Working with your forest seedling nursery

TIPS TO SELECTING, ORDERING, AND INSPECTING STOCK

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FOREST RESOURCE DEVELOPMENT AGREEMENT

Canada BC

STOCK TYPE SELECTION

Species and Stock Type Selection*

Species selection should be based on:

- site ecological acceptability
- timber production goals
- silviculture system
- forest health
- TSA plan
- other resource requirements
- local experience

Stock type selection and number of seedlings required should be based on the consumers' morphological specifications, the anticipated delivery date, and stocking standards.

**More detailed information on nursery culture is available in the following FRDA course workbook:* Scagel, R. and R. Evans. 1990. A consumer's guide to tree seedlings: a workbook on production, testing, and handling. For. Can. and B.C. Min. For., Victoria, B.C.

A concise summary of information on stock handling is available in the following colour brochure: Silviculture Branch, 1990. Nursery to planting site: a team effort. For. Can. and B.C. Min. For., Victoria, B.C.

On a site-specific basis, identify the potential limiting factors to survival and growth and select a seedling morphology and planting window that will avoid or minimize the effects of these limitations:

- browsing
- brush competition
- surface temperature
- available soil moisture
- soil depth
- soil coarse fragment content
- snow press
- site accessibility
- planting contractor availability
- season

You should also develop contingency plans to cover the possibility of site preparation and nursery problems.

Seedlings are custom-grown to your specifications so test different morphological specifications, stock types, and nursery cultural techniques as they become available.

Major Stock Types of Principal Reforestation Species

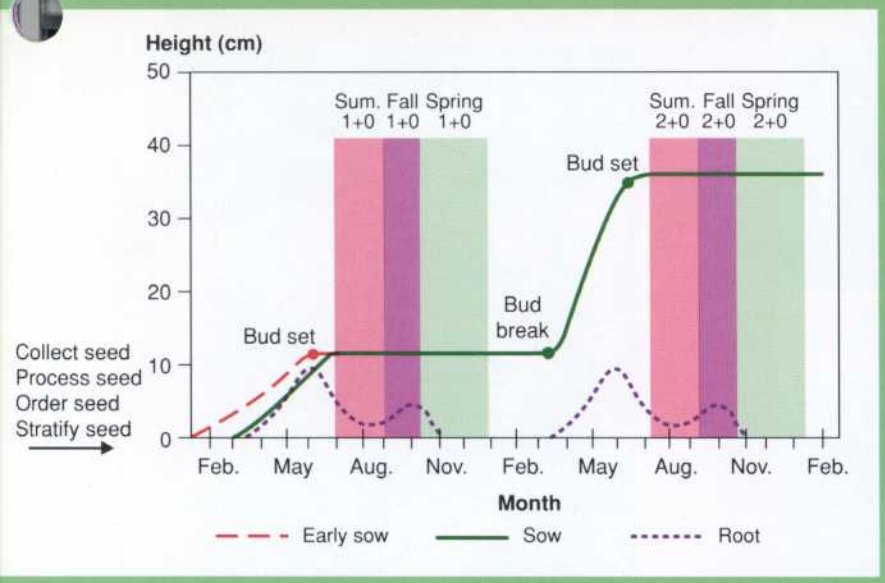
The diagrams illustrate the relative size, dimensions, and other characteristics of the major stock types of principal reforestation species. In particular note the date of the photograph, the relative succulence of the stock, and the relative size of roots and shoots. The seedlings selected meet or exceed the current Ministry of Forests target morphological specifications. These characteristics are also similar to those for species not shown here.

Si Stock Types

The photograph was taken in early August while the stock was still succulent but height growth had ceased.

Pli Stock Types

The photograph was taken in early September. Although the apical bud has set in all the stock types, the container crops have candled and the stem has stretched slightly below the bud. Note the presence of secondary needles on the field-grown crops.



Crop height growth in relation to major crop cycles.

Bars indicate the lifting windows for major stock type age-classes. Diameter growth generally follows height growth. Root activity has a seasonal fluctuation with maximum rates occurring immediately before bud flush and immediately after bud set.

Crop Cycle Selection

The sowing date determines the delivery date of ordered seedlings. The major crop cycles should be selected on the basis of whether the anticipated delivery date coincides with an acceptable planting window, sufficient morphological size, and vigour. Delaying sowing by two or three weeks can have a major effect on the nature of the crop.

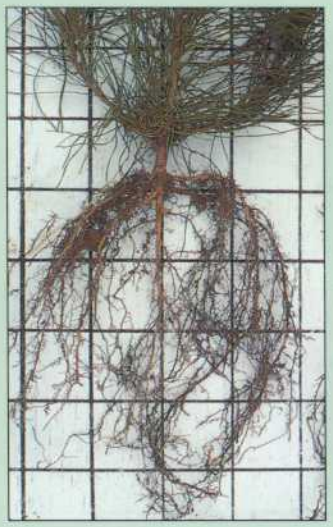
When making a crop cycle selection, the nursery must work backwards from the anticipated delivery date to schedule all aspects of crop culture. Modification of crop cycles are limited, so advise the nursery if you anticipate changes in the delivery date. If unforeseen site factors delay or prohibit planting, a customer should consider trading stock with licensees and the Ministry of Forests.

Once a sowing date has been selected, a sowing request should be prepared and submitted to the Tree Seed Centre. Prepare the sowing request as early as possible to allow the Seed Centre time to withdraw and prepare the seeds for sowing. Processing sowing requests is time-demanding and requires careful scheduling at the Tree Seed Centre. Seed preparation and stratification, especially for Ba, Bg, Bl, and Cw affect sowing date and cultural conditions during germination.

Fdc Stock Types

The photograph was taken in early September. All stock had ceased height growth. The M⅜+⅜ were still succulent. The slight yellowish colour to the PSB 415B 2+0 probably shows a nitrogen deficiency.

Root Activity and Form



Note the fine root structure and branching of the Pli BBR 2+0.

G. Matthews

Note the prolific root activity indicated by white root tips on the Si PSB 313B 2+0.

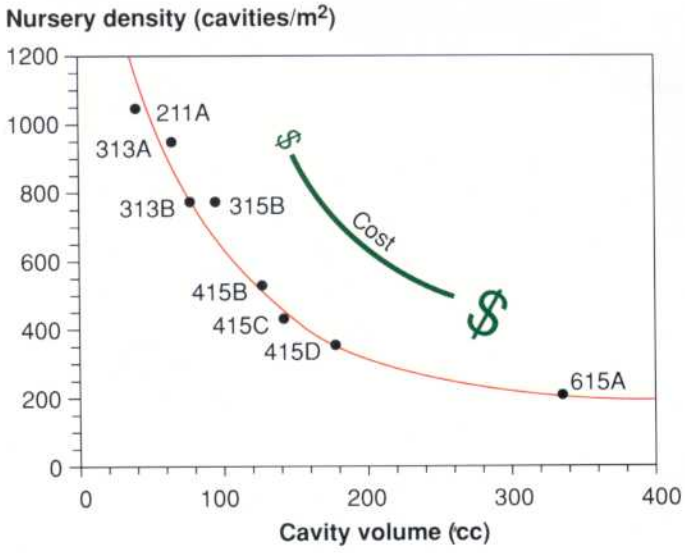
ORDERING

Stock Type Cost Factors

The selected morphological specifications and delivery date will determine the cost of the seedling by:

- the amount of nursery space required: *larger morphological specifications require more space.*
- seed quality: *poor germination vigour will require more space and thinning.*
- the type of facility: *greenhouse, open-compound, fields.*
- sowing date: *early sowing requires significant heating costs*
- special handling or treatment: *blackout, extended photoperiod.*
- age: *2+0 open-compound crops may require special overwintering facilities.*
- packaging: *larger morphological specifications may require more or larger cartons.*
- storage: *stock to be delivered in the spring will require frozen or cold storage; storage space is sold on the basis of volume, duration of storage, and storage conditions.*
- lifting and grading: *the cost of cull seedlings is borne by the cost of the acceptable seedlings.*

Larger stock types will cost more to plant and may present special handling problems and handling concerns — they may not be the most cost effective stock type for all purposes. A silviculture budget should be developed to reflect the required morphological specifications.



Poor Seed Germination in a Seedlot of Bg

Such seedlots should be noted and the Tree Seed Centre and owner advised of their poor performance. The performance of seed and seedlot should be taken into consideration by the customer when ordering seedlings.

Shipping Cartons

Three major shipping and storage cartons are available *(left to right)*: coffin-box; regular; and dairy crate for summer planting. The recently developed recyclable boxes are not shown. In addition the orientation of bundles of seedlings can also influence storage costs and seedling quality.

Nursery Facilities

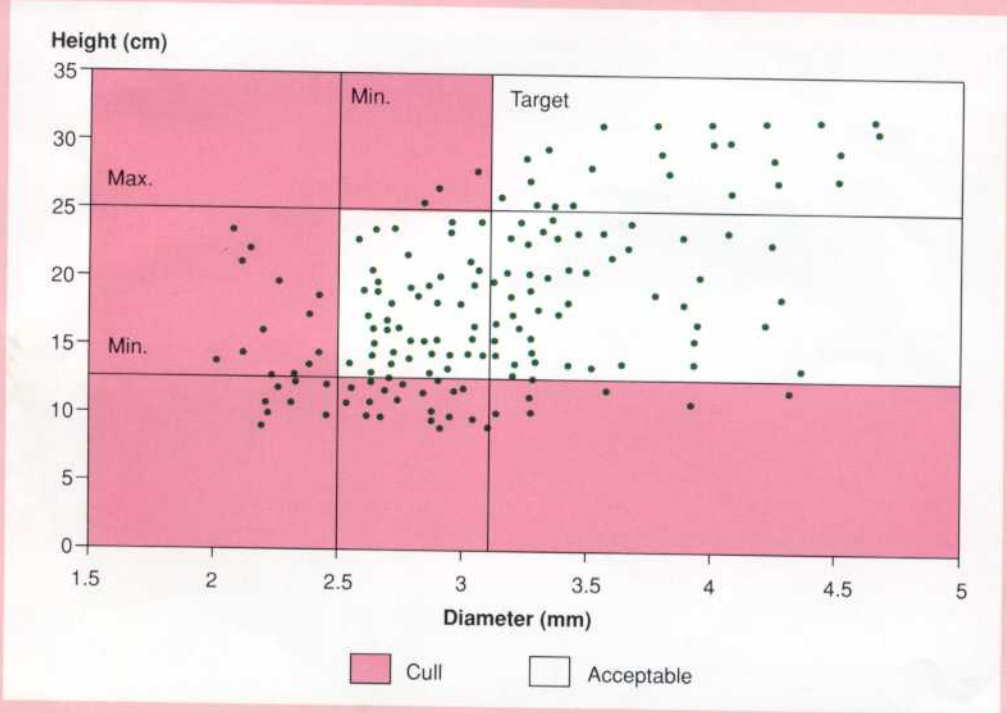
Glass-covered greenhouse with moveable palletized styrofoam blocks of seedlings. Other features in this greenhouse are CO_2 generators, under-bench heating, and boom-mounted irrigation. Such facilities are well suited to early sown crops.

Field nursery culture. Si PBR 1+1 with 6 rows of seedlings per bed.

Open compound Si PSB 415B 2+0 crop.

Note lights that can be used to extend the photoperiod for the crop.

Culls



Although they should not show up in the delivered seedlings, culls are part of the production cost of the saleable seedlings. Morphological specifications determine how much culling will occur. Therefore choose your specifications realistically, basing them on plantation performance and the advice of the nursery. When inspecting a scattergraph consider both what you are buying and what you might be throwing away.

INSPECTING SEEDLINGS

Inspecting Seedlings in the Nursery and Outplantings

Seedlings should be inspected twice: once during crop culture and again immediately before lifting. Ask yourself the following questions when evaluating seedlings at the nursery:

- Do these seedlings have the potential to do the job?
- Is this really what I thought I was ordering? *Too small, too big?*
- Does this stock have characteristics which suggest that it may be at risk when it is outplanted? *Too succulent, too dormant?*
- Are there unforeseen opportunities here? *Earlier planting dates, more trees?*

If necessary, more detailed seedling inspection using physiological, phytopathological and histological techniques can be performed by the Ministry of Forests, Forestry Canada, and private labs.

A formal assessment of the stock should also be performed at lifting before delivery or storage. The objective of a formal adjudication is to determine whether the nursery is delivering what was requested in the growing contract. Planting supervisors should receive a copy of the adjudication so they are aware of the nature of the stock they will be handling.

Root Diseases

G. Shrimp

Root diseases are a major cause of seedling losses in nurseries and plantations. They are generally difficult to detect and are frequently overlooked unless the infestation is severe. Some root diseases may be visible early in crop culture, as in the example of *Fusarium* infestation of Se PSB 313 1+0. Other root diseases, notably *Cylindrocarpon*, require careful examination and stripping of the root system to detect dieback.

Infection can result in a drastic reduction in height growth and delayed mortality - in the example of Fdc PSB 615 1+0, two years after outplanting.

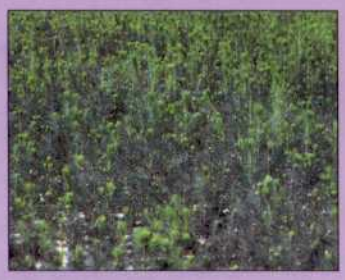
Sampling Seedlings

All sampling uses only a very small sample of the seedling population and can lead to a misleading assessment of the crop. Take a sample from throughout the crop and check the roots for activity and characteristics. Excavate seedlings from the middle of nursery beds, and lift several seedlings from across a styrofoam block. Check for storage molds.

G. Matthews

Reflushing

Once bud set has occurred, seedlings may reflush. The entire crop may be affected or only a few trees, as in the Si crop.



The Fdc seedlings illustrate a range of reflushing from incipient to complete reflushing and a firm bud. Succulence, as a result of reflushing, is unacceptable if the crop is scheduled for summer or fall planting.

incipient flush | slight flush | complete reflush | partially hardened reflush | firm bud

Mycorrhizae

Mycorrhizal seedling roots may resemble — but should not be confused with — storage molds. In addition to fungal mycelia, seedling roots may also display different morphology depending on the colonization by the fungi. On the non-mycorrhizal seedling, note the presence of root hairs at the elongated root tip. Mycorrhizal roots lack the root hairs and have forked, stubby root tips.

mycorrhizal

non-mycorrhizal | mycorrhizal

non-mycorrhizal

mycorrhizal

all: G. Hunt

Weeds

Weeds may proliferate in container-grown crops, especially where seedling densities are high. Liverworts are one of the more serious weed problems and may lead to storage molds on dead foliage and root collar and promote adventitious rooting that prohibits lifting. Inspect seedlings for storage mold and dead foliage to determine whether there is the potential for mold development.

G. Shrimpton

Botrytis on Si PSB 313 2+0.

Liverwort infestation in Se PSB 313 2+0

G. Matthews

Adventitious rooting in Si PSB 313 2+0.

Drought Stress

Wilted tops, rings of dead needles, and reduced needle size all indicate drought stress in a PSB 313 1+0 Se crop. Notice how trees along the block edges are more wilted and yellowish compared to trees in the centre of the block.

G. Matthews

Winterkill

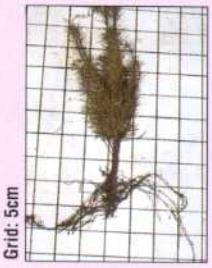
G. Matthews

Species and seedlots can vary in their tolerance to cold damage. The Sx seedlot on the right was damaged more than the Si crop on the left. Winterkill is a possibility in any crop that is overwintered outside, particularly container-grown crops.

To avoid winterkill in container crops, the styrofoam blocks must be placed on the ground or inside to minimize damage.

Root Physical Damage

Grid: 5cm



Grid: 5cm

Field-grown crops should be examined carefully after lifting to determine whether extensive damage has occurred. The examples *(left)* minor root stripping damage of Pli BBR 2+0 and *(right)* severe root damage to Fdc BBR 2+0 associated with improper mechanical lifting or root culture (wrenching, undercutting) of stock. Note the lack of fine roots on the Pli.

Nursery Outplanting

Performance of seedlings in nursery outplanting plots should be checked against results from field monitoring programs. Evaluating these plots can provide you with information on stock quality and help you develop stock types and nursery culture. On walking through the outplanting plots, examine your seedlings carefully and consider which stock types appear to be superior to others.

Grid: 5cm

2.0-2.4 mm | 2.5-2.9 mm | 3.0-3.4 mm | 3.5+ mm

Diameter class outplanting comparison.

A nursery outplanting comparison of different diameter specifications for Se PSB 313A 1+0.

Grid: 5cm

summer | frozen stored | succulent hot-plant

Planting time outplanting comparison.

A comparison of different planting dates of Se PSB 313A 1+0.

Seedlot Differences

Seedlots respond differently, and often in unpredictable manners. The Si seedlot on the right ceased height growth at the end of extended photoperiod treatment; the Si seedlot on the left continued to grow. The bluish color is due to thickened cuticles and deposition of waxes on the more phenologically advanced seedlot.

G. Matthews

Stock Condition Rating Table

		Con	1	2	3	4	5	6	7	8	9	10	Pro	If con then suggests:
Foliage	Colour	brown, red					yellow						green	Nutritional problems
	Lower foliage	dead, dropping											live	Potential mold problem
	Needle succulence	dry, withered											turgid, cool, moist	Drought
	Needle abnormality	necrotic					mottled						normal	Nutritional problems
	Needle uniformity	variable											uniform	Drought
	Needle wax	absent											present	Stock not hardened off
	Needle length	decreases											uniform	Drought
	Insect damage	present											absent	How severe?
	Foliage notes													
Flushing	Flushing	no flush											flushed	Stock is active
	Flush condition	wilted											healthy	Drought
	Flush colour	white					yellow						green	Stock how active?
	Flush length													Stock how active?
	Flush notes													
Buds	Bud size	small, button-like											large	Little bud development
	Bud break	present											absent	Stock is active
	Bud scales	white, translucent											brown	Incipient flush
	Bud scales	separating											tight	Stock is active
	Rosette buds	present											absent	Nutritional problem
	Insect damage	present											absent	How severe?
	Bud notes													
Stem	Forked from base	forked					dominant leader						none	Acceptable?
	Forked in top third	split											none	Acceptable?
	Twin seedlings	two											one	Acceptable?
	Bark stripping	brown					mottled						green	Frost, insect, physical damage
	Lammas growth	present											none	Will it be a problem?
	Bark damage	damaged											none	How severe?
	Swollen stem bases	swollen											none	Pathogen present
	Broken tops	broken											intact	How many?
	Insect damage	present											absent	How severe?
	Stem notes													
Mold	Lower foliage	active											arrested	How severe?
	Upper foliage	active											arrested	How severe?
	Stem	active											arrested	How severe?
	Root collar penetration	present											absent	How severe?
	Foliage colour	black, slimy											green	How severe?
	Odour	musty											pinesol	How severe?
	Mold notes													
Roots	Root stripping	brown											white	Root rot
	Occurrence	localized											throughout	How severe?
	Mycorrhizae	absent											present	Why not?
	Root branching	sparse											abundant	Too wet
	Root hairs	sparse											abundant	Stock damaged?
	Root activity (white roots)	none											abundant	Stock is active
	Root moisture	dry											moist	Drought
	Root damage	stripped, torn, broken											none	How severe?
	Hypertrophied lenticels	abundant											none	Too wet
	Insect damage	present											absent	How severe?
	Root notes													

Morphological specifications

Height											
Caliper											
Root oven-dry weight											
Shoot oven-dry weight											
Root/shoot ratio											
Needle weight											
Foliar nutrients	N	P	K	Mg	Ca	B	Cu	Zn	S	Fe	Mn

Notes **highlighted and in bold face** *should be considered during a routine assessment. Others should be considered if a specific problem occurs.*

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