REFORESTATION RESEARCH IN THE PRAIRIES: AN OVERVIEW

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INTRODUCTION

As the title suggests, my assigned task this morning is to talk to you about reforestation research activities in the three prairie provinces--Alberta, Saskatchewan, and Manitoba. Owing to the diverse backgrounds and the wide geographical distribution of the members of the Intermountain Nurserymen's Association, I thought it appropriate to spend a few minutes at the outset of this presentation to familiarize you with the region and to briefly outline the role of the Canadian Forestry Service as a research agency. Such an overview will, I hope, make it easier for you to relate to my comments about reforestation research.

The Canadian Forestry Service (CFS) is an element of Environment Canada. The Northern Forest Reserch Centre (NoFRC) is one of six regional establishments and two national institutes responsible for fulfilling the federal role in forestry research, development, and technology transfer. Today, the NoFRC serves a vast area lying north of the US border between the Rocky Mountains in the west and the province of Ontario in the east, totalling 3 120 000 km^2 (1 200 000 sq. mi.) of land area in the three prairie provinces and the Mackenzie District of the Northwest Territories. About one-third of this land mass, or 1 040 000 km^2 (400 000 sq. mi.) is classified as being forested, roughly equivalent to the combined areas of the states of Montana, Idaho, Utah, and Wyoming.

The NoFRC maintains work programs in Forest Resources Research, Environmental Forestry Research, and Forestry Extension and has an Administrative Services Unit, for a total of 117 person-years. In the Forest Resources Research Program, projects include Silvicultural Prescriptions, Tree Improvement, Fire Management Systems, Resource Policy Guidelines (Resource Economics), Forest Resource Data, Yields of Managed Stands, Forest Resource Management Options, and Computer Applications. Projects in the Environmental Forestry Research Program are Forest Hydrology, Long-Range Transport of Air Pollutants, Remote Sensing, Toxic Substances, Climatic Studies, Biophysical Classification of National Parks, Scientific and Technical Information, and Environmental Impact Assessments. Forestry Extension activities include the Forest Insect and Disease Survey, Insect and Disease Management Systems research, and various laboratory services. Major clients include provincial forest services and environment departments, commercial tree nurseries, lumber companies, pulp and paper firms, national and provincial parks, and other federal government departments.

REFORESTATION RESEARCH

Management of forest lands on a sustained yield basis is accepted as a desirable objective by all provincial resource management agencies. Failure to regenerate forest lands after harvest or wildfire in the past has resulted in reforestation shortfalls, particularly in the mixedwood forest region. Happily, the problem has been recognized and regeneration programs are increasing rapidly. New forestry leases and

agreements, such as the Forest Management Agreements *(FMAs)* in Alberta, contain stringent reforestation requirements. Similarly, the establishment of additional forest tree nurseries in recent years has resulted in a substantial increase in the production of containerized seedlings. In the area of reforestation research, the primary objective of the *CFS is* to provide forest management agencies with guidelines and prescriptions for prompt regeneration and growth of major commercial species and/or cover types. The actual work may range from basic to operational, according to needs of client agencies and the nature of reforestation activities in various parts of the region. I consider the following to be highlights of our reforestation research and technology transfer program in the prairies.

Nursery Operations

Liaison with and service to both government and industrial nurseries across the region are provided by this study. During the 5-year period ending in 1980, the rapid expansion of nursery and greenhouse facilities has resulted in a three-fold increase in seedling production to over 50 million, with the result that the work is particularly relevant and in high demand in support of both bare-root and container production facilities. Regional nurseries are surveyed for problem identification and assessment, and recommendations are made to improve facilities and production schedules.

There is evidence that outplanting mortality is related to both cultural and pathological problems in the nursery system. The handling of seedlings, disease and weed control, improvements in cultural operations, and development of new techniques for seedbed treatments are therefore likely to contribute substantially to improved nursery practices. New work is under way to determine seedbed density effects and to develop a method for mechanical thinning of seedbeds.

Nursery Soil Fertility and Seedling Growth

This study is concerned with the growing of bare-root and containerized coniferous stock under different fertilizer regimes and cultural practices to optimize production. Recent studies have dealt with seedling nutrition and soil amendments regarding the use of N, P, K, S, and peat. Recommendations have enabled nursery managers to use fertilizers more effectively and to improve stock quality. A manual entitled "Guidelines for Rearing Containerized Conifer Seedlings in the Prairie Provinces" has been published and is in widespread use throughout the region.

Current work stresses research and advice on production factors such as the growing medium and the use of water and fertilizers in both bare-root and container stock. Special emphasis is being placed on the maintenance of seedling quality throughout the production cycle. Since regional nurseries have recently expanded their operations, research and advisory services pertaining to soil fertility and tree nutrition have been stepped up accordingly.

Storage of Winterized Containerized Conifer Seedlings

Containerized seedlings are reared throughout the year; those reared in spring and summer, but not planted in the year of production, need to be stored over winter. This study addresses problems of preconditioning and storage of stock to reduce winter damage, a problem of particular importance in pine.

Any program to increase the availability of seedlings for reforestation should provide 1) flexibility and safe storage of seedlings, 2) ease of handling of containerized seedlings, 3) an increased capacity for seedling production, and 4) protection against frost injury and dessication. Recent and ongoing research work includes the assessment of growth characteristics and mortality before and after outplanting and overwintering of pine and spruce seedlings in field demonstration plots. A new experimental seedling storage facility has been constructed and tested and has been found to be effective in reducing temperature fluctuations. A manuscript outlining guidelines for overwintering container stock is being prepared and will include a section on the detection of frost damage in coniferous seedlings.

Development of Silvicultural Prescriptions

The need for site-specific prescriptions to improve success of reforestation and to maintain the long-term productivity of forest sites in the region is assessed in this study. We have concluded that a good deal of information needed to upgrade silvicultural practices in the region is already available but must be packaged in a form to be of optimal use in support of forest management decision-making. Efforts are under way to establish a silvicultural data bank, including the development of criteria for judging utility and reliability of research and operational data and for aggregating stock performance data. In a related development, the NoFRC has assumed responsibility for the establishment, maintenance, and updating of a data bank on site preparation, regeneration, prescribed burning, and stock performance for all regions of Canada. This data is being assembled with the assistance of provincial forestry agencies and will become an integral part of the national Forest Resource Data Program.

At present, a silviculturalist, a site productivity specialist, and a physiologist are assigned to the silvicultural prescriptions project, the latter two at an early development stage of research work. The site specialist will be concentrating on forest site relationships, initially using biogeoclimatic data as one aspect of field study. The physiologist will probably concentrate on seedling conditioning and field performance, with emphasis on roots.

Field Performance of Planted Stock

This study is aimed at documenting the growth rates and survival of forest plantations throughout the region, providing background information for reforestation prescriptions. The work involves cooperative research trials with provincial agencies and pulp and paper companies as well as in-house research.

Research plantations of bare-root stock were established in this region as early as the 1920s and continued into the 1950s by the CFS and its predecessors. The oldest are located in Manitoba and Saskatchewan, and several are still intact. By the early 1960s emphasis was directed to container planting, and several research and trial plantations were and continue to be established. Performance data are available for a number of container types with various rearing regimes for periods up to 20 years.

While these older plantations are most useful for determining performance on a variety of sites for a number of coniferous species, both native and exotic, there are problems associated with stand dynamics that still require research. The impact of losses due to insects, diseases, animals, and climate has not been fully documented. In some cases ingress occurs after reforestation. These factors must be considered when

determining initial spacing and juvenile thinning regimes. Studies to document these losses have been initiated in Alberta and Manitoba.

Performance data are necessary as input to intensive forest management simulation models currently being developed. Although existing research plantations will be helpful, there is a need for the establishment of many more plots or trials to provide a data bank of performance information, including all usable CFS research plots, which will permit accurate determination of future yields on forest lands. Subsequently, a new study has been initiated to assess tree mortality attributable to insect and disease attacks from time of plantation establishment until crown closure at age 25 to 35 years. An estimate of this mortality will be obtained by establishing plots in a number of stands of different age classes and on a variety of sites. The intent is to prepare composite survival curves for each site to gauge pest damage in plantations and to determine the feasibility of obtaining quantitative estimates of these effects on tree mortality and growth loss.

A new study is also under way to determine the amount and quality of seed available, particularly for white spruce. Seed production and quality are known to fluctuate markedly from year to year. In years when the cone crop is light, insect and disease damage is often severe and results in over 90% seed destruction. The study involves the collection of cone samples from seed producing agencies in the prairie provinces, cone dissection, and the identification of insect pests causing the damage. This information will help us to assess the severity of the problem and to devise remedies before forest managers demand immediate answers in support of intensive management.

Control of Pests and Vegetation in Managed Stands

The development and assessment of the use and effectiveness of herbicides and pesticides as forest management tools are being investigated. From 1972 to 1979, efficacy tests were conducted with numerous insecticides, and sufficient data have been submitted for the registration review of 22 chemical products for the control of 33 insect pests attacking 22 species of trees and shrubs.

The release of conifers from brush, weed, and grass competition is a serious concern in the prairie provinces, especially in the mixedwood region. We have recently initiated, in cooperation with the Alberta Forest Service (AFS), small-scale field trials to evaluate the effects of selected herbicides on competing vegetation. Preliminary assessments have been made at all test plots established in 1980 and 1981 to monitor results of conifer release, site preparation, and artificial (chemical) thinning following different application dosages, formulations, and techniques. Various formulations of Velpar have given generally good to excellent control of unwanted vegetation on conifer release sites. Hyvar shows potential for chemical thinning of dense pine stands. Foresters consider herbicides to be a very promising tool, but care must be exercised to ensure that adverse environmental impacts and public health hazards are at acceptable levels.

Tree Improvement

This project includes a) plantation performance experiments on genetic variation within forest species among populations of varying origins (provenance experiments initiated from 1955 to 1972) and b) a breeding program initiated in 1967, intended to increase productivity of jack pine plantations by means of genetic improvement. About 90-95% of project resources are expended on the jack pine breeding program.

Progress on the breeding program has included selection of parent trees; establishment of twelve replicated family-test plantations; establishment of two preliminary clone banks, a permanent clone bank, and a seedling seed orchard; selection of about 50 parent clones top-ranked for fifth-year progeny height in the family tests, production of seed orchard grafts of the selected clones for use by client agencies; and selection thinning of the seedling seed orchard. Preliminary results indicate a 12% gain in height growth attributable to genetic selection. A comprehensive report on the program is being prepared.

Activities in the next **3** years will include measurement of family-test plantations at 10 years from planting; controlled pollination followed by seedling clone production, as well as grafting; using selected parent and progeny clone bank grafts, and analysis of family test data to refine breeding tactics and strategies in order to maximize genetic gain.

Yields of Managed Stands

With increasing forest harvesting in the region, the need is increasing for reliable information on growth and yield of stands under a variety of conditions. We continue to collect such data from growth-plot remeasurements and to analyze and publish the information as yield tables or models. Yield tables for the most important commercial forest types in the region have been developed. Work is now in progress to develop, or adapt, computerized growth simulation models for our stands, to be used for growth and yield predictions in updating forest inventories as well as for predicting the outcome of various silvicultural treatments.

At present, two stand treatments are of particular interest to us for improving merchantable yield: a) thinning, b) fertilization. Studies are in progress to obtain information on growth response to different treatment levels in lodgepole pine, jack pine, and aspen. A major part of the effort is concentrated on lodgepole pine, a commercially important species that often regenerates in over-dense stands. In such stands, tree growth is reduced and early thinning offers an opportunity to as much as double merchantable yield at harvest. We are monitoring growth response after both selective and nonselective (mechanical-strip) thinning of different intensities, the latter being a low-cost approach.

As in agriculture, mineral fertilization in forestry can play an important role in improving crop yields. We are conducting studies in lodgepole pine to give us some answers as to what age, site, and nutrient combinations would give optimal response and final yield.

With ever-larger areas of forests being harvested each year in the region, the level of initial stocking of regeneration and the spacing distance in plantations assume great importance in terms of both establishment costs as well as consequent growth and yield of the new stands; therefore, standards for regeneration have been developed. NoFRC scientists are involved in a cooperative study with the AFS to gain better insight into the dynamics of ingress and regeneration development under different conditions to enable us to refine stocking standards. Studies are continuing into stand development at different initial spacings--for lodgepole pine in Alberta and jack pine, red pine, and white spruce in Manitoba.

In addition to these ongoing programs in growth and yield, some pressing problems arise from time to time that require immediate attention. For instance, just

now we are involved in a study, requested by the AFS, to assess tree growth response to openings in the forest for pipelines and seismic lines. We want to find out the overall effect of such openings on growth and yield per total area--including the opening.

Coordination and Future Direction of Reforestation Research

Silviculture research conducted by the provinces is operationally oriented. Field performance studies are done for all nursery stock shipped out in one of the provinces. Intermediate stand treatment research is being maintained and expanded, particularly in the area of juvenile spacing of pine. The Alberta Forest Service supports contract research through the Forest Development Research Trust Fund.

A regional Reforestation Technical Committee provides communication and coordination between federal and provincial silviculturalists in matters of research needs and priorities and development of operational reforestation programs.

Increased emphasis on reforestation research in the prairies is seen as a high priority area. The current emphasis on regeneration, covering stock production through to field performance of new plantations, involves about 15 scientists and support staff at the NoFRC. Should new resources become available in the near future, new or expanded initiatives will probably include studies of forest ecology relationships (including aspen and peatlands), mixedwood silviculture, use of herbicides in forest management, development of reforestation prescriptions and growth and yield models for managed stands, and possibly shelterbelt management. Implementation of any new programs will be carried out within federal-provincial forest research agreements now being developed with Alberta and, we hope, with Saskatchewan and Manitoba in the near future.