COOPERATIVE MONITORING PROGRAM FOR INTERIOR SPRUCE

(CLRS, Oct. 16 & 17, 1984)

WORKSHOP REPORT

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Research Branch
Introduction

The Interior Spruce planting program accounted for 53% of the total number of seedlings planted on Crown and Private lands in B.C. in 1983/84 (56.7 million). The Ministry's 5 year plan (1984/85 - 1988/89) projects the total planting program to increase to 160 million seedlings by 1988/89 of which 55% will be Interior Spruce. By all accounts, Interior Spruce planting figures very significantly in B.C.'s present and planned future reforestation program. Comprehensive information on the performance of Interior Spruce plantations is not available, yet it is widely held that establishment success is inadequate and must be improved upon.

Discussions between Silviculture and Research Branches, and Interior Regions over the past years have led to the conclusion that planting stock and plantation monitoring programs for this species in particular must be improved. Furthermore, that work should begin immediately in designing a pilot scale monitoring program for Interior Spruce reforestation system (i.e. including the nursery phase), as a cooperative undertaking between silviculture operations and research. In effect, this program would represent a "fact finding" mission on how and what to monitor, the results of which may be extended to general practice.

Workshop Mission

To establish a cooperative monitoring system on a pilot scale basis in the Interior Spruce planting program to help identify what key information needs collecting on a routine basis for operational and research use.

Conditions

All aspects of the planting program, from seed operations through to achievement of free-growing seedlings will be monitored "as is", by assessing and recording present cultural practices and procedures. No experiments are included at this stage.
The target population for monitoring will be certain amounts of the new 2 year rotation container spruce stock type and another stock type to afford some basis for comparing performance.

**Desired End-products from Workshop**

A monitoring system framework related to all elements of the planting program from seed operations to free-growing seedlings.

Identification of what information is to be collected and by whom, when and how it is to be collected, and when and how it is to be used.

Identification of target planting stock population for pilot-scale monitoring re amounts, sources of stock.

Implementation roles and responsibilities

**Workshop Structure**

(see attached agenda and list of participants)

Workshop participants were pre-selected to obtain research and operational input on all phases of the planting program. Attendance was restricted to Branch and Regional staff at this stage (District input would be solicited when the target population is defined and implementation phases are ready to be discussed).

1. Outline of workshop mission by the Branch Directors together with background information on the importance of the Interior Spruce planting program.
2. Presentation of some background information and ideas on elements of the planting program by speakers, with emphasis on the status/needs for performance monitoring and feedback.

   - Free-growing seedlings
   - Planting and stand maintenance
   - Regeneration performance assessment
   - Nursery production
   - Nursery stock quality control & monitoring
   - Research/operations interface

   M. Wyeth  
   B. Williams  
   J. Pollack  
   D. Armit  
   N. Burdett  
   A. Vyse

3. Presentation and discussion of a simple model of the planting system (Fig. 1). The workshop mission is to focus on the dashed lines linking activities in the planting system to "research, planning and performance evaluation", i.e. what should be the nature of information flows, where do they go and why?

4. Treated in isolation, each activity has its own information flows (Fig. 2) but these also require linkage with one or more other activities (Fig. 1).

5. Workshop participants split into 3 Working Groups:

   - seed operations, nursery operations, storage and transport
   - harvesting and site preparation
   - planting, regeneration maintenance and free-growing.

6. Working Group instructions:

   Objective - Identify and rationalize information requirements within and between planting program activities.
Identify for each activity -
. information inputs required - what and for whom?
. information outputs - to whom and why?
. information retained to account for/describe activity
. method of information collection and timing.

Approach -
. without reference to present information system, identify what you
  feel is needed
. then, compare with present information system and identify
  shortcomings
. identify areas of concern and rank
. propose solutions and options.

Check -
If any of the activities being addressed by your Working Group is
later identified as having a problem, will the responsible personnel
have the necessary information to be able to pinpoint possible causes?

Presentation of findings -
Working groups to summarize their findings on wall charts in the following
format:

<table>
<thead>
<tr>
<th>ACTIVITY:</th>
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<tbody>
<tr>
<td><strong>INPUTS</strong></td>
<td><strong>AREAS OF CONCERN</strong></td>
<td><strong>OUTPUTS</strong></td>
</tr>
<tr>
<td>from Activity #</td>
<td>(for accountability, solving problems, initiating improvements)</td>
<td>to Activity #</td>
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<tr>
<td></td>
<td></td>
<td>description</td>
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<tr>
<td>What do we need?</td>
<td>What do we think other activities need?</td>
<td>Why? When?</td>
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<td>Why? When?</td>
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7. Spokesperson representing each Working Group in turn to present findings, explain areas of concern and rationalize need for additional information. Other Working Groups to be asked, where necessary, if they have identified the "missing" inputs on their lists. If not, why not? This leads to a discussion of the rationale for collecting the information, consideration of options and, in the end, resolution and agreement between the Working Groups.

8. Final agreement on areas of concern in the present monitoring and information system.


Directors of Silviculture and Research Branches to set basic parameters for a discussion on:

- # seedlings, nurseries involved
- presentation of pilot-scale monitoring system concept and need for participation to Branches, Regions and Districts.
- steering committee or working group to prepare forms, schedules, etc.
- preparation of plan for IFMSA funding, 1985/86 - 1989/90
Workshop findings

The following pages document Working Group findings, as presented on their wall-charts, for each of the Activities in the Reforestation system:

Seed Operations  
Nursery Operations  
Storage and Transport  
Harvesting  
Site Preparation  
Planting  
Plantation Maintenance  
Free Growing

Due to time limitations, findings were not presented in the prescribed manner (above). Working Groups did, however, exchange ideas and amend their charts to match information outputs and inputs between Activities.

Rather than devoting the small amount of time remaining to a discussion on implementation, the Directors requested input on the weakest aspects of the planting program and priorities for information collection. They indicated that follow-up to the Workshop would be delegated to an individual or task group.

Weakest links in the Planting Program were identified as follows:

Operational implementation

1. Site Preparation -- must bring to the attention of the Executive that all-season burning is urgently needed to achieve adequate site preparation. This was provided for in the prescribed fire policy, approved 2 1/2 years ago. Penalties against licencees must be eased.
2. Brushing and weeding
3. Stock handling and storage
4. Pre-harvest prescriptions - no standards, not yet implemented.
Information system

1. Survival and performance feedback to nursery.
2. No stock quality determination at planting.
4. Lack of free-growing evaluation.
5. Need for assessments of vegetative competition.
6. Lack of diagnostic information to explain why and when plantations fail.
SEED OPERATIONS

Areas of concern:

1. Species identity
2. Seedlot variability
3. Seed vigour
4. Seed sources - Natural stands, seed orchards
5. Lab germination vs. field germination
6. Seed purity
7. Seed stratification treatments
8. Seed-borne diseases

Legend:  (O)  =  Output Information
         (I)  =  Input Information
         (D)  =  (Retained) Activity Description
1. **Species identity**
   (Type of Hybrid or provenance,
   Se or Sw; Se or Ss; Sx(wet) or Sx (dry); S x S?)

   . what is proper identification method?
   . who does it and where?  – ideally do it in field at time of
collection
   . designate wet vs dry type S/L (from F.S. 72l). Ecological
identification (ecosystem type) not included in T.S.R.
   . nursery feedback onto T.S.R. on growth character (i.e. wet or
dry and S x S hybrid)
   . responsibility - District, Seed Centre, Region, Branch.

2. **Seed variability**

   . slow germination rate
   . nursery performance feedback to T.S.R. and District

   . height and root collar diameter distribution at nursery

3. **Seed vigour**

   . nursery performance feedback to T.S.R. and District
   . seed centre and Research Branch to provide vigour rating to
nurseries, Regions and Districts
   . seed maturity identification problems, field and Seed Centre

4. **Seed sources**

   Natural stands
   . ‘pooling’ small seedlots in current inventory to improve
nursery operations (reduce costs)
   . seed planning and use - large collections of superior
provenances and allocation by Branch to various
Regions and Agencies
   . monitor performance of new rules
Seed Orchards

- provide for future monitoring of S.O. seed in terms of nursery and plantation performance (I)
- provide estimates of future production to Regions (O)

5. **Lab. vs field germination**
   - lab. germination is done to ISDTA standards
   - field germination is done to what standards? (MOF nursery procedures established, but nothing set for private nurseries)
   - field germination results need to be rapidly fed back to lab., Regions, Districts. In monitoring, include temp., pest problems, treatments and refer problems to appropriate agency including Research Branch

6. **Seed purity**
   - increase in impurities during stratification and seed handling process
   - continue impurity monitoring at nursery and feedback to Seed Centre

7. **Seed stratification treatments**
   - record date at which stratification is started

8. **Seed-borne diseases**
   - continue to monitor diseases on seeds after processing and in nursery - record on T.S.R. (I)
   - monitor disease by collection method
   - investigate methods to eradicate disease, prior to use in nursery.

9. **Seed withdrawal problems**
   - monitor sowing dates
   - monitor timing of seed withdrawals and record on T.S.R. to meet seed collection planning needs.
NURSERY OPERATIONS

Areas of Concern:

1. Sowing requests and allocation
2. Sowing
3. Monitor field germination
4. Growing – cultural techniques
5. Quality control monitoring
6. Stock conditioning tests
7. Information dissemination
8. Inventory and recovery
9. Stock standards and adjudication
10. Lifting, sorting and packaging
11. Post-lifting grading and quality assessment
12. Pest management
1. **Sowing requests and allocation**
   - monitor sowing allocation, and feedback to Regions and Districts. Time-frame needs to be established (D)
   - sowing allocation reports do not show morphological dimensions for containers (D)

2. **Sowing**
   - purity needs monitoring at sowing (D)
   - monitor precision and efficiency of equipment, training of operators; develop control charts (D)
   - need higher seed germination standards (I)
   - monitor seed cover and medium (D)
   - monitor additional seed requests above the allocation (I/O)
   - investigate potential for pelletized sowing
   - investigate transplanting into containers (fill blanks)

3. **Monitor field germination**
   - investigate adequacy of standards for optimal field germination (containers) (D)
   - monitor field germination conditions (containers)
   - feedback germination and disease problems to seed centre, Regions, Districts
   - monitor disease control treatments and report mortality (D)

4. **Growing – cultural techniques**
   - monitor growing media and mixes (peat fibre length, lime particle size, pH, conductivity during growing season, density prilled materials - osmocote -, minor element incorporation in mix, mixing times, moisture content) (D)
   - require improved laboratory analysis services, turnaround time
   - monitor cultural prescriptions (light [daylength; intensity]; temp.; rel. humidity; moisture levels by block weight; water pH, conductivity, . temperature and quality; fertilizer type, application schedules, amounts) (D)
   - investigate density (seedlings/m²)
5. **Quality control monitoring**
   - growth rate
   - tissue analysis and dry weights
   - establish and report outplant results.

6. **Stock conditioning tests**
   - schedule, monitor and investigate stock conditioning treatments
   - measure effectiveness of treatments i.e. by frost hardiness testing.
     - investigate relationship between frost hardiness and post-storage RGC
     - monitor chilling hours
   - investigate drought conditioning and nutrient priming of stock for mid-summer planting (high priority)

7. **Information dissemination**
   - report significant events (e.g. environmental or pest damage) forthwith to Regions and Districts, and incorporate into nursery information system
   - report relating RGC to stock conditioning tests for Research
   - develop communication system with Research Branch (esp. reporting physiological data)
   - communicate stock quality data to Regions, Districts and Research Branch
   - require Regional, District, Agency staff to visit nurseries
   - plan required information or survival and performance from field for Silviculture and Research Branch
     - 1st season environmental and physiological factors, a sample taken one month after planting of PMS shoots, roots, and field root establishment
     - 2nd and 5th year survival and growth (height, root collar diameter, needle length)
8. **Inventory and recovery**
   - report all inventories on schedule to Regions and Districts
   - report final recovery figures a.s.a.p. to Regions and Districts
   - report losses and causes when deviation is over 5% of target
   - evaluate procedure and precision of inventory sampling by (hand-held) data recorders.

9. **Stock standard and adjudication**
   - communicate changes in standards to Regions and Districts
   - Regions to provide standards

10. **Lifting, sorting, packaging**
    - monitor lifting date and period
    - investigate lifting "windows" by nurseries
    - monitor environment and PMS of stock during lifting and storage
    - monitor stock quality protection during processing
    - investigate root pruning (of containers)
    - monitor compliance to standards and report to supervisor
    - monitor stock size distribution as it affects grading.

11. **Post-lifting grading and quality assessment**
    - measure height and root collar diameter and their ratio (and variance of ratio)
    - sample shoot and root dry weight
    - sample crop RGC on a paired test basis:
      - one retained sample at nursery
      - one sample returned to nursery after regional storage (sample analyzed prior to planting)
      - nursery TGC testing to be supplemented by Research Branch facilities
      - problem seedlots
12. Pest management
   - monitor, identify and control pests e.g. fungi, insects, weeds (moss, liverworts), chemicals, birds, rodents (D)
   - record and report pesticide usage (D)
   - explore biological and alternative control methods (D)
   - monitor sanitation level of facility and reacting (follow-up) (D)
STORAGE AND TRANSPORT

Areas of Concern:

1. Storage duration and environment
2. Transport duration and environment
3. Number of handling steps
4. Definition of responsibilities
5. Non-dormant stock handling and transport
6. Development of facilities or alternative types of storage
7. Cartons and pallets
1. **Storage duration and environment**
   - monitor nursery lifting window and storage environment
   - monitor seedling physiology at spring lifting and prior to planting.

2. **Transport duration and environment**
   - monitor mode of transport and transport temperature e.g. installation of temp. warning devices and thermographs for MOF and commercial carriers
   - monitor loading and air condition
   - schedule timing and regime for thawing of stock in readiness for planting
   - input from "planting activity" on schedule for planting and local storage conditions
   - monitor thawing temperature
   - investigate thawing guidelines

3. **Number of handling steps**
   - monitor number and reason for transshipment points

4. **Definition of responsibilities**
   - more work required!

5. **Non-dormant stock handling and transport**
   - report lifting window to Region and District
   - investigate and determine lifting window
   - schedule lifting closely to planting and vice versa
   - monitor transport environment and duration, and deliver stock as close as physically possible to planting site
   - lift and deliver to meet a maximum of 5 days supply
   - investigate basis for 5 days supply figure
   - monitor and investigate stock handling at planting site
6. **Development of facilities or alternative types of storage**
   - plan annual and long-term requirements
   - investigate "ice-cache" storage techniques and recommendations
   - feedback field storage experience to Silviculture Branch for dissemination from "planting activity" (I)
   - investigate alternative field storage methods and primary storage methods

7. **Cartons and pallets**
   - establish and monitor carton standards (MOF and private)
   - investigate optimal materials handling methods and systems (e.g. 'unitization')
HARVESTING

Areas of concern:

1. **Pre-harvest silvicultural prescription (F.S. 711)**
   - new format
   - tied to stocking standards policy
   - not fully implemented

2. **Post-harvest assessment (F.S. 89)**
   - post-logging inspection form not rationalized/compatible with F.S. 711

SITE PREPARATION

Areas of concern:

1. **Site preparation prescription (F.S. 117)**
   - form not rationalized with F.S. 711 or F.S. 89

2. **Site preparation report (F.S. 737)**
   - form not rationalized with F.S. 117, F.S. 711 or F.S. 89
Harvesting Activity

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<th>Inputs</th>
<th>Activity</th>
<th>Outputs</th>
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<td>site &amp; stand info</td>
<td>PHSP data collection (F.S. 711a, b, c)</td>
<td>regen. declaration</td>
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<td>s. ops. sowing request</td>
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<td>s.p. site prep concerns, recomm.</td>
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<td>p.m. brush hazard, harvest prescr. CP &amp; FS 711c</td>
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<tr>
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<td>harvesting ops</td>
<td>s.p. site preparation</td>
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<td>C.P. &amp; F.S. 711c</td>
<td>post-harvest assess FS 89</td>
<td>prescription FS 117</td>
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<td>PMSP review</td>
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Site Preparation Activity

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<td>Site prep. ops</td>
<td>prepared land</td>
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<td>stock avail (n.ops)</td>
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<td>weather</td>
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<td>prepared land</td>
<td>site prep. assess (F.S. 117b, FS 737)</td>
<td>p. objectives met or</td>
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<td>p.m. not met</td>
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<td>site prep?</td>
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<td>rehab plan</td>
<td>backlog ops.</td>
<td>planting prescription</td>
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PLANTING

1. Sowing requests
2. Planting prescription
3. Transport and field storage
4. Stock conditioning
5. Planting hazard indices
6. Planting quality description
7. Microsite choice
8. Auditing performance
1. **Sowing requests**
   - limited basis for justifying selection of stock type in terms of biology, ecology and interaction with site preparation treatment*
   - need to monitor reliability of seed provenance and transfer rules, and feedback results to seed operations
   - timing of sowing requests in relation to pre-harvest assessment or site preparation for backlog
   - need for request/reality audit, consumer complaint %. 5 year plan out of sequence?

2. **Planting description**
   - pre-harvest assessment must be used to project methods, stocking, species selection, timing and cost
   - stock type x site preparation compatibility essential, but limited information base to work with*. Operationally, need to record problems with stock type, site preparation incompatibility

3. **Transport and field storage**
   - stock quality deterioration. RGC and environmental conditions need monitoring from regional reefer to planter's hand

4. **Stock conditioning**
   - condition stock from reefer to time of planting, and relay stock performance to nursery

5. **Planting hazard indices**
   - need to monitor/test links between environmental conditions and performance

* Research needs
6. **Planting quality and microsite choice**
   - effect on planting stock performance needs to be established

7. **Auditing performance**
   - establish actual versus expectation in pre-harvest assessments, and feedback results to seed and nursery operations, site preparation and (pre)harvesting phases
PLANTATION MAINTENANCE

Areas of concern:

1. Stocking surveys
2. Competition indices
3. Response to treatment
1. **Stocking surveys**
   - need comprehensive regen. acceptance standards for use in stocking surveys (regeneration and free growing) which include consideration of:
     - disease and insect damage
     - mechanical damage
     - species acceptability
     - max., min., optimum stocking levels
     - clumpiness

   This information needs consideration at the harvesting, site preparation, nursery and seed operations activity levels i.e. governs decision to: wait, rehabilitate or confirm free-growing status.

2. **Competition indices**
   - need vegetative competition indices for use in free-growing assessments and in surveys for possible brushing and weeding or conifer release treatments.* Research needed to identify appropriate survey methods and intensity, provide background successional information and ensure a linkage with pre-harvesting assessment and RPA. Survey output to site prep and (pre-) harvest activities

3. **Response to treatment**
   - response to plantation maintenance work must be monitored, in terms of crop tree growth and cost-effectiveness
FREE GROWING

Areas of concern:

- free growing assessment must consider stocking, competition index and RPA (height growth performance), as a basis for determining need for additional treatment

- linkage with Inventory update, growth and yield projections for TSA planning must be established

- consider preparation of "free-growing" report, including review and evaluation of treatments; costs/ha incurred up to this stage. Basis for audit?
Figure 1. Information pathways for the Planting Program.
Figure 2. Information pathways for an activity in the planting program.
Workshop attendance (by Working Group)

1. Seed Operations, Nursery Operations, Storage Transport
   D. Armit     N. Burdett     J. Konishi     H. Benskin
   L. Ebell     M. Wyeth      J. Sweeten

2. Harvesting and Site Preparation
   B. Storey    D. Spittlehouse B. Fraser
   R. Jones     B. Williams    E. Hamilton

3. Planting, Regeneration maintenance, Free-growing
   D. Draper    J. Pollack     L. Herring    R. Brown
   G. Lloyd     Y. Yano       A. Vyse      S. Willis

Observers: C. Johnson and J. Dangerfield