

WHITE SPRUCE SUPERIOR TREE SELECTION AND COLLECTION PROJECT

COMPARISON TREE METHOD

GENERAL INFORMATION AND GUIDELINES

**Leonard Barnhardt
Alberta Forest Service
Genetics & Tree Improvement Centre
August, 1991
Revised 2007**

GENERAL INFORMATION AND GUIDELINES

This package provides information, guidelines and standards for superior tree selection project planning. It is organized into six sections with tally sheets and forms added in the APPENDIX.

Section 1 General Information for Superior Tree Cruising

- this section provides an overview of project objectives, stand and tree selection methodology and documentation

Section 2 Candidate Stand Requirements and Superior Tree Selection Guidelines

- this section is the main reference for "Candidate Stand" requirements and methodology, as well as methodology and criteria for "Superior Tree" selection

Section 3 Guidelines and Procedures for Field Collection of Wood Samples,

- this section outlines procedures and requirements for collection of wood density samples

Section 4 Guidelines for White Spruce Scion Collections

- this section outlines procedures and requirements for collecting, packing, and shipping scions

Section 5 Guidelines for Writing Superior Tree Project Reports

- this section describes the format and desired content of reports to be submitted to Genetics and and Tree Improvement Section

Section 6 Guidelines and Procedures for Collecting Cones from White Spruce

- this section contains procedures and requirements for monitoring, planning, collecting, handling, and shipping of cones

APPENDIX

White Spruce Candidate Stand Cruising Form

Prioritized Candidate Stand Form

Parent Tree Selection Form – Wild Stands & Plantations

White Spruce Superior Tree Project: Code Sheet

White Spruce Superior Tree Project: Equipment List

Cone Crop Status Survey Form for Superior SW Trees

SECTION 1: General Information for Superior Tree Cruising

1.0 Listing of "Candidate" Stands for Cruising

There are several possible sources which may be used to compile a list of Candidate stands.

- Request to the districts for a list of superior stands based on their local knowledge.
- Computer search of Phase III or AVI.
- Records of information from previous cruises.
- Company Records.

Ideally, a "White Spruce Candidate Stand Cruising Form" should be filled out for these stands during the planning phase of a Superior Tree selection project. This will require two field cruises rather than one, however, when enough lead time exists and it is done as part of operational work it makes the actual selection project much more efficient by eliminating stands without potential eg. too old, logged, inaccessible etc.

Once the information is collected on the "White Spruce Candidate Stand Cruising Form" a prioritized list of Candidate Stands can be compiled based on location, access, and potential of the stand to provide a selectable tree.

An example "White Spruce Candidate Stand Cruising Form" and "Priorized Candidate Stand Form" are attached.

If lead time does not allow for full execution of these steps, prioritization of potential stands on the "Prioritized Candidate Stand Form" using whatever information is available should still improve the efficiency of the Superior Tree Cruise.

Detailed guidelines for "Candidate Stand" selection are contained in Section 2.

1.1 Cruising for Superior Trees

The cruise consists of a systematic search for superior trees.

Selected superior trees must have the following characteristics:

- Very good to excellent form.
- Good leader growth (at least 15 cm in the current year).
- Height/age ratio must:
 - exceed 25 cm per year wherever possible.
 - must exceed the height/age ratios of at least two of the comparison dominants (preferably all three).

- The last ten years diameter growth should generally not indicate any rapid slowing in growth over last 11-20 years diameter growth.
- Have a relatively slender crown and thin branches.
- Branches attached to the stem as near to perpendicular as possible.
- Not be crooked or forked (even at base).
- Must be free from any apparent disease or defects.

WHITE SPRUCE CANDIDATE STAND CRUISING FORM

1) Phase III Stand Description for candidate stand:

- a) Timber type C4 Sw A -L
- b) Stand number 7
- c) Area ~10 ha

2) Ground Survey:

- a) legal location (exact) C4 Sw A - L
- b) elevation (m) 723
- c) aspect SW
- d) slope (%) 2%
- e) landform/topography glacial lacustrine/flat
- f) stand access (road, helicopter, trike, etc) Trike in the summer
4x4 in the winter
- g) stand composition

	species	%
major	Sw	70
minor	Aw	25
minor	Bw	5

- h) estimated number of White Spruce stems/ha 800
- i) ground truthed timber type of stand C4 Sw (Aw)
- j) biogeoclimatic subzone: Boreal mixedwood ecoregion
site type: Sw Bw Alder Cranberry
- k) additional comments: some ferns & lilies; good moisture

3) Observations on White Spruce Only:

Age-class distribution:

Class	% of Trees
Overmature (120+)	10
Mature (80-120)	65
Immature to mature (40-80)	25

4) Focusing only on Mature Age-class of White Spruce:

- a) General observations (circle yes or no)
- i) are the trees generally straight stemmed? Y or N
- ii) stand lacks "wolf" or bushy crowned trees? Y or N
- iii) do the trees have pronounced leader growth? Y or N
- b) sample tree data – from 5 randomly chosen dominant trees spread throughout the stand:

Tree#	BH Age (yrs)	Height (m)	DBH (cm)	Radial Increment (cm)	
				Last 10 yrs	Last 11-20 yrs
1	79	31.0	54.5	1.8	3.1
2	81	32.2	60.2	2.0	3.1
3	58	24.5	35.2	3.3	3.5
4	70	28.7	46.9	2.2	2.4
5	158	34.3	72.1	0.6	0.9

- 7) Additional Remarks on the Stand (defects, windblow, excellent growth, excellent timber-type stand) Stand partially logged, dense spruce in clumps, lots of advanced regen
-
- 8) Cone Crop Status of White Spruce Good cone crop

PRIORITIZED CANDIDATE STAND FORMForest: Bow/CrowDate: 86/11/10

Stand#	Priority	Location	Access	Remarks
66	1	10-11-27-6	Road	D3Sw
09	4	7-6-27-5	Road	C4Sw
52	8	13-11-27-6	Road winter trike summer	B4Sw
63	5	6-32-26-5	Road permission required	D3Sw(Pl)
35	6	16-4-27-5	trike	C3Sw
114	9	1-9-27-5	quad	B3Sw
117	11	8-32-27-5	trike	B3Sw
135	2	11-9-27-5	road	C4Sw(Fd)
147	13	4-36-26-6	helicopter	B3Sw(Aw)
16	3	15-12-28-6	road	C4Sw(Aw)
17	7	13-35-27-5	road	C3Sw
210	10	14-31-27-5	helicopter	C4Sw(Pl)
211	12	16-31-27-5	helicopter	C3Sw

1.2 Quick Check to Confirm Tree has Superior Potential

When a tree has been found which looks superior:

- Confirm height, age and height/age ratio (age here is defined as Dbh ring count).
- Ascertain that it has good leader growth.
- Ascertain that it is free from disease and defect.

1.3 Documenting and Marking of a Superior Parent Tree

- If it passes the preliminary quick check, pick three comparison trees that are the tallest dominants in the same age class within a 50 metre radius of the potential superior tree. Document all four trees completely on the "Parent Tree Selection Form" Using the "Superior White Spruce Project: Code Sheet" (both attached in the APPENDIX).
- Review the selected potential superior tree according to the guidelines in SECTION 2.
- If the selected tree meets the requirements of a "Superior Parent Tree", a temporary field number is to be assigned to it until it is assigned a unique identifier (ID). The field number is to consist of the management unit, year of selection, and tree number, eg. G10-90-1, and is to be marked in the upper line of the "Parent Tree Selection Form".
- A completed "Parent Tree Selection Form" for selected and comparison trees is attached for guidance.
- The superior tree and comparison dominants are marked with orange and blue paint. The comparison dominants are marked '1', '2' and '3' in orange paint. The superior tree is marked 'S' in orange paint with a band of orange above and blue below. Two coats should be applied so the trees can be located in the future for scion and cone collections.
- Photograph the superior tree from a couple of different angles to illustrate it for permanent pedigree records. Take care that camera is adjusted for backlighting so that superior tree is visible in photo.

1.4 Report on the Project

A report is submitted on completion of this phase of the project. Guidelines for this are provided in SECTION 5, "Guidelines for Writing Superior Tree Project Report".

Parent Tree Selection Form - Wild Stands and Plantations

Species White Spruce **Field Number** TIC-01-09 **Unique Identifier** AT00266
Selection Agency SRDI/ATISC **Selection Date** 29-Jan-07

STAND INFORMATION

Collection Site: ATISC - South of field B1 Natural Subregion: Dry Mixedwood
 Legal Location: 10-12-059-16-W4M Seed Zone: DM2.1
 Latitude: 54° 5' 17.2674" Site Type: BM a1.3 P/green alder/lichen
 Longitude: 112° 15' 45.036 Stand Type: C4SwA
 Elevation (m): 603 Moisture Regime: Well drained

Stand Comments: Mixed species, age clas partial. Site quality good. Stand is patchy due to partial burning and cutting.

TREE INFORMATION

Sex Male Female *Monoecious*
 Wood Sample YES NO Collection Date: 29-Jan-07
 Scions YES NO Collection Date: 29-Jan-07
 Open Pollinated Seed YES NO Collection Date: 29-Jan-07
 Root Sections YES NO Collection Date: _____

Trait	Select Tree	Dom. ¹ 1	Dom. ¹ 2	Dom. ¹ 3	Superiority ¹ (%)	Comments
Height (m)	27.00	24.00	26.5	20.5	14.1	
Age	60	66	67	65		
Natural Pruning (%)	50.00%	60.00%	50.00%	50.00%	-6.3	
Height/Age (cm/yr)	45.0	36.4	39.6	31.5	25.6	
DBH (cm)	30.8	20.5	26.7	21.5	34.5	
Radial Increment						
Last 10 yrs (mm)	1.40	1.40	1.70	1.20	-2.3	
Last 11-20 yrs (mm)	1.20	1.20	2.10	1.30	-21.7	
Stem Form	5	4	4	3	36.4	
Branch Angle	3	1	2	1	125.0	
Branch Thickness	3	3	1	1	80.0	
Crown Width	3	2	2	2	50.0	

¹ Dominant tree data required when making selections using the comparison tree method

Tree Remarks: Tree marked with yellow and pink ribbon

Parent Tree Location Map	Description
	Location/Access: <u>Select tree is 140 m west</u> Tree Marking: Photo Attached Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>

AGENCY REPRESENTATIVE _____ **Signature** _____ **Date** _____

SECTION 2: Candidate Stand Requirements and Superior Tree Selection Guidelines

2.0 "Candidate" Stand Requirements:

It is central to Superior Tree Selection Methodology to select Superior trees from stands showing good form, growth and vigor. To be cruised for superior trees stands must meet most of the following requirements:

- Be well stocked and relatively uniform
- Show active and better than average height growth
- Not be overmature or decadent
- Be pure or predominantly white spruce
- Be a minimum of 2 ha in size
- Distance between candidate stands should be a minimum of 3 km. This may be relaxed to 2 m if difficulty is encountered in finding sufficient numbers of candidate stands to provide an adequate geographic distribution of selected trees
- Although the objective is to select only one tree per stand, in the case of exceptional quality stands, two trees may be selected providing they are separated by a minimum of 200 m to avoid their being related
- Have been reviewed for cutting plans to reduce the possibility of a selected tree being logged.

2.1 Selection of a Superior Tree and Comparison Trees within "Candidate" stands

- Once a candidate superior tree has been located the 3 tallest dominants within a 50 m radius are chosen as comparison trees and statistics for all 4 are documented on the "Parent Tree Selection Form" (attached in the APPENDIX).
- Comparison trees are to be of the same age-class as the potential superior tree.

2.2 Aging Requirements of Selected and Comparison Trees

- Ages from the selected tree and dominants can be initially read from the small increment core sample.
- The final age for the selected tree must be read off the 12 mm core sample. The vigour measurements are taken from the large core sample as well.
- The increment borer must be kept sharp so that rings can be easily read.
- Ages and core samples must be taken at dbh (1.3 m).
- Selected trees should, where possible, fall between 60 and 110 years.
- The dbh age is to be regarded as the actual ring count. Unlike timber cruising, there is no correction factor to be added for stump height.
- Age count must be correct and verifiable within ± 2 years.

2.3 Height Requirements of Selected and Comparison Dominants

- Heights must be within ± 0.5 metres using a 30 metre tape and hand held clinometer or laser or sonic hypsometer.

2.4 Mean Annual Height Increment of Selected Trees

- The mean annual height increment should be 25 cm/year or greater.
- If the mean annual height increment is less than 25 cm/year but greater than 23 cm/year, then at least two trait categories (form, branch angle, branch thickness, crown size) must be rated as excellent.
- The mean annual height increment of the selected tree must be greater than at least two of the comparison dominants which allows for selection of trees which:
 - are slightly taller and older than the comparisons.
 - have excellent stem form and branching traits.

2.5 Selected Tree Height

- The selected tree should be taller than comparison dominants: if it is not (eg. it is younger) it must meet the mean annual height increment requirement outlined in section 2.4 above.

2.6 Dbh of Selected and Comparison Dominants

- Dbh is taken at 1.3 metres
- Dbh read in cm to the nearest 0.1 cm
- Dbh of selected tree to be average or greater than that of dominants and co-dominants in the stand; emphasis on DBH is not as great as other traits due to its sensitivity to competition history.

2.7 Radial Increment

- Radial increment is taken at dbh and measured in cm for:
 - the last 10 years (0 - 10)
 - the prior 10 years (10 - 20)

2.8 Leader Growth

- When possible, selected trees should have minimum leader growth of 15 cm, large healthy scions improve the chances of grafting success.

2.9 Natural Pruning

- Height is taken from ground to base of lowest living branches and expressed as a % of total tree height.

2.10 Taper (not applicable for white spruce)

- Ratio between diameter at 6.3 metres and diameter at breast height, i.e. breast height and 5 metres above.

2.11 Stem Form and Crown Characteristics

- The following codes are to be used in filling out the attached "Parent Tree Selection Form".
 - the selected tree stem form score must be at least 3.
code
 - 1 crooked in two planes or forked stem
 - 2 crooked in one plane
 - 3 slight sweep in one plane or pronounced basal sweep
 - 4 slight basal sweep
 - 5 straight
 - the selected tree crown size score must be at least 2. Scoring to be based on general crown profile as compared with other crop trees in stand.
code
 - 1 crown visibly wider than average for the stand
 - 2 crown approximately average for the stand
 - 3 crown visibly narrower than average for the stand
 - branch angle between branch and stem in upper middle crown
code
 - 1 most branch angles less than 70°
 - 2 most branch angles greater than 70° but less than 90°
 - 3 most branch angles 90°

- branch thickness in area of upper middle crown based on average for crop trees in the stand.
- code**
- 1 most branches thicker than average for stand
 - 2 most branches about average for stand
 - 3 most branches thinner than average for stand

Note: In the field it may be useful when comparing selected and comparison trees to use a code along with a + or - sign to provide more gradations eg. 1+ or 3-.

2.12 Disease and Defects

- Selected trees must be carefully scrutinized for any signs of disease (conks, punks, broken tops, heart or saprot) or defects (spiral grain, frost cracks, unaccountable scars, etc.).
- If any of these symptoms or signs are present the tree should be discarded unless the defect can definitely be attributed to mechanical damage rather than biological origin.

2.13 Large Core Samples

- Ensure that the guidelines for core collection are followed as per Section 3 "Guidelines and Procedures for Field Selection of Wood Samples".

2.14 Location and Marking of Superior and Comparison Trees

- Trees are marked as outlined in Section 1.5 of "General Information for Superior Tree Cruising".
- Plot should be tied with a bearing and chainage to an identifiable landmark. A diagram and location notes can be made on the "Parent Tree Selection Form" in the Map and Description sections.

2.15 Data Sheets

- In the stand remarks section, notes can be made of such things as unusual defects or disease indicators in the stand, blowdown, widespread crooks, poor vigour etc. The tree remarks section should be reserved for any similar comments to be made on the selected tree.
- The formula for calculating % superiority is:

$$\frac{\text{Superior tree value} - \text{avg. value for 3 comparison trees}}{\text{Avg. value for 3 comparison trees}} \times 100$$

When calculating the percent superiority, only the whole numbers from the various traits are used (e.g., 3+ becomes 3 while doing the calculations).

SECTION 3: Guidelines and Procedures for Field Collection of Wood Samples

3.0 *Field Samples*

Wood samples are obtained to determine average fibre length and wood density. Fibre length is measured from a composite of 4 rings at a constant age and position (dbh) in the tree and a weighted average is calculated on a full disk at dbh basis. Rings 17-20, 47-50 and 77-80 are sampled to represent juvenile, intermediate and mature wood, respectively. Wood density is the ratio of oven dry weight to green volume. It is determined for juvenile, intermediate and mature wood at dbh corresponding to rings 0-20, 21-50 and 51+, respectively. A weighted average wood density is then calculated on a full disk at dbh basis.

Since white spruce selections will not generally be felled until there is an adequate cone crop, two large diameter cores are to be removed from each tree. Large diameter increment cores are used for wood property measurements because the samples are more representative. Samples are taken at a constant height (dbh) to reduce variation caused by sampling at different points on the stem.

For accurate determination of average fibre length and wood density, sample cores must fulfill the following criteria.

- pith is present in at least one wood sample
- core is in one piece (preferably) or in no more than 4 segments so proper ring sequence is maintained
- wood is clear i.e. no knots or uneven shaving, gouging or roughness on core

The following steps should be carefully followed to obtain good, usable, cores and to avoid damage to equipment.

- After the tree is selected, choose two approximate areas on the stem opposite to each other at breast height where there are no branch stubs.
- Be sure that the path the increment borer will take to the middle of the tree will not intercept branch wood. This is more important than having the cores exactly opposite each other! You can violate having the cores exactly opposite each other on the stem by three to four inches to **ensure the cores will have clear wood.**
- Use a borer jack and harness to start the 12 mm borer in the tree
- Once the increment borer is started in the tree, be sure it is aligned so that it will intercept the pith of the tree.
- When the borer appears to be at the pith, give it one more full turn to **ensure that the pith has been reached.**
- The second core, from the other side of the tree, should be taken one or two inches above or below the approximate plane of the first core to avoid extracting damaged wood near the pith.
- **Label each core twice with the entire tree number** (once near the pith and once on the outer edge using an indelible pencil).

- Place each core in clear, plastic PVC pipe and tape the ends securely (ATISC uses 5/8" I/D x 7/8" O/D NSF-51 PVC pipe). Mark the tree number on the tape so it is clearly visible. Also indicate collection date and name of collector.
- A sturdy box, e.g., cooler or tool box, should be used for storing the cores.
- Ship cores immediately to the laboratory or store at -18° C until shipping.

3.1 Care and Maintenance of the 12 mm Suunto Increment Borer

The following points should be noted to ensure samples and equipment are properly cared for:

- After every second core, smear a small portion of vacuum grease (e.g., Dow Corning Silicone Vacuum Grease) on the bit of the borer.
- The threads on the increment bore starter should be lubricated with LDS or WD-40 brand lubricant after every five or ten trees.
- After every second tree, smear a small portion of silicone on the bottom of the extractor spoon.
- Resin buildup on the borer after daily use should be removed with isopropyl alcohol and a rag.
- The borer must be kept sharp. It can be sharpened and touched up several times with a portable increment borer sharpening kit but periodically should be sent out for professional sharpening to prevent a wavy edge and ‘funneling’ of the barrel end.

3.2 Most common reasons for rejecting core samples at the laboratory

- Neither core intercepted the pith, age cannot be determined.
- Core intercepted a knot, unacceptable for wood density estimation.
- Core in too many segments, ring sequence cannot be determined (4 or more segments increases processing time and increases possibility of introducing error into weighted density calculations because green volume and dry weight determinations must be done on each separate core segment).
- Very rough core with the less dense early wood disproportionately gouged out due to dull increment borer, unacceptable for wood density estimation.
- Core shaved to aid in age determination (uneven shaving may remove disproportionate amount of higher or lower density wood), unacceptable for wood density estimation.

SECTION 4: Guidelines for White Spruce Scion Collections

4.0 *Introduction:*

Grafting of selected white spruce is an integral part of the Alberta Tree Improvement & Seed Centre program. Through vegetative propagation an exact genetic duplication is made of the parent tree. This grafted material is used for both gene preservation and seed orchard establishment. A healthy scion is essential for successful grafts, so the general rule when collecting scions is to carefully select the most suitable material described as follows:

4.1 **Characteristics of a Good Scion:**

- To 9 cm in length consisting of current years growth

NOTE: When collecting from over-mature trees, scions tend to be very short and spindly and it may be necessary to cut several years growth to obtain reasonable scion length. See Figure 1.

- Straight.
- 4 to 8 mm in diameter.
- At least **one living bud**.
- Free from insect and disease damage.

4.2 **Collection Procedures:**

- Scions are selected from the top 2 to 4 whorls of the crown; because the trees cannot be felled until an adequate cone crop occurs, approximately the top 1 metre is shot off using a small calibre, high velocity rifle and light expanding ammunition (see section 4.4).
- Scions are collected from the terminals of secondary and tertiary branches. See Figure 2.

Note: Scions from other areas of the tree retain branch characteristics after grafting i.e. grow horizontally rather than vertically. However, upper crowns of over-mature trees provide poor scion material because of slow growth and greater possibility of buds being reproductive rather than vegetative. Therefore, it may be necessary to collect from the lower crown to obtain scions meeting the minimum requirements for grafting.

- Cut scions with pruning shears (do not rip or wrench off).
- Cut twice as much length as the 4-9 cm required for grafting to prevent desiccation during shipping and storing.
- Collect a minimum of 35 scions from each selected tree.

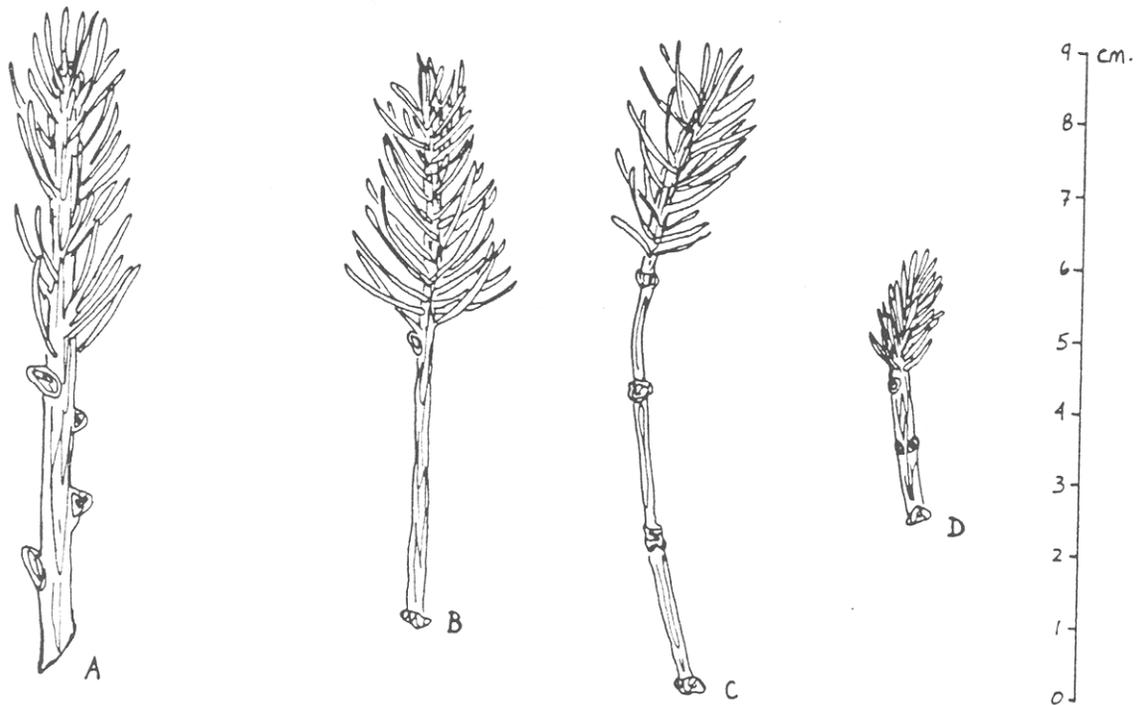


Figure 1. Types of white spruce scions used for grafting.

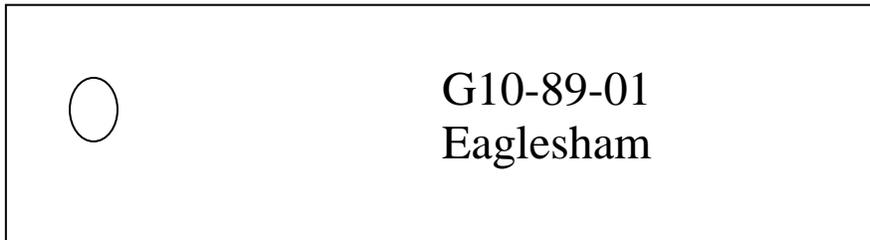
Scion 'A' demonstrates the qualities of an ideal scion:

- 4 – 9 cm in length, current years growth, straight
- 4 – 8 mm in diameter
- At least ONE LIVING BUD
- Free of disease and insect damage

Scion 'A' would be rated very good. Scions 'B' and 'D' are examples of good scions. While scion 'B' is thinner than desired it provides enough length to obtain a good 'cut'. Scion 'D' is short but sturdy enough for easy handling. Scion 'C' would be rated poor. The scion is very skinny and current years growth is very short so the 'grafting cut' will be made on second and third year wood. This type of scion has a very poor success rate.

4.3 Storage and Shipping:

- Place scions in a heavy plastic bag (2 mil) packed with snow.
- Write parent tree number on 2 tags with water proof pen. Place one in bag and attach other to outside of bag.



- Close bag tightly and place in cooler packed with snow.
- Store cooler at temperatures of -5°C to -18°C for a maximum of two weeks.
- Secure coolers well for travel and address clearly.
- Ship scions by coolest, fastest, available way.
- All shipping arrangements to be made through Tree Improvement Forester, Alberta Tree Improvement & Seed Centre, telephone 780/ 656-5072.

4.4 Rifle and Ammunition Specifications for Scion Collection

- Shooting off of crowns at a diameter of approximately 2" requires an accurate and well maintained firearm; as it is usually necessary to shoot several times per tree and collect from a number of trees per day, fatigue is an important factor in selecting a firearm.
- Genetics section uses 25-06 rifles with high quality scopes. These rifles provide the following:
 - high muzzle velocity and flat trajectory for accuracy.
 - reduced noise and recoil fatigue due to small calibre (varmit models are often heavier but recoil less and are less noisy than sporting models).
- Ammunition should be as frail as possible especially in warmer weather when crowns may not be frozen: experience indicates that for the 25-06 calibre, 90 grain hollow point is the best; if tops are frozen, 90 grain positive expanding shells are adequate for a good explosive shattering of the stem and are often more available.

4.5 Maintenance of Rifles

- Special care must be taken in the handling and transport of these rifles and scopes as accuracy is critical to efficiency!
- If the rifle has been used (and is going to be stored for a period of a week or so), it should be cleaned using the cleaning kit provided in the following manner:
 - assemble aluminum rod and attach wire brush;
 - remove bolt pointing the gun away from you;
 - slide the rod through the bore from the muzzle end 3-4 times;
 - remove the wire brush and attach nylon patch holder with an oiled patch twisted around holder (start by putting the patch through the slot in the holder);
 - run the oiled patch through the bore 3-4 times;
 - clean off the barrel and other metal parts with an oiled patch or rag to prevent rusting.
- If it is suspected that the scope has been bumped, set up a target and shoot from a rest at approximately the same distance as would be used for shooting scions; fire several rounds, preferably with more than one person to determine where the rifle is shooting. Adjust the scope by removing small cap and moving tab to correct scope (one division usually translates to about 1" at 100 yards).
- If further information is required regarding the gun please contact Leonard Barnhardt at the Alberta Tree Improvement & Seed Centre (ATISC); phone 780/ 656-5072.

4.6 Procedure for the Storage of Scions After Field Collection

Objectives:

- Avoid dehydration of plant tissue.
- Avoid temperature fluctuation of plant material in storage.
- Transport harvested scions to ATISC as soon as possible by method of transportation guaranteed to maintain moderate frozen temperatures.

Scion storage procedure:

- Bury scions in soft snow in a heavy (4ml) plastic bag. Freezer sip-lock bags are recommended.
- Identify scions and note date of collection with a waterproof pen on two tags – one inside the bag and one secured to the outside of the bag.
- Seal the bag and store buried in snow in a cooler.
- Store the cooler at a temperature of -5°C for a maximum of 2 weeks. Storage outside in a shaded area, preferable buried in snow, at the same temperature scions were collected is acceptable. Avoid fluctuations in temperature.

In the event of insufficient snow for packing:

- Wrap scions (totally cover) with several layers of damp unbleached paper towels. Procedure: Saturate paper towels in 2 cm water in a large shallow pan. Lay 2-3 layers of dripping paper towels on flat surface. Place scions on paper towels and wrap tightly. Pack in sip-lock plastic bags. Store in a cooler as above.

Conditions to avoid:

- Do not store plant material in gunnysacks, scented garbage bags or paper boxes.
- Do not thaw and refreeze plant material.
- Do not store scions in water or blocks of ice.

SECTION 5: Guidelines for Writing Superior Tree Project Reports

Once the superior tree cruise and related field work is finished, a report is completed by the Forest or Company to be forwarded to the Alberta Tree Improvement & Seed Centre (ATISC), attention: Tree Improvement Forester. The report serves as permanent documentation for all Genetics superior tree cruise projects and the information is extremely important for pedigree records and locational and trait details of the selected trees.

Standard format for the report and an outline on information to be included is described below.

5.0 Area Covered

Provide a paragraph or so description, i.e., management units, general topography, forests of the area, general comments on existing reforestation, etc.

5.1 Stands Cruised

Provide a paragraph or so description on how many stands were compiled and how many were prioritized and cruised; comment on size of stands, their elevations, composition, sites, etc.

5.2 Description of Field Work

Provide 1-2 paragraph description on the following:

- Staff who did the field work
- Time when field work was done
- General comments on problems, difficulties, etc., that may have been encountered.

5.3 Cost Summary

Provide cost summary:

- Manpower spent
- Truck miles spent, helicopter time, etc.
- Miscellaneous expenses.

5.4 Parent Tree Records

Superior "Parent Tree Selection Forms" must be completely filled out for each tree and included in the report (see attached example in SECTION 1). Also provide one good photo for each tree if possible. The photo should have its tree number written on it. Photos can be digital.

5.5 Location of Selected Trees

Provide location of individual trees in a geographically referenced map(s) attached to the parent tree selection report.

5.6 General Comments

Provide any feedback and critique that may improve planning, organizing, and carrying out of similar projects.

SECTION 6: Guidelines and Procedures for Planning, Executing, and Reporting on White Spruce Cone Collections

6.0 *Cone Collection from Superior White Spruce*

Cone collection from Superior lodgepole pine is conducted at the same time as wood density and scion collection, making it possible to include this information as part of the Superior Tree Project Report. With Superior white spruce, cones are not retained on the tree making it necessary to maintain the tree for several years until an adequate cone crop for collection occurs. This requires annual maintenance of trees, annual cone crop status surveys, and when an adequate crop does occur, a cone collection and submission of a cone collection report.

6.1 Cone Crop Status Survey Guidelines

It is important that an annual cone crop survey of selected superior trees be made as it is quite easy to miss light cone crops that are marginal for general collection but may be adequate for any given Superior Tree. Backlogs of trees from which cone collections are pending increase the risk of loss to logging and windthrow etc. which causes delays in the establishment of progeny trials and seed orchard improvements.

The "Cone Crop Status Survey Form for Superior SW Trees" attached in the APPENDIX is intended to be filled out in late July to aid in determining the areas where collections are feasible and to assist in planning for collections in August when cones are mature.

In conducting the survey and filling out the form the following guidelines should be followed:

- Visit every superior tree from which collections are outstanding.
- Checking should be done with high power binoculars or a spotting scope with careful attention to upper crowns.
- Check that tree corresponds to clone/field number and location in the first two columns of the form.
- After careful observation of the superior tree, fill out the "tree cone crop code" column with appropriate rating code as described below:

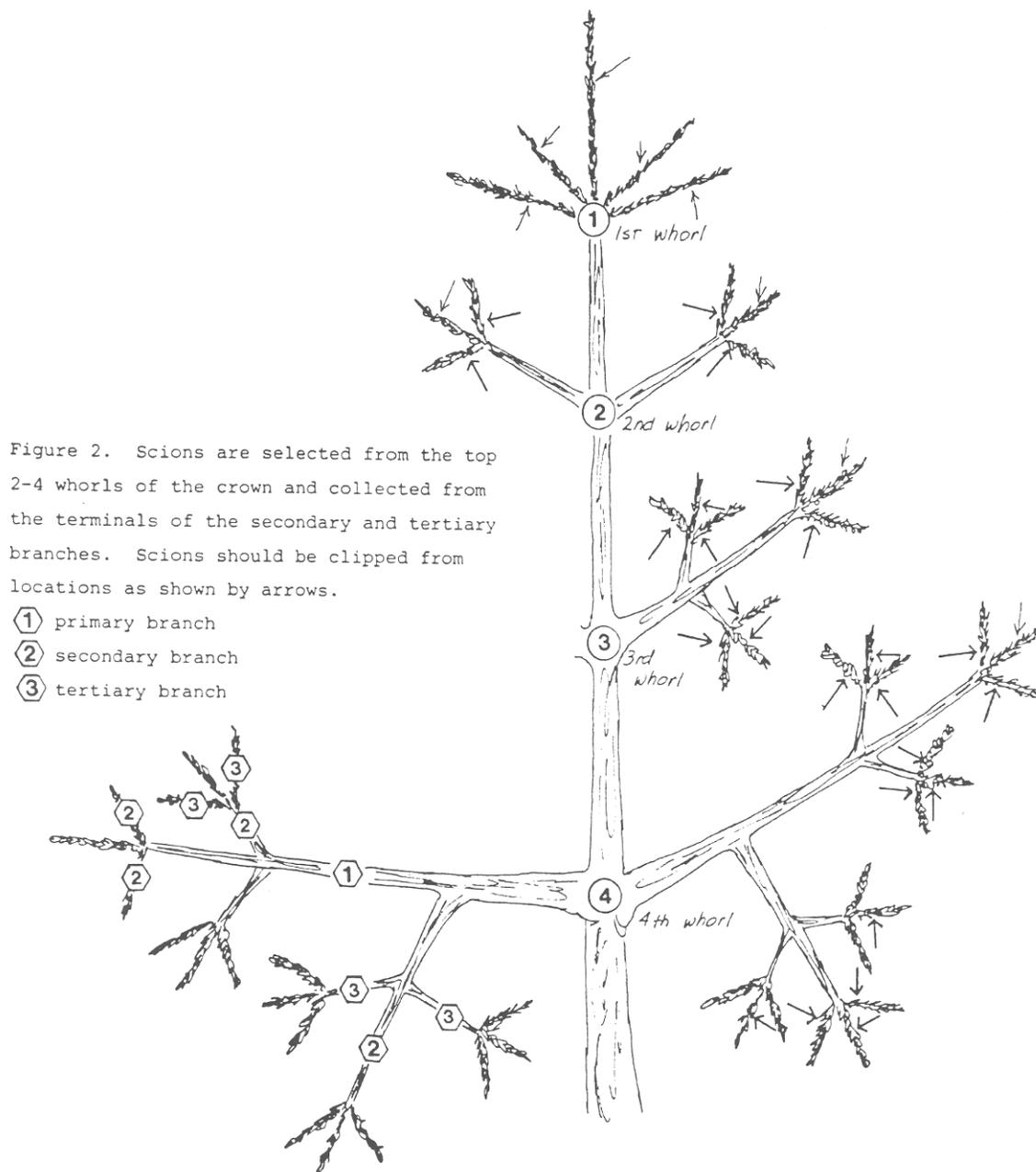


Fig. 2 Scions are selected from the top 2-4 whorls of the crown and collected from the terminals of the secondary and tertiary branches. Scions should be clipped from locations as shown by arrows.

1. Primary branch 2. Secondary branch 3. Tertiary branch

- 1 = Nil
- 2 = Poor – i.e. tree has at least 1 cone bearing branch meaning total number of cones on tree is at least 50
- 3 = Fair
- 4 = Good
- 5 = Very good
- 6 = Excellent – i.e. half of living crown is loaded with cones

Note: where crop on superior tree is rated poor or fair, estimate total number of cones and record in "Remarks/Notes" column of form, eg. 100 - 200 cones on tree etc.

- After surveying the superior tree observe the stand in its immediate vicinity (approx. 1 acre) and make an assessment of the % of mature trees (eg. 30%) bearing cones. Note this in the "% trees column" under "stand cone crop".
- Once the % of trees bearing cones is assessed make an estimate of the average extent of the crop in the same area i.e. Poor, fair, moderate, good etc. And record it under the "cone crop size column"
- The "notes/remarks" column is provided for comments or special observations with respect to subject tree or stand. For example: will require helicopter access, cones have rust, tree not found or already cut down, etc.

6.2 Guidelines and Procedures for Cone Collections from Superior White Spruce

- Once it is determined from the 'Cone Crop Status Survey' that a collection is feasible, i.e. about 30% of trees have a collectable crop, collections should be made commencing usually in mid to late August and finished before the end of August.
- The Superior Tree (marked with a large "S") is checked to ensure that it will yield the required number of cones before felling. If cone crop on tree is light consider shooting branches as cones will splatter on ground if tree is felled.
- When an adequate cone crop exists, and scions have already been collected, the tree can be felled and cones collected making sure there is no contamination with cones from other trees.
- If scions have not been collected and a collectable crop exists, shoot off upper branches which have clusters of cones: try and remove these branches below the top 4 whorls to leave sufficient top for collection of scion material in the next winter season.
- Only sound cones should be picked. However, if cone crop on tree is poor, pick all reasonable cones.
- Collect as many cones as possible but do not exceed 500 as it is difficult to keep more than 500 cones per sack from heating (minimum required is 80).
- Cones are shipped in cone bags provided: contact Tree Improvement Forester, Alberta Tree Improvement & Seed Centre @ 780/ 656-5072 when shipping.

- One bag to be used per Superior Tree with 2 labels per bag marked clearly in indelible ink with the following:

*parent tree field #

*parent unique ID if available

*legal location of tree

*date of collection

*collectors name

G10 – 89 01
XX02823
Ls 4sec 1twp 50 rge 26-W5
90-08-23
Joe Smith

- one label to be placed inside the bag and one tied with twine to the sack.

- Once collection is completed forward cone bag (s) to ATISC, Attention: Tree Improvement Forester. It is important that cone bags be shipped promptly, i.e. within 2 days of collection even if batches are small. If this is not possible, shipper should ensure that cones are handled properly to prevent heating or molding i.e. that cones are stored in a cool dry shaded area with good aeration around cone bags.

APPENDIX

Containing:

- White Spruce Candidate Stand Cruising Form
- Prioritized Candidate Stand Form
- Parent Tree Selection Form
- Standards and Code Sheet for Field Use
- Equipment List
- Cone Crop Status Survey Form for Superior Sw Trees

WHITE SPRUCE CANDIDATE STAND CRUISING FORM

1) Phase III Stand Description for candidate stand:

- a) Timber type _____
- b) Stand number _____
- c) Area _____

2) Ground Survey:

- a) legal location (exact) _____
- b) elevation (m) _____
- c) aspect _____
- d) slope (%) _____
- e) landform/topography _____
- f) stand access (road, helicopter, trike, etc) _____
summer, 4x4 winter _____
- g) stand composition

	species	%
major		
minor		
minor		

- h) estimated number of White Spruce stems/ha _____
- i) ground truthed timber type of stand _____
- j) biogeoclimatic subzone: _____
site type: _____
- k) additional comments: _____

3) Observations on White Spruce Only:

Age-class distribution:

Class	% of Trees
Overmature (120+)	
Mature (80-120)	
Immature to mature (40-80)	

4) Focusing only on Mature Age-class of White Spruce:

- a) General observations (circle yes or no)
 - i) are the trees generally straight stemmed? Y or N
 - ii) stand lacks "wolf" or bushy crowned trees? Y or N
 - iii) do the trees have pronounced leader growth? Y or N
- b) sample tree data – from 5 randomly chosen dominant trees spread throughout the stand:

Tree#	BH Age (yrs)	Height (m)	DBH (cm)	Radial Increment (cm)	
				Last 10 yrs	Last 11-20 yrs
1					
2					
3					
4					
5					

7) Additional Remarks on the Stand (defects, windblow, excellent growth, excellent timber-type stand) _____

8) Cone Crop Status of White Spruce _____

Parent Tree Selection Form - Wild Stands and Plantations

Species _____	Field Number _____	Unique Identifier _____	
Selection Agency _____		Selection Date _____	

STAND INFORMATION

Collection Site: _____	Natural Subregion: _____
Legal Location: _____	Seed Zone: _____
Latitude: _____	Site Type: _____
Longitude: _____	Stand Type: _____
Elevation (m): _____	Moisture Regime: _____

Stand Comments: _____

TREE INFORMATION

Sex	Male <input type="checkbox"/>	Female <input type="checkbox"/>	<i>Monoecious</i> <input type="checkbox"/>
Wood Sample	YES <input type="checkbox"/>	NO <input type="checkbox"/>	Collection Date: _____
Scions	YES <input type="checkbox"/>	NO <input type="checkbox"/>	Collection Date: _____
Open Pollinated Seed	YES <input type="checkbox"/>	NO <input type="checkbox"/>	Collection Date: _____
Root Sections	YES <input type="checkbox"/>	NO <input type="checkbox"/>	Collection Date: _____

Trait	Select Tree	Dom. ¹ 1	Dom. ¹ 2	Dom. ¹ 3	Superiority ¹ (%)	Comments
Height (m)						
Age						
Natural Pruning (%)						
Height/Age (cm/yr)						
DBH (cm)						
Radial Increment						
Last 10 yrs (mm)						
Last 11-20 yrs (mm)						
Stem Form						
Branch Angle						
Branch Thickness						
Crown Width						

¹ Dominant tree data required when making selections using the comparison tree method

Tree Remarks: _____

Parent Tree Location Map	Description
	Location/Access: _____ Tree Marking: Photo Attached Yes <input type="checkbox"/> No <input type="checkbox"/>

AGENCY REPRESENTATIVE _____ **Signature** _____ **Date** _____

SUPERIOR TREE SELECTION PROJECT

Standards and Code Sheet for Field Use

Age

Taken at breast height (1.3m)
Must be correct within ± 2 years

Height

Must be correct to ± 0.5 m
Using 30 metre tape and
handheld clinometer.

Natural Pruning

Height to live crown expressed as a percentage of total
height.

Dbh

Taken at 1.3 m in cm
must be correct to ± 0.1 cm

Radial Increment

Radial increment for the last 10 year growth period and
for the last 11-20 year growth period in cm's. (taken at
dbh)

Form (VIEW THE TREE STEM FROM ALL SIDES)

1. Crooked in two planes, forked stem
2. Crooked in one plane
3. Slight sweep in one plane or pronounced basal sweep
4. Slight basal sweep or lean not effecting stem
5. Straight

Branch Angle

(upper middle crown)

1. Most branch angles (i.e., between branch and stem) less than 70°
2. Most branch angles less than 90° but greater than 70°
3. Most branch angles 90°

Branch Thickness

(upper middle crown)

1. Most branches greater than 4 cm diameter
2. Most branches between 2 cm and 4 cm diameter
3. Most branches less than 2 cm diameter.

Crown (general crown profile)

1. Comparatively wide crown
2. Average Crown width
3. Comparatively wide crown

Taper (ONLY TO BE MEASURED ON FELLED TREES AFTER CONE COLLECTION)

Ratio between diameter at 6.3 metres and diameter at
breast height.

Notes:

The highest value of a code always represents the most desirable expression of that feature

Be rigorous in the application of standards. If in doubt grade downwards

Equipment List

Checklist of Equipment for Superior Tree Cruising
Sunto Clinometer
Metal Diameter Measuring Tape
Increment Borer (Standard size)
Pocket Calculator
Permanent Felt Marker
Binoculars
Phase III Stand Maps
Surveyors Hand Compass
Metric Topofil (with string)
Cloth Tapes (30 and 50 metres)
Plastic Ribbon (flaggin)
Cruiser Vest
Magnifying Glass (10X)
Tree Paint (aerosol -- blue and orange)
Camera and film (b/w)
Altimeter or topographic maps
Superior parent tree data forms
Equipment for Collection of Wood Samples (from standing trees)
Large diameter (12 mm) increment borer
Increment borer started and reverse jack
Indelible pencils (waterproof)
Aluminum foil
Silicone vacuum grease
WD-40 or LDS type lubricant
Isopropyl alcohol
Sample storage box
Small hatchet (or axe)
Masking tape
Equipment for Collection of Scion Material
25-06 rifle with scope, carrying case, and cleaning kit
Ear protection
Ammunition (25-06, 90 grain, hollow point)
Cooler
Plastic bags with twist ties
Tags
Indelible pencils (waterproof)
Pruning shears

