SEEDING AND PLANTING BIRCH

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ARTIFICIAL REGENERATION of hardwoods does not have a very good reputation. Many of the early attempts to establish these species by seeding or planting resulted in failure. Then too, natural regeneration is usually adequate on cut over areas, so that there is little need for artificial regeneration on such areas.

Nevertheless there are situations where artificial regeneration will be needed. It may be desirable to fill in blanks in existing natural reproduction, or to increase the proportion of valuable species such as birch. Any stand with an inadequate seed supply would be a candidate for artificial regeneration, and we are beginning to realize that seed supply may limit natural birch regeneration more often than was previously believed.

Artificial regeneration will certainly be required to introduce genetically improved birches—once they become available. And seeding or planting is required to establish birch on land that has been abandoned for agriculture or other nonforest land uses.

The reasons for past failures have been well documented. Much of the problem can be traced to the fact that hardwoods were planted on sites and with techniques that were more appropriate for conifers. Also, most of the plantings were made in old fields that were particularly poor because the soils had been depleted of nutrients and organic matter, the areas often had a heavy sod cover, and these fields generally had high rodent populations.

We know now that only the best sites should be used for seeding or planting hardwoods, and that site preparation is absolutely essential; competition must be controlled until the seedlings are established. And the seedlings must be protected from animals.

We still have much to learn about planting and seeding of hardwoods. But we have learned how to avoid some of the problems on old fields, and we have achieved a pretty fair level of success in artificial regeneration of recently cut over forest lands. This paper summarizes the current state of our knowledge.

To Seed or To Plant

The decision to seed or to plant will depend on the individual circumstances involved. For a given area, seeding can be done more rapidly than planting *(Shirley 1937)*. This is important because more acres can be treated in the relatively short period in the spring when moisture conditions are best. Sowing may also result in seedlings with better root systems *(Chapman 1940)*; since the seedlings do not have to be lifted or planted, there is little danger of mechanical injury, as there is in planting *(Hirt 1959, Little et al. 1958)*. Root systems distorted by planting may be an important factor in poor survival and growth *(Hirt 1959, Rudolf 1939)* although the evidence is not conclusive *(Gruschow 1959, Wakely 1954)*.

Despite these advantages there are situations in which planting may be better. Well-developed seedlings with their greater size and vigor can more easily overcome the hazards encountered on certain sites. Thus planting might be the wiser choice on sites where the soils are subject to surface drying, on sites likely to erode, or on sites where herbaceous vegetation can be a serious competitor.

Let's look at the results of some birch seeding and planting trials and research conducted in northern New England and adjoining New York.

Seeding Birch

Trials of direct seeding birch on old fields have been limited in both extent and in degree of success. Nash et al. *(1951)* have reported on a series of direct seeding trials with paper and yellow birch in Maine. They found that removing the sod by bulldozing

and furrowing resulted in good germination on some plots. Fall sowing generally gave better results than spring sowing; germination of spring-sown seed sometimes was delayed until late in the growing season. Most of their trials resulted in high mortality due to severe drought conditions, mouse feeding, and grass competition.

Much better results have been obtained in direct-seeding birch in recently cutover areas. Horsley *(1968)*[1] found large numbers of paper birch seedlings after direct seeding in 50-foot wide east-west strip cuttings in New York.

He found that tractor scarification resulted in better survival and growth after 2 years than did spot scarification with hand tools. The spots frequently filled with leaves that apparently smothered some seedlings, acted as a barrier to root extension, and reduced the amount of light and moisture that reached the seedling. Reduced height growth in the spots was thought to be a result of nutrient deficiencies brought about by complete removal of the humus. Although tractor scarification stimulated the growth of herbaceous vegetation and increased competition losses, the overall result was better than with spot scarification.

Horsley also found that germination is reduced if the scarified seedbeds are allowed to dry before seed is sown in the spring. To insure best results, seeding should be done right after snowmelt, or immediately after scarification. The importance of moisture was also evident in the larger numbers of seedlings found in the shaded—as opposed to the sunny—portions of the strips.

An important point to be made is that it will generally be a waste of effort to attempt direct-seeding without first insuring that the basic requirements for light, moisture, temperature, and nutrients have been satisfied. Horsley did this by using narrow strip cuttings and seedbed preparation in all his study treatments.

There are many other examples of successful direct-seeding of birch in cutover areas. Numerous studies aimed at natural regeneration have employed the sowing of seed and have resulted in successful regeneration. The White Mountain National Forest and the Northeastern Station now have a large-scale study of strip cutting, scarification, and direct-seeding under way, and initial observations indicate that very good results are being obtained.

Although many improvements in technique, especially to reduce costs, are still needed, it appears that direct-seeding of birch on cutover forest land is possible today for those areas where natural regeneration is not expected to be adequate. However, direct seeding of birch in old fields is not recommended at this time.

Planting

Early planting trials with birch seedlings in old fields revealed that furrowing gave better results than other techniques to control the sod. Bulldozing, plowing, harrowing, burning, and herbicides all were less satisfactory *(Nutting 1953, 1957)*.

More recent experiments by the Northeastern Forest Experiment Station *(Bjorkbom 1968)* have substantiated the fact that survival and growth are better when the sod is removed than when it is left intact. Of the various site-preparation treatments used, planting on the second slice of a double furrow provided best 10-year survival (58 percent), as opposed to planting in furrow bottoms (44 percent), on scalps (37 percent), and in the sod (27 percent).

Best growth in our studies was also obtained from seedlings planted on the furrow slice—many of these were in the larger diameter and height classes (table 1). Trees in the other treatments did not do nearly as well, especially those in the sod. The largest trees now have diameters of about 3 inches and heights up to 24 feet.

Animals have caused much damage to seedlings planted in old fields. Almost all surviving trees have been damaged in one way or another by deer or mice. We tried repellents, but they proved ineffective in our studies because of the long intervals between applications and the high animal populations. The use of poisoned baits seemed to offer some promise against mice, at least in our small study plantings.

In addition to animal damage, seedling mortality in our studies could be attributed to frost heaving, poor site or soil conditions, poor

[1] Horsley, Stephen B. DIRECT SEEDING PAPER BIRCH (BETULA PAPYRIFERA) IN STRIP CLEARCUTTINGS. Univ. Mass. master's thesis. 116 pp., illus., 1968.

planting technique, and poor planting stock. Some of the seedlings were extremely small when planted, and probably should have been discarded. In general, larger seedlings have been found most likely to survive.

Apparently few attempts have been made to plant birch in recently cutover areas. One attempt that I know about involved a small number of paper birch seedlings planted in recently clearcut patches on the Bartlett Experimental Forest in New Hampshire. Although deer damage was severe during the first few years, some seedlings survived and grew very well. After 10 growing seasons, there are a fair number in the 2-inch diameter class, and a few in the 3-inch class. Heights range from 25 to 30 feet.

To date, we have not demonstrated that birch plantings can be made with any assurance of success, either on old fields or in recently cutover forests. This is not to say that all plantings have been failures. The isolated instances of high survival and good growth are indicative of what can be expected. And we have learned how to avoid some of the failures.

When old fields are to be planted, site conditions must be considered carefully. It is not safe to plant birches on these sites just because they may be growing in the adjoining forest. Cultivation has probably depleted the nutrients, has resulted in some topsoil and humus erosion, has compacted the surface, and has changed soil porosity, among other things *(Bedwell 1937, DenUyl 1951)*. Plantings should therefore be attempted only on those soils that appear to be better than average in terms of nutrients, moisture conditions, and physical properties.

Where soils seem to be suitable, planting of birch in old fields might be attempted on a limited basis. Site preparation is an absolute necessity. Until better techniques are developed, planting seedlings on the second slice of a double furrow will give the best results. Control of competing vegetation near the seedling is another requisite. Mulching around the seedlings might be one way to accomplish this for the critical first few years. The largest and best planting stock should be used; usually 2-0 stock is required. And animal populations should be determined and appropriate control measures should be employed. It will generally be useless to invest in planting unless all of the factors above are considered.

What of the Future?

As forest land management becomes more and more intensive, it seems almost certain that the need for artificial regeneration of birches and other hardwoods will increase. In anticipation of this need, we will have to learn a great deal more about both seeding and planting. More effective methods of site preparation will be needed — methods that expose the favorable mineral soil without exposing infertile soil horizons, methods that do not provide a runway for rodents as a furrow does, methods that provide effective and long-lasting control of sod and other competitive growth. Effective treatments for control of animal damage are a must. And techniques for evaluation of site suitability will also be required, to permit intelligent selection of sites to be planted and to guide us in the use of fertilizers or mulches needed to improve soil conditions.

There is also much room for improvement in seeding and planting techniques. For example, the possibilities of container planting need to be explored. And more information

Table 1.—*Percentage distribution of seedlings by diameter class, height class, and treatment after 10 growing seasons*

Treatment	Diameter class			Height		
	Less than 1-inch	1-inch	2-inch and larger	9.5 feet and less	9.6 - 14.5 feet	14.6 feet and larger
Furrow slice ..	26	47	27	37	43	20
Scalp	51	36	13	62	27	11
Furrow bottom.	53	39	8	60	40	0
Sod	68	32	0	78	22	0

is needed about seeding methods and rates, planting-stock grades, and spacing of planted seedlings. Economic evaluations are also needed.

All in all, many diverse problems remain to be solved. But with a well-reasoned approach to the development of new ideas and the refinement of old ones, practical methods for the successful artificial regeneration of birch stands can be found.

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