Update on soil rehabilitation research in the southern Interior

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INTRODUCTION

Efforts to restore productivity to degraded soils have accelerated since the implementation of the Forest Practices Code, and because of investments made by Forest Renewal BC. Soil rehabilitation can be included as a strategy to maintain or enhance timber supply in the working forest. Restoring productivity to degraded soils can also enhance other environmental values.

Several research projects are under way in the southern Interior to keep pace with the demand for information on the effectiveness of common rehabilitation techniques, and to test approaches that may reduce the cost of such work. Here we summarize current results from a number of research projects that have been implemented recently in the southern Interior.

MATERIALS AND METHODS

We developed research summaries for seven research projects funded by Forest Renewal BC to provide recent results and interim recommendations. These projects pursued diverse approaches to research, including retrospective study, designed field and laboratory experiments, operational trials, and adaptive management monitoring. The characteristics of the approaches were compared and contrasted, especially the role each plays in developing an integrated research program to provide new and relevant information to rehabilitation practitioners. The results were then integrated into a statement of several principles to guide soil rehabilitation projects. Finally, contact information for each project was summarized so interested people can obtain more information.

RESULTS AND DISCUSSION

Retrospective Studies: Landings Rehabilitated by Winged Subsoiler

A research project was recently completed that evaluated the effectiveness of previous soil rehabilitation projects on landings in three Interior forest districts. Survival of planted lodgepole pine seedlings was

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generally adequate to establish a new forest on these areas, although establishment problems occurred in one district. Growth rates on the rehabilitated landings ranged from 51% to roughly 100% of the growth in the adjacent plantations after 5 years. Surface soils on landings had lower C and N, but nutrient status and seedling growth were not correlated. Surface soils (to 20 cm) for both rehabilitated landings and regenerating plantations had bulk density values that were below the expected threshold for growth limitation. In contrast, the landings in one district, where penetration of a steel probe was restricted, also had slower tree growth.

Skid Road Rehabilitation Study, Nelson Forest Region

The Nelson Forest Region has a long history of rehabilitating constructed trails on steep slopes. This study observed that incomplete rehabilitation of skid roads, consisting of simple recontouring without full decompaction, commonly led to enhanced growth for trees planted on berms and sidecast soil material compared to trees growing on the former inner track and mid-road positions. Site-specific conditions, such as presence of calcareous soil material and choice of tree species, had an influence on the range of growth response observed at different parts of the skid roads. Skid-trail rehabilitation has evolved since the first work was carried out. Modern rehabilitation techniques, involving more complete water management, decompaction of the running surface, and retrieval of sidecast topsoil in layers, are expected to lead to improved success.

Experimental Research: Use of Wood Waste for Rehabilitation

Many waste materials that are unsuitable for further processing may be suitable for improving degraded soils. Experimental sites were established in 1998 to evaluate the use of woody residues for soil rehabilitation. At Okanagan Falls, an excavator decompacted landings and applied wood waste either as mulch or incorporated into the surface soil. Results showed that seedlings planted on the rehabilitated plots had better survival than those on the untreated control. A separate plot treated with wood waste and sewage sludge compost had poor seedling survival, and weed problems developed. The rehabilitation treatments reduced soil bulk density compared to the untreated control plots.

Experimental Research: Suitability of Biological Inoculants for Rehabilitation

Most roads and landings are comprised of subsoil with low biological activity and low inoculum potential for beneficial organisms such as mycorrhizae. Laboratory and field investigations have been undertaken to assess commercially available biological inoculants for their suitability to enhance seedling survival on rehabilitated roads and landings. Preliminary evaluations of seedlings produced in British Columbia showed tremendous variation in the amount of colonization between different nurseries and tree species. Douglas-fir had particularly low rates of mycorrhizal colonization. Two field sites were established in 1999 to evaluate field performance of inoculated and uninoculated seedlings. These field sites will be planted in spring, 2000.

Experimental Research: Air-vent Blocks and Microbial Inoculants

A research project is investigating whether or not root system development is altered in air-vent blocks compared to untreated or copper-treated styroblocks, and whether such alteration depends on the type of planting environment (e.g., rehabilitated landings). Interim results from first-year plantings near Princeton indicate that root egress in the upper part of the plug was stimulated by air-vent blocks, as well as by copper-treated styroblocks. In addition, first-year field growth was similar in both air-vent and copper blocks. A second site was established near Westwold in 1999 to further evaluate whether seedling and stock type differences can affect rehabilitation success.

Operational Trial: Landing Rehabilitation in the Cariboo

An extensive operational trial was established by Lignum Ltd. beginning in 1996 and continuing to 1999. The main study included 451 landings treated with various decompaction, soil amelioration, and revegetation techniques. A subsidiary cattle management trial, consisting of 131 landings, was established in 1998. Decompaction costs in 1997 varied from $204 per hectare for a disc trencher to $1725 per hectare for a silvatiller. For most treatments, average soil bulk density for decompacted soils was similar to that of adjacent plantations, indicating that machine cost and availability should be a major factor determining equipment choice for rehabilitation. Average seedling density after 1 year was 1329 stems per hectare for landings planted in 1997, and 1181 stems per hectare for landings planted in 1998. Seedling density was inversely related to grass cover on the landings. Cattle management strategies implemented in 1998 seemed to result in lower rates of basal scarring on seedlings.

Adaptive Management Monitoring: Adams Lake Landing Rehabilitation

Interfor (Adams Lake) began a program of landing rehabilitation in 1996, and continued until 1998. A monitoring project was recently implemented to evaluate the effectiveness of the work, and to establish permanent plots for further monitoring. Interim results indicate that seedling survival was somewhat lower than rates expected for plantations, but was generally above 1000 stems per hectare after 3 years, except in areas of high range use. Survival and growth were best for landings with medium- and coarse-textured soils.

SUMMARY

Recently implemented research on soil rehabilitation has adopted various approaches to developing and extending new knowledge. Retrospective studies have provided information quickly, but these studies are restricted to evaluation of existing projects. Experimental research addresses many of the subtle questions surrounding the long-term effects of numerous treatments. In addition to questions of effectiveness, costs and feasibility are evaluated through operational trials. Finally, where work is being carried out as part of existing programs, a monitoring plan can provide important information for enhancing the value of new work.

Early results from these projects suggest the following integrating principles can be adopted for forest soil rehabilitation in British Columbia.

- Survival rates for trees planted on rehabilitated landings may be lower than rates expected in plantations, but initial establishment of a new forest is still remarkably successful in many cases.
- A commercial tree crop may be possible from many rehabilitated areas. The best results are expected on medium- and coarse-textured soils.
- In areas of high range use, cattle damage is a significant challenge to restoration.
- Modern rehabilitation techniques, incorporating topsoil respreading, a wide range of equipment options, and a better understanding of seedling response factors have the potential to be more successful and less costly than work carried out in the past.

ADDITIONAL CONTACT INFORMATION

Retrospective studies of soil conditions and forest productivity on rehabilitated landings: Interior British Columbia. Matthew Plotnikoff and Margaret Schmidt, Simon Fraser University (Telephone: 604-291-3323).

Tree growth on rehabilitated skid roads in southwestern British Columbia. Mike Curran, Nelson Region, B.C. Ministry of Forests (Telephone: 250-354-6274).

Rehabilitation of forest roads and landings with wood waste. Kirsty Venner and Cindy Prescott, University of British Columbia (Telephone: 604-822-4701).

Suitability of biological inoculants for conifer seedlings on reclamation and standard reforestation sites. Guoping Xiao, University of British Columbia (Telephone: 250-604-328, Ext. 2618); Shannon Berch, Research Branch, B.C. Ministry of Forests (Telephone: 250-952-4122).

Air-vent blocks and microbial inoculants: effects on pine. Melanie Jones, Okanagan University College, Kelowna (Telephone: 250-862-5464, Ext. 755); Anne Flanagan, University of Alberta, Edmonton (Telephone: 780-492-3281); Steve Kiiskila or Peter Richter, Pacific Regeneration Technologies, Vernon, Prince George (Telephone: 250-963-9199).

Operational trials of landings rehabilitation: Lignum landing rehabilitation. Bill Chapman, Cariboo Region, B.C. Ministry of Forests, Williams Lake (Telephone: 250-398-4718); Derek Hodgkins and Ron Meister, Inland Timber Management, Williams Lake (Telephone: 250-392-7177).

Evaluation of seedling growth on rehabilitated landings: Adams Lake. Graeme Hope, Kamloops Region, B.C. Ministry of Forests, Kamloops (Telephone: 250-828-4176); Alan Thorne, Interfor, Adams Lake (Telephone: 250-679-3234).

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