BIRCH SPECIES SURVIVE WELL ON PROBLEM COAL MINE SPOILS

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ABSTRACT

Seven species of birches from 10 seed sources were evaluated for survival and growth rates on coal mine spoils in Pennsylvania. The seedlings were planted on eight very acidic strip-mine spoil areas, pH 3.0 to 3.8, one acidic strip-mine area, pH 3.3. After 3 years, survival was rated satisfactory to good on all the spoil areas. Birches from three sources did not survive satisfactorily on the deep-mine refuse. Height evaluations were biased by damage caused by browsing deer. Nevertheless, a few seedlings attained heights of 200 cm or more. Paper birch from a northeastern seed source is recommended for reclamation plantings in Pennsylvania.

INTRODUCTION

Unvegetated spoils are a relic of mining practices common before the enactment of strict reclamation legislation. Many acres of these problem or orphan spoils are still in evidence, barren and unsightly. A variety of tree species have been planted on most of these areas, but survival rates were too low to provide effective cover.

Several conditions may contribute to the difficulty in establishing vegetation on such sites. These include extreme acidity, usually pH 4.0 or lower; toxic levels of chemical elements; deficiencies of essential elements; extreme soil-surface temperatures; or lack of enough soil-si7ed particles (c2 mm) to support plant life. The most common condition is extreme acidity.

Gray birch, Betula populifolia, (Cornwell and Stone 1973) and sweet birch, B. lenta, (Schramm 1966) often become established naturally on low-pH spoils if a seed source is nearby. The success of European white birch, B. pendula in reclamation plantings suggested that other species of the genus Betula might be adaptable to growth on problem spoils. Therefore, we planted several species of birch to determine which would survive and grow on very acidic spoils.

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THE STUDY

In the spring of 1972, we planted 7 species of birch from 10 seed sources (table 1). The seedlings were grown in the Pennsylvania Bureau of Forestry nursery at Mont Alto. They were outplanted as 2-0 stock.

The number of seedlings from each seed source varied from 50 to 500. With the exception of B. nigra, the seedlings were divided equally among 10 planting sites, i.e., 10 seedlings per seed source for each site. The 50 B. nigra seedlings available were divided so that 4 sites received 10 seedlings each and 2 sites received 5 seedlings each. Species and seed sources are shown in table 1.

Ten sites in the bituminous region of Pennsylvania were selected for this study. Included were eight sites used in a previous problem-spoil study, a less acid stripped area, and a deep-mine coal-breaker refuse pile. The pH values of the eight problem sites ranged from 3.0 to 3.8, that of the less acid spoil was 4.0, and of the deep-mine refuse, 3.3.

Each site had two blocks, each with 9 or 10 rows. The seedlings were planted by hand in randomly selected rows with 2 feet between seedlings and 6 feet between rows. The experimental design is a complete randomized block with 20 replicates on 10 sites.

RESULTS

After one growing season, overall survival of the birches was 89 percent. Survival ranged from 84 percent for the paper birch from Alaska to 96 percent for European white birch (seed lot 4315). Survival of seedlings averaged 91 percent on the problem spoil sites, 95 percent on the pH 4.0 spoil, and 72 percent on the deep-mine refuse.

Height and survival measured after three growing seasons showed that overall survival of the birches was 68 percent. Survival was 66 percent on the problem spoil sites, 93 percent on the pH 4,0 spoil, and 61 percent on the deep-mine refuse (table 2).

Damage caused by browsing deer was observed on all sites except the deep-mine refuse. Browsing undoubtedly caused some mortality and reduced the growth in height. Yellow and sweet birches seem to have been browsed more heavily than the other species in the test.

Analysis of variance showed significant differences in survival between birches from different sources. Gray birch, European white birch, and paper birch (N. H.) had significantly higher survival rates than did blue, yellow, or sweet birch according to Duncan's test (table 3).

Despite browsing by deer, a few seedlings attained heights of 200 cm or more after three seasons. All sources except the N. H. yellow birch and the river birch had at least one replicate with an average height of more than 100 cm. Yellow birch from both seed sources had the lowest average height.

Seed was observed on at least one seedling of European white birch (seed lot 4316) at the end of the third growing season on 9 of the 10 sites, Only one other species, gray birch, produced seed, and that was on the pH 4.0 site.

DISCUSSION

Birches from all sources in this study appear to be suitable for planting on problem spoils and moderately acidic sites. Best survival and growth occurred on the pH 4.0 spoil. On problem spoils, survival was lower and growth in height was less, but both were satisfactory. However, trees from three sources (N. H. yellow birch, blue birch, and Alaska paper birch) planted on the deep-mine refuse had survival rates too low to be considered satisfactory. River birch had not been planted on this site.

Potential damage by deer must be considered if birch plantings are planned. Where deer are plentiful, it may be best not to plant yellow or sweet birch. In areas of low deer density, seedlings should grow out of reach of the deer within 3 or 4 years.

No problems with insects or disease were noted for any trees during this study. However, these factors should be considered before establishing birch plantings. Bron-e birch borer is a serious insect enemy of European white birch and of gray birch (Ko-el and Toth 1975). It also prefers sweet birch growing on poor sites (Collingwood and Brush 1974); river birch, yellow birch, and paper birch are much less susceptible to attack (Ko'el and Toth 1975). Leaf miners prefer gray birch, but are not considered a serious pest of paper birch (Ko-e1 and Toth 1975).

Dieback, a limiting factor for European white birch, also occurs in paper birch grown south of its natural range (Collingwood and Brush 1974). The bronze birch borer is often associated with dieback in paper birch (Hyvarinen 1968).

The data of this study suggest that paper birch from a northeastern seed source is the best choice of birch species for reclamation planting in Pennsylvania. It survived well, had satisfactory growth, and is resistant to many insect and disease problems.

LITERATURE CITED

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Table 1. -- Species and seed sources of birches used in study

Species		Source
European white birch	Betula pubescens Ehrh.	Belgium (4315-5-67) Belgium (4316-5-67)
Yellow birch	B. alleghaniensis Britt	Michigan; New Hampshire
Paper birch	B. papyrifera Marsh.	Alaska; New Hampshire
Sweet birch	B. lenta L.	Vermont
River birch	B. nigra L.	Maryland
Gray birch	B. populifolia Marsh.	Tamaqua, Pennsylvania
Blue birch	B. coerulia grandis Blanch.	Vermont

Table 2. -- Third-year survival of birches on various spoil types

Species	Source	Problem spoils (8 sites)		pH 4,0 spoil (1 site)		Deep-mine refuse (1 site)		Total of all sites	
		Planted	Mean survival	Planted	Survived	Planted	Survived	Planted	Mean Survival
		No.		No.		No.		No.	
European white birch	Belgium (4315-5-67)	160	71	20	95	20	80	200	74
European white birch	Belgium (4316-5-67	160	77	20	95	20	90	200	80
Yellow birch	Michigan	80	50	10	90	10	70	100	56
Yellow birch	New Hampshire	400	50	50	96	50	44	500	54
Paper birch	Alaska	320	75	40	85	40	25	400	71
Paper birch	New Hampshire	400	58	50	98	50	74	500	74
Sweet birch	Vermont	400	49	50	96	50	50	500	54
River birch	Marylan		67	10	90	--		50	74
Gray birch	Pennsylvania	400	83	50	82	50	76	500	82
Blue birch	Vermont	240	70	30	100	30	37	300	70
	Totals	2600	66	330	93	320	61	3250	68

a/ Planted on only five sites because supply of seedlings was insufficient.

Table 3. -- Third-year survival comparisons

Species (sources)	Mean survival rate a/
Gray birch	81.80
European white birch (4316)	80.00
Paper birch (N.H.)	74.40
European white birch (4315)	74.00
Paper birch (Alaska)	70.75
Blue birch	70.35
Yellow birch (Mich.)	56.00
Sweet birch	54.50
Yellow birch (N H)	53.80

a/ Differences between means within each bracket are not statistically significant at pc.05 by Duncan s new multiple range test.