Results of Research in Northern Hardwood Silviculture at Dudswell

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Abstract

The stand improvement and regeneration treatments carried out by the Department of Fisheries and the Environment of Canada at Dudswell Experimental Forest in cooperation with Domtar Ltd. are producing results after 15 years of observations. These are directly applicable to management for timber, recreation, wildlife, and water in Quebec hardwood stands dominated by sugar maple, beech, yellow birch, or red maple. Research results indicate marked advantages, in stands of good quality hardwoods, of thinning taking 30 to 40% of the total volume and of group or strip selection cutting, and, in stands of poor quality hardwoods, of strip clear cutting. Site preparation and artificial regeneration are not required to obtain a stand of a quality at least equal to that of the original stand.

Résumé

Fournissant maintenant des données de 15 ans, les traitements de peuplement et de régénération faits par le ministère des Pêches et de l'Environnement du Canada à la Forêt Expérimentale de Dudswell en coopération avec Domtar Ltée produisent des résultats directement applicables à l'aménagement pour le bois, la récréation, la faune et l'eau des peuplements québécois à dominance d'érable à sucre, hêtre, bouleau jaune ou érable rouge. Les résultats de recherche indiquent des avantages marqués à employer, dans les peuplements de feuillus de bonne qualité, l'éclaircie en enlevant de 30 à 40% du volume total et le jardinage par groupes ou par bandes et, dans les peuplements de feuillus de mauvaise qualité, la coupe à blanc par bandes. La préparation de site et la régénération artificielle ne sont alors pas nécessaires pour obtenir un peuplement de qualité au moins égale à celle du peuplement original.

Introduction

The time has come when we can no longer be content with merely providing the hardwood veneer and saw logs needed by our forest industries at the lowest cost. We must also insure this wood supply on a sustained yield basis by using appropriate stand and regeneration treatments. We need to understand the impact of various stand treatments on forest resource values and to apply our forestry skills accordingly.

Initial efforts concentrated on the effects of stand and regeneration treatments on yellow birch in the major forest types in the Eastern Townships region. This research was conducted by the Laurentian Forest Research Centre and the Forestry Faculty of Laval University at the Dudswell Experimental Forest. We received excellent cooperation from Domtar Ltd., from Quebec's forest industry, from many logging contractors, and from provincial and federal agencies.

These cooperative efforts have permitted the study and dissemination of information on many aspects of stand and regeneration treatments carried out at Dudswell in a systematic way (Lavallée 1968, Lavallée and Lortie 1968, Hubert and Gonzalez 1970, Lavallée and Bard 1971, Gonzalez and Hubert 1972, Gonzalez 1974, Lachance 1974, Popovich 1974, Fortin et al. 1975, Roberge 1975a and b, Fournier et al. 1977, Roberge 1977). Information is also available concerning recreation, wildlife, and water. This paper summarizes the highlights of what was learned about northern hardwood silviculture at Dudswell and what could be applied by the Quebec forest industry.

Forest Description

The Dudswell Experimental Forest consists of a 700-ha drainage basin within Dudswell Township in Quebec's Eastern Townships region, at longitude 71°42' west and latitude 45°38' north in Domtar's freehold near Windsor Mills. The elevation is about 300 m and the mean frost-free period is 134 days. During this period, the mean precipitation is 33 cm and the mean temperature 17°C.

Eight forest types have been identified. Two are hardwood types dominated by sugar maple and have good soil drainage with fresh moisture regimes; one occurs on hill tops and upper slopes and the second on middle slopes. Two are hardwood-softwood types dominated by yellow birch and located on lower slopes with good drainage; in one the soil is fresh and, in the second, moist. Two are softwood-hardwood types dominated by red maple and located on lower slopes where the soil is moist; in one the drainage is good and, in the other, poor. Two are softwood types dominated by balsam fir where drainage is poor and the soil moisture regime is wet; one occurs on flats and the other in depressions.

The stands on 580 ha are uneven-aged and have been selectively cut in the past; they are classified as "mature", "young", or "regenerating" according to standing total volume and rate of growth. The stands on the other 120 ha are even-aged and of fire origin; they are 70 years old. Trembling aspen was cut 20 years ago for pulp.

Stands of good and of poor quality hardwoods have also been identified. If the stands of good quality hardwoods were cut according to present Quebec diameter limit rules, between 30 and 70% of the total volume would be removed.

Stand and Regeneration Treatments

From 1962 until the spring of 1977 yearly experimental cuttings of about 1500 m³ of pulp wood and 150 m³ of veneer- and saw-logs have been carried out in the forest types and stand conditions occurring at Dudswell. The cutting has al-

ways been done by the same crew of two men supplied by Domtar Ltd. and paid at the same rates paid in other operations in the region. Trees were felled and limbed with a power saw. Tree-length logs were skidded to a roadside landing with horses and J-5 tractors.

Stand treatments consisted of a) thinnings at intensities ranging from 20 to 70%, b) thinning and fertilization with urea at 100 and 200 kg/ha of nitrogen, c) 0.08-ha group selection cuttings, d) strip selection cuttings in strips 30, 60, 120, and 240 m wide, e) strip clearcutting in strips 30 m wide, and f) clearcuttings in rectangular patches of 5, 8, and 15 ha.

Regeneration treatments consisted of a) seeding of yellow birch, b) soil scarification, c) soil scarification and seeding of yellow birch, d) planting of yellow birch of different ages, e) planting of Norway spruce, red spruce, red pine, European larch, and red oak.

Results

Thinnings

Thinnings aimed at harvesting first the mature crop trees and second, immature trees, to release better stems and intensities ranged between 20 and 70% of the original volume. In the first 10 years following thinning the average volume growth was 34 m³/ha, ranging between 1 m³/ha and 54 m³/ha. Poor volume growth was characteristic of the 70% thinning intensity in softwood-hardwood and softwood types and of mature and regenerating uneven-aged stands of poor quality hardwoods. Excellent volume growth was characteristic of 30 to 50% thinning intensities in young, even-aged hardwood stands of good quality hardwoods.

Without thinning, the average volume growth was 29 m³/ha, ranging between 2 m³/ha and 48 m³/ha. Poor volume growth was characteristic of mature and regenerating uneven-aged stands of poor quality hardwoods. Excellent volume growth was characteristic of young, even-aged and uneven-aged stands of good quality hardwoods.

Diameter was 40% greater in thinned than in unthinned stands and occurred on better quality trees. It is possible that more veneer and saw log material will be produced at an earlier age following thinning than without thinning. Moreover, much veneer and saw log material that would have been lost to suppression and overmaturity was harvested.

Thinning and Fertilizing

In the first five years following the application of urea to a young even-aged stand of good quality hardwoods volume growth increased by 11 m³/ha in the thinned plots but was unchanged in the unthinned plots.

Group Selection Cuttings

Five years after creating 0.08-ha openings in uneven-aged hardwood, hardwood-softwood, and softwood-hardwood stands, the sapling stratum

in the openings contained 1500 stems/ha with an average dbh of 4 cm. Ten years after cutting there were 1000 stems/ha with a 7-cm average dbh. Percentage composition of sugar maple, yellow birch, beech, balsam fir, and red spruce was somewhat lower than in the original stand, whereas the percentage composition of red maple, mountain maple, striped maple, and pin cherry was somewhat higher. There were few stump sprouts.

Strip Selection Cuttings

In this treatment bands occupy 20% of the stand area were cut to a 9-cm dbh limit at intervals of 20 years. Compared with the clearcut openings the clearcut strips 60 m, or less, wide contained slightly more stems per hectare with a slightly lower average diameter. The percentage composition of sugar maple, yellow birch, beech, balsam fir, and red spruce was slightly lower than that of the original stand. The percentage composition of red maple, mountain maple, striped maple, and pin cherry was slightly higher and there was some increase in stump sprouts. When the clearcut strips were 120 m, or more, wide the results were essentially the same as those observed in the clearcut patches.

Strip Clearcutting

In strip clearcutting, bands 30 m wide occupying one third of the stand area were cut at intervals of five years. The results after five years in the first band were essentially the same as those observed in the 30 m-wide clearcut strips of the strip selection cuttings. The results in the other bands are not yet available.

Clearcuttings in Patches

There was little difference among patches of 5, 8, or 15 ha. The quantity, quality, and rate of growth of the regeneration was poor to excellent depending on the development of the advance growth at the time of cutting. Where advance growth was well-developed there was abundant regeneration with good growth, but with a species composition shift towards more sugar maple, beech, balsam fir, red spruce, and eastern hemlock than in the original stand. In hardwood stands where advance growth was poorly developed there was abundant regeneration with poor growth often subject to excessive competition from pin cherry, striped maple, and stump sprouts and a species composition shift towards yellow birch, white ash, basswood, trembling aspen, and red maple. In hardwood-softwood and softwood-hardwood stands species composition shifted towards yellow birch and red maple with excessive competition from mountain maple, pin cherry, striped maple and stump sprouts. The softwood stands had not regenerated five years after clearcutting.

Regeneration Treatments

Establishment of yellow birch was increased by artificial seeding, scarification with or without artificial seeding, and planting. The effectiveness

of these treatments decreased from fresh to wet soils and from large to small clearcut areas.

Development of yellow birch was increased by scarification and planting. It decreased from fresh to wet soils and from small to large clearcut areas. Maximum survival of yellow birch was obtained by planting on moist soils in small clearcut areas.

Development and survival of Norway spruce, red spruce, red pine, European larch, and red oak was poor due to competition from natural regeneration and the response of these planted trees was similar to that of yellow birch.

Conclusion

Veneer and saw timber is an important component of the hardwood forest region in Quebec. It is desirable: 1) to harvest the veneer and saw timber that would otherwise be lost to over-maturity and suppression; 2) to maintain, or even increase, the quality and the rate of growth of veneer and saw timber approaching maturity in mature and young stands of good quality hardwoods; 3) to liberate good quality hardwoods in regenerating stands from poor quality residual trees; this would require removal of large non-merchantable stems; 4) to establish a regeneration of good quality hardwoods in mature, young, and regenerating stands of poor quality hardwoods, and to ensure the development and survival of this regeneration. Research results at Dudswell indicate that objectives 1 and 2 can be satisfactorily achieved by thinning and that 4 can be achieved by clearcutting by groups or strips. These treatments would have negligible adverse effects on water and soil and important beneficial effects on wildlife and recreation. As elsewhere, the lack of markets for poor-quality hardwoods is a major silvicultural constraint.

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