PLANTING BLACK SPRUCE ON BRUSHY LOWLAND SUCCESSFUL IF DONE IN UNSHADED SPHAGNUM

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Reforesting brushy lowland by planting black spruce *(Picea mariana* (Mill.) B. S. P.) has had little success in the Lake States despite many attempts during the past 2 decades. Yet reforestation of the 3 1/2 million acres of brushy lowland in this region is desired and should be possible, because much of it was previously occupied by black spruce. A black spruce planting study by Roe (1960) on 2 areas of brushy lowland in north-central Minnesota showed poor survival and growth, attributed to planting methods and browsing by snowshoe hares. As a result, Roe recommended using transplants rather than seedlings, avoiding low planting spots, and protecting against browsing. A new study, implementing these recommendations, was established in 1963 to evaluate the effect of competing vegetation and condition of ground surface on survival and growth of planted black spruce. After 2 years, spruce survival was good only on living sphagnum moss, and growth was greater on open than on shaded plots.

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Procedure

The study area is in a large lowland about 30 miles south of the Canadian border near Big Falls in Koochiching County, Minn. The study was made where a well-stocked stand of black spruce was clear cut in 1954. When this study began 9 years later, the vegetation was primarily dense clumps of speckled alder *(Alnus rugosa* (Du Roi) Spreng.) interspersed with patches of grass and sedge. The ground surface was a mosaic of dead leaf litter and living sphagnum moss, the two surface types most characteristic of brushy lowland (fig. 1). The depth of organic soil varied from 40 to 140 cm.

Black spruce transplants (2-2 stock) of uniform size and quality were planted on patches of shrub leaf litter and on patches of sphagnum moss in late May (fig. 2). Six transplants were planted on each of 24 milacre plots of shrub leaf litter and on each of 24 milacre plots of sphagnum moss. The milacre plots were treated in the following ways prior to planting: (1) One-fourth were compacted, (2) one-fourth were scalped, (3) one-fourth were burned, and (4) one-fourth were left undisturbed. Despite the high

Figure 1.—Typical mosaic of shrub leaf litter (center and upper left) and living sphagnum moss (upper right and lower left) occupying ground surface in the study area.

water table, an attempt was made to spread the roots above saturated material and thereby avoid the detrimental effect of planting spruce too deeply in organic soil (Roe 1960, Zehetmayr 1954). Half the plots of each surface type were kept unshaded by frequently clipping the vegetation, while the other half were left shaded by the vegetative growth. All plots were fenced to protect the transplants against browsing by hares and white-tailed deer.

Results

Black spruce transplants had good survival at the end of 2 years only where they were planted in living sphagnum. The only plots having this condition were undisturbed and compacted sphagnum, where results were similar. In contrast, survival was generally poor on plots of leaf litter and on plots of

Figure 2.—Planting black spruce in patch of living sphagnum moss on plot with all vegetation clipped. Note dense stand of tall shrubs (mainly speckled alder) and stump in background.

scalped or burned sphagnum. Survival averaged 96 percent on living sphagnum, compared with 62 percent on plots lacking living sphagnum. The difference was even greater for trees considered established, averaging 75 percent on living sphagnum but only 18 percent without it. Most trees not planted in living sphagnum had chlorotic foilage, short leaders, and dying root systems by the end of 2 years.

Good survival seemed to depend on the development of adventitious roots above the nursery root collar. When the trees were lifted for growth measurement, it was obvious that the more vigorous ones had many adventitious roots. Maximum root length per tree for trees planted in living sphagnum moss averaged 69 cm. compared with 48 cm. for trees planted in other material.

Root length and tree weight were greater on open than on shaded plots at the end of 2 years. Maximum root length averaged 60 cm. on open plots and 47 cm. on shaded plots. Trees averaged 66 g. (ovendry weight) on open plots compared with 42 g. on shaded plots.

Discussion

Planting black spruce in living sphagnum was successful presumably because the moist moss surrounding the lower stem produced conditions favoring the development of adventitious roots. These roots were shallow and followed the microrelief of the ground surface. It was practically impossible, however, to plant the nursery root system this close to the surface and keep the trees firmly upright. Thus, the study indicated that establishment of black spruce transplants requires the development of an adventitious root system. Studies of spruce planting in organic soil in Great Britain have shown similar results (Laing 1932, Steven 1954).

Data from this study also indicated that good growth of planted black spruce requires keeping shade-producing vegetation at a low density. Herbicide spraying is probably the most practical way to kill back this vegetation before planting and when necessary after planting.

Therefore, reforesting brushy lowland with black spruce transplants should be successful if competing vegetation is killed back and if trees are carefully planted in patches of living sphagnum moss. This may result in somewhat irregular spacing, but it should be acceptable because sphagnum usually occurs in well distributed patches on brushy lowland.

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