	13	0	0	0
Average	58	44	37	27

Mortality

Planting failure (mortality within 1 month of planting) accounted for about 12 percent of the total mortality in all plantations combined. Although there were differences by plantation, most occurred in the sod and on the furrow slice. Presumably the sod provided excessive competition for the seedlings and also made planting difficult. The furrow slice was also difficult to plant and, in addition, the overturned litter and loosened soil dried quickly. As much as one-fourth of the total mortality in a single plantation was due to planting failure.

Mouse-caused mortality accounted for about 12 percent of the total mortality. Generally,

this was most common in the furrow bottom treatment and more common in scalps or in sod than on the furrow slices. Of this mortality, about 61 percent occurred in the 6-month period (June to October 1959) after planting, and an additional 33 percent occurred during the first winter (October 1959 to June 1960). Mouse-caused mortality accounted for as much as 45 percent of the total mortality in a single plantation and as much as 61 percent of the total mortality in a single treatment (furrow bottom) in one plantation.

Deer were not a factor in mortality; but rabbits, hares, frost heaving, and other factors did kill some seedlings. Seedlings dead because of such factors have been included with those dead from unknown or multiple causes. And these unknown causes accounted for 76 percent of the total mortality in all plantations combined.

Tree Height

For all plantations combined, average height after ten growing seasons was best on the furrow slice. The average heights of seedlings planted in furrow bottoms and in scalps were much alike—and better than those planted in the sod. This pattern of height growth was the same in most of the plantations (table 2). The substantially greater average heights in plantation 3 were probably due to more favorable soil characteristics — a deeper soil, better moisture conditions, and higher fertility.

Table 2.—*Average height of trees, by treatment and plantation, after 10 growing seasons, September 1968*

Plantation	Treatment			
	Furrow slice	Furrow bottom	Scalp	Sod
	Ft.	*Ft.*	*Ft.*	*Ft.*
1	11.8	7.5	7.2	6.4
2	11.3	9.1	9.1	7.6
3	15.6	12.3	13.3	9.6
4	11.7	8.8	8.0	12.6
5	6.1	4.3	4.1	4.3
6	9.6	8.7	8.4	7.0
7	10.6	(1)	(1)	(1)
Average	11.2	8.5	8.6	7.0

[1]No survivors.

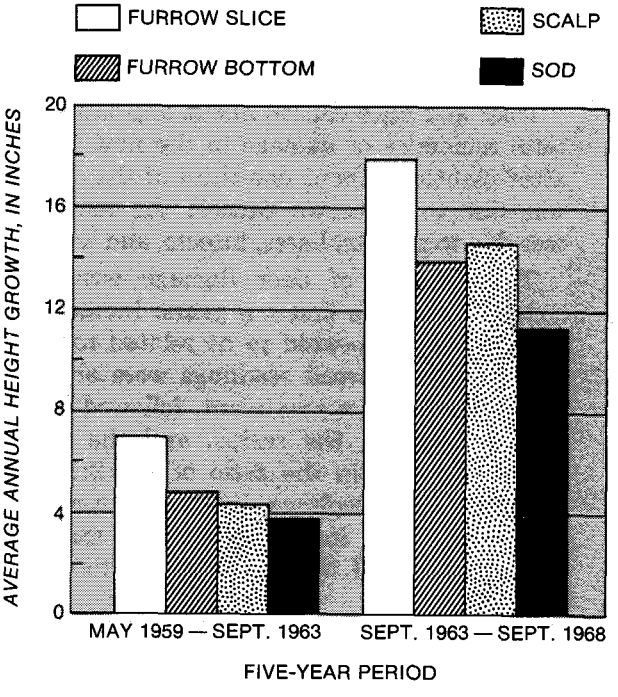
A maximum height of 24 feet was attained on the furrow slice. And although a number of trees were 20 feet tall or taller, these trees represented only 2 percent of the total number of seedlings planted on the furrow slice. The distribution of surviving trees by height class and treatment was:

Treatment	*Height class*		
	Less than 10.0 feet (pct.)	*10.0-19.5 feet (pct.)*	*20.0 feet and taller (pct.)*
Furrow slice	37	61	2
Furrow bottom	60	40	0
Scalps	62	38	(1)
Sod	78	22	0

[1]Less than 0.5 percent.

Height growth the first 5 years after planting was relatively slow but improved as the seedlings recovered from the initial shock of planting, as they became acclimated to their environment, and as the incidence of deer browsing dropped off. In the second 5-year period, the average annual height growth in each treatment was about three times greater than it was in the first 5-year period (fig. 3).

Figure 3.—Average annual height growth, by 5-year periods after planting.



Tree Diameter

After 10 growing seasons, the largest trees were in the 3-inch diameter class (larger than 2.5 inches and up to and including 3.5 inches measured at breast height). Although few in number, they occurred in all treatments and were most common on the furrow slice.

Small diameter trees were the rule (table 3). One-fourth of the trees planted on the furrow slice and one-half to two-thirds of the trees planted in the other treatments were below the 1-inch diameter class.

Table 3.—*Percent distribution of planted paper birch trees, by diameter class and treatment, after 10 growing seasons, September 1968*

Diameter class (inches)	Treatment			
	Furrow slice	Furrow bottom	Scalp	Sod
	Pct.	*Pct.*	*Pct.*	*Pct.*
<1	26	53	51	68
1	47	39	36	26
2	22	8	12	6
3	5	(1)	1	(1)

[1]Less than 0.5 percent.

Damage

Deer and mice caused about one-half of the total incidence of damage in the first 5 years after planting. About one-third of the damage was due to unknown causes; the remainder was due to rabbits, hares, insects, and weather.

The amount of deer damage was fairly constant over the first few years. Incidence of deer damage appeared to be related to treatment. More browsed seedlings were observed in the furrow slice treatment, followed by the furrow bottoms, the scalps, and the sod in that order and in the ratio of 4:3:2:1. Presumably the seedlings in the furrow slice treatment were more visible and easier to reach because of their position on top of an overturned slice and because of their better height growth.

Most of the mouse damage occurred in the first year after planting; 36 percent between June and October 1959, 45 percent between October 1959 and June 1960. The incidence of mouse damage on seedlings planted on furrow slices or in furrow bottoms was about twice that for seedlings planted in scalps or in sod. The furrowing treatments apparently provided the mice with maximum protection from predators.

The damage resulted from mice feeding on the bark and cambium. Generally this occurred low on the stem. Depending on the size of the wound, seedling vigor was impaired, and damaged stems were more susceptible to breakage at the point of injury.

Few seedlings were damaged by adverse weather conditions in this period, but occasional frost heaving did occur. And in some instances, birch seedlings were broken or bent to the ground when the taller competing herbs collapsed on the seedlings under the weight of snow.

Snow damage occurred in the second 5-year period also. At times the weight of the snow was great enough to break the long lower branches on some of the larger trees. Some of these branches remained attached to the main stem; but others broke off and, in the process, tore a narrow strip of bark from the bole. In addition to the breakage, snow bending occurred. In itself, this was not serious, but the stems and branches bent over to the snow surface were easily reached and stripped of their bark by snowshoe hares.

Tree Form

Where the crowns had not closed, trees were bushy with branches almost to the ground. Only a few places had complete crown closure. Usually this was where furrow slices or furrow bottoms adjoined, and where survival and growth were good. In these limited areas, some natural pruning had taken place. On the best sites, this began about 5 years after planting.

DISCUSSION

The 10-year results of planting paper birch in old fields show that both survival and growth are better where the sod has been removed than where it is left intact. Among the sod-removal treatments, the best results were associated with the furrow slice—a treatment that gave the maximum width of desodded strip. Damage was still a problem, although it was much reduced. By this time, most of the survivors were large enough to escape serious injury from both rodents and deer.

Earlier trials of planting paper birch in old fields in other locations have also demonstrated that survival and growth were better where the sod was removed. In Maine, furrowing gave better sod control than did bulldozing, plowing, harrowing, burning, or herbicides *(6,7)*. In New York, hardwood plantings —including paper birch—failed because the sites were not prepared and the seedlings were not protected *(4)*. Other hardwood species also tend to respond favorably to site preparation *(2,3,5)* and sometimes require cultivation to maintain acceptable survival *(8)*.

The results of this study show that we cannot yet recommend planting paper birch in old fields. If we are to plant successfully in these sites, we need better information for judging site suitability, we must determine the effect of site preparation on the microenvironment, and we must find more effective methods of preventing animal damage.

But if there is a real need or desire to plant in old fields now, select only the best sites, be sure to remove the sod from within about 2 feet of the planting spot, plant carefully, use only the best stock, and provide protection from rodents and deer. In this way, your chances for planting success will be increased.

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