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**THE BENEFITS OF SITE PREPARATION
FOR REFORESTATION**

REFORESTATION PRACTICES

Presented at:

WORKSHOP ON

**"FOREST MANAGEMENT ON FIRST NATIONS
FORESTED LAND IN ALBERTA"**

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Prepared by:

Derek Sidders
Canadian Forest Service
Northern Forestry Centre
Edmonton, Alberta
T6H 3S5

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TREE PLANTING

INTRODUCTION

The following pages identify the components included in the supervision and co-ordination of Tree Planting; Thinning and Releasing; and Site Preparation silviculture field operations.

The intent of the workshop and this booklet is to give you the background information required to plan and implement these silviculture field operations from a supervisor's or project co-ordinator's perspective.

The reference information included in this booklet was put together by Forestry Canada* staff and represents present practices in Saskatchewan.

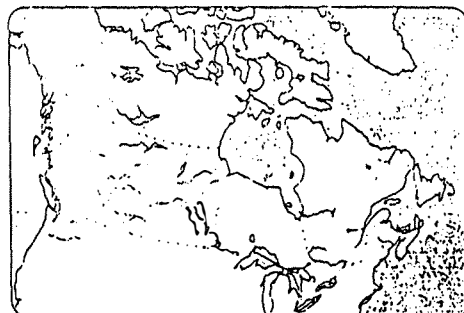
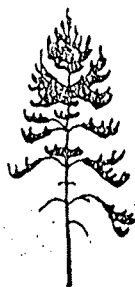
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* now referred to as Canadian Forest Service

JACK PINE

Pinus banksiana Lamb.



FORM—Jack Pine is quite variable in form. In the open, it has a conical open crown of ascending and arching branches and a tapered trunk. In a closed stand, the live-crown becomes greatly reduced, usually covering less than one-fifth of the length of the tree; the trunk is slender, straight, and with little taper. On poor soils and rocky sites, the tree is short, often twisted, with wide-spreading, tightly foliated branches, some of them dead or dying, which gives the crown an unkempt appearance. In western Canada where the range of Jack Pine overlaps that of the closely related Lodgepole Pine, the two are often difficult to separate because of the many hybrids between them. The root system is wide-spreading, moderately deep and without a tap-root, except on deep porous soils.

HABITAT—Characteristically Jack Pine is a tree of the Boreal Forest Region and grows in pure stands or in mixture with Black Spruce. Also in mixed conifer/hardwood stands it is found with White Spruce, Black Spruce, Balsam Fir, Trembling Aspen, Balsam Poplar, and White Birch. It reaches its best development on the sandy soils in a wide area north and west of Lake Superior.

SIZE—In closed stands on favourable sites, it reaches 80 ft. in height, with a straight trunk 2 ft. in diameter but, normally, it is 40 to 60 ft. in height and 8 to 12 ins. in diameter.

LEAVES—In two's, $\frac{3}{4}$ to 2-ins. long, needle-shaped, straight, or slightly twisted, stiff, sharp

pointed, light yellowish-green, spread apart, the edges toothed; clusters with persistent basal sheaths.

CONES—Variable in shape, oblong to conical, asymmetrical, straight or curved inwards, 1- to 3-ins. long, stalkless, often whorled, usually pointing forward; scales with thickened tips, smooth or with a minute prickle, usually remaining closed, but occasionally opening on some trees; cones persistent on the tree; seeds $\frac{1}{2}$ -in. long, black, often ridged; seed-wing about $\frac{3}{4}$ -in. long.

TWIGS—Slender, yellowish-green becoming dark greyish-brown; buds pale reddish-brown, rounded, $\frac{1}{2}$ -in. long.

BARK—Thin, reddish-brown to grey on young stems becoming dark brown and flaky on old trunks furrowed into irregular thick plates.

WOOD—Moderately hard and heavy, not strong; heartwood light brown, sapwood nearly white.

SEEDLINGS—Four or five seed-leaves, without teeth.

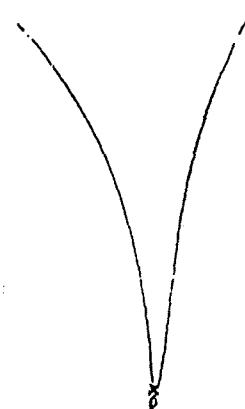
IMPORTANCE—Used in general construction and for pulp; other uses are railway ties, poles, pilings and mine timbers.

NOTES—Parboiling the male flower clusters to remove excess resin makes them suitable for eating.

Early settlers considered the Jack Pine to be an evil tree—probably because their crops failed to survive on the poor soil in which this tree sometimes grows.

Banksian Pine

JACK PINE



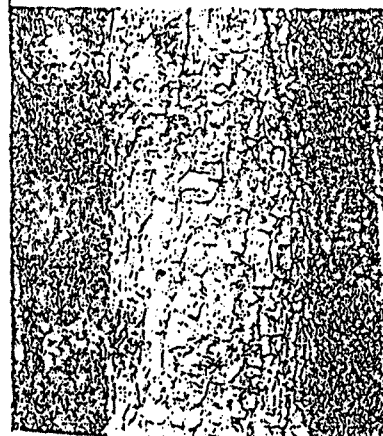
LEAVES NOT TWISTED, BUT SPREAD APART



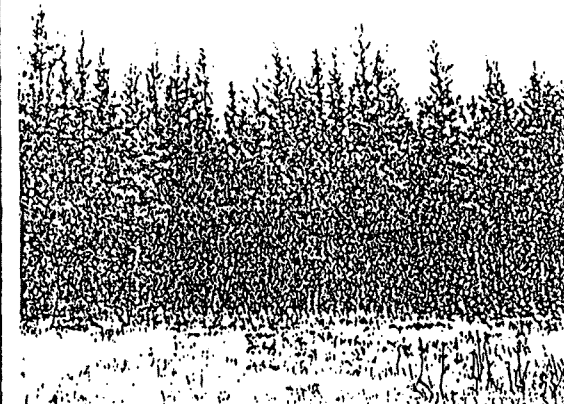
COMMON CONE SHAPES



OCCASIONALLY, CONES OPEN ON SOME TREES



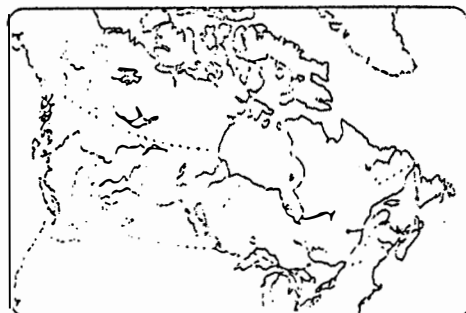
BARK OF MATURE TREE IS FLAKY



STAND OF JACK PINE

WHITE SPRUCE

Picea glauca (Moench) Voss



FORM—White Spruce has a uniform conical crown with branches that spread or droop slightly and extend to the ground, concealing a trunk with a pronounced taper and thin scaly bark. Quite tolerant of shade, the tree retains its leaves and branches low on the trunk but, in dense stands where there is little light, it gradually sheds its lower branches. In these conditions, the tree develops a long, slightly tapering trunk, almost free of branches, with the crown occupying about half of the tree's height. The root system is shallow with many tough, pliable, wide-spreading laterals, but the tree has only moderate resistance to wind-throw. Two western varieties have been named: Western White Spruce (*Picea glauca* var. *albertiana* (S. Brown) Sarg.) which has shorter and broader cones than those of White Spruce and a very narrow columnar crown; and Porsild Spruce (*Picea glauca* var. *porsildii* Raup) which has quite smooth bark covered with many resin blisters.

HABITAT—White Spruce is a characteristic tree of the Boreal Forest Region, although it can be found almost everywhere in Canada. With such a wide distribution, it grows in a variety of soils and climates, yet it rarely forms pure stands. The best examples of the tree are found in mixed stands on well-drained but moist, silty soils. The commonest associates are Trembling Aspen, White Birch and Balsam Fir, but it grows in mixture with other conifers and broad-leaved trees.

SIZE—On the average, White Spruce is 80 ft.

in height with a diameter of 2 ft., but some trees attain heights of 120 ft. and diameters of up to 4 ft.

LEAVES—Broad needle-shaped, about $\frac{3}{4}$ -in. long, stiff, with blunt ends, straight, four-sided in cross-section, green to bluish-green but often with a whitish bloom, aromatic when crushed.

CONES—About 2-ins. long, slender, cylindrical, with stiff, smooth-margined, often indented, roundish, close-fitting, light-brown scales which spread almost at right angles on open cones and are easily crushed. Cones open in autumn and fall during the winter or the following spring.

TWIGS—Usually without hairs, whitish-grey to yellowish; outer bud-scales pointed, but not projecting beyond the tip of the bud.

BARK—Thin, scaly, light greyish-brown; inner bark silvery-white.

WOOD—Light, soft, resilient, straight-grained; white, with little contrast between sapwood and heartwood.

SEEDLINGS—Five to seven thick seed-leaves; juvenile leaves toothed.

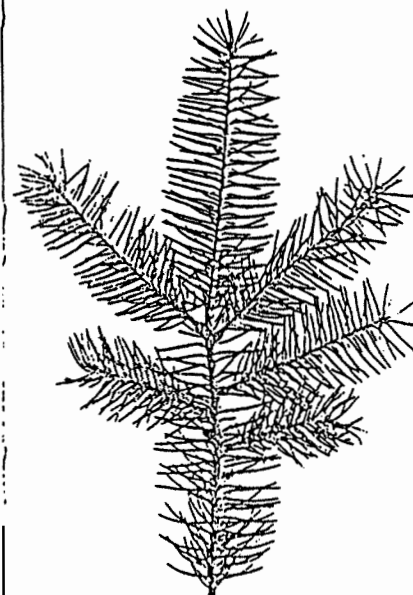
IMPORTANCE—One of the most important trees in Canada for pulpwood and lumber.

NOTES—The roots of this tree are so pliable that the Indians often used them for lacing the birch bark on canoes.

White Spruce is too aromatic for use in making spruce tea, but most of the other spruces make a palatable brew.

Cat Spruce

WHITE SPRUCE



LEAVES ARE STRAIGHT



CLOSE-FITTING SCALES HAVE SMOOTH MARGINS



BUD-SCALES SHORTER THAN BUD

LEAF-BASES STAND OUT FROM HAIRLESS TWIG



MATURE BARK HAS THIN SCALES

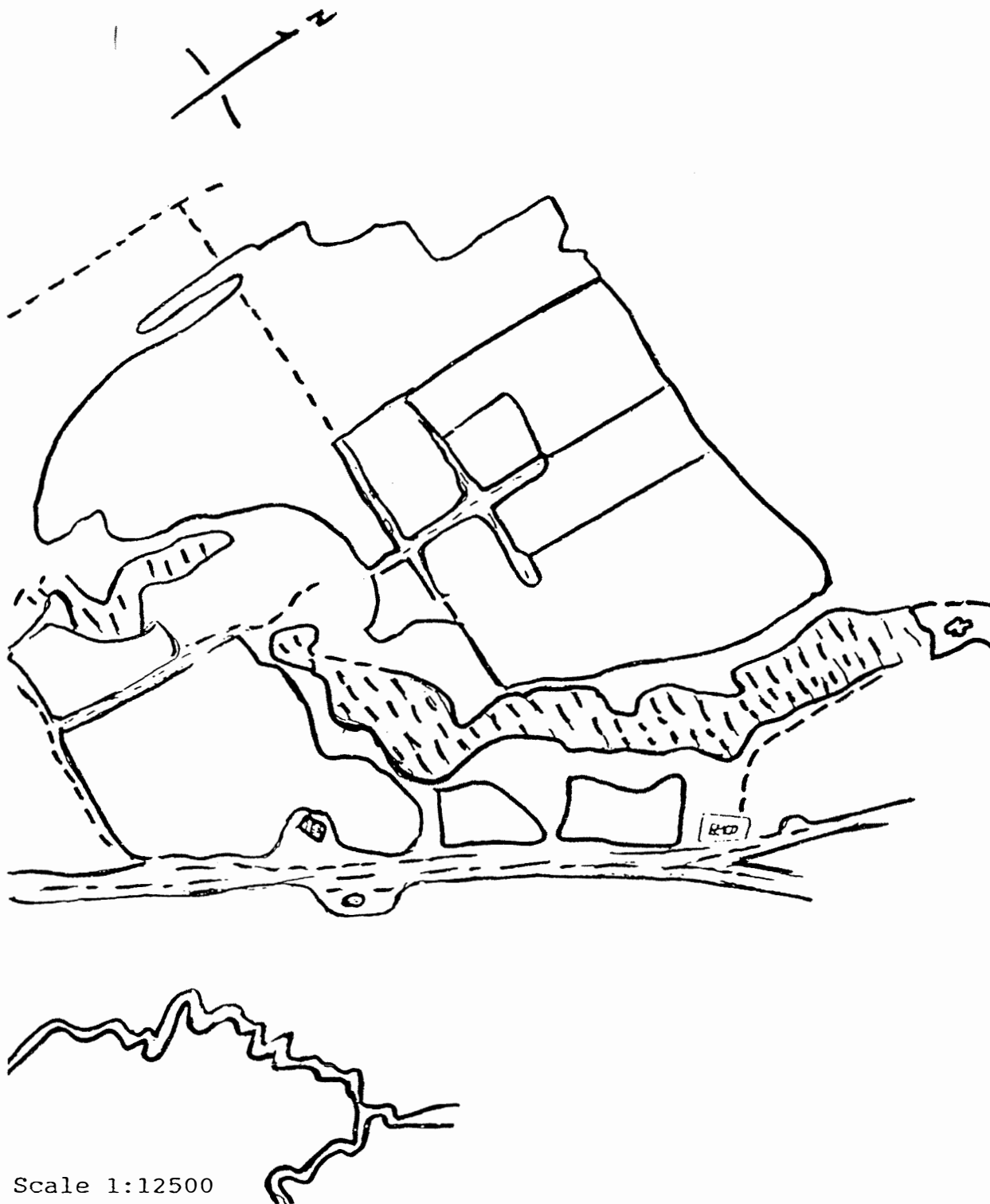


TREE PLANTING	B: Pre-Planning and Preparation
1. Site Inspection	<ul style="list-style-type: none"> - using site map and aerial photo (if available) inspect site for access, water supply and camp location; - inspect site preparation for consistency, planter obstructions (slash), excess moisture and length of rows and pattern; - observe field storage sites, natural crew distribution areas * see page 1-5
2. Planting Crew	<ul style="list-style-type: none"> - based on the number of planting days to complete the work; the total number of trees; and the estimated daily planter production; determine the number of planters to hire (allow for a 20% turnover of planters); - based on crew size, determine the number of crew foremen required; - other support staff required include one tree handler per 20 planters, and one clerk per 50 planters
3. Equipment Acquisition	<ul style="list-style-type: none"> - determine the equipment required for the planters (allow for 20% spares), based on tree type and size (or contract spec's); - determine the equipment for the crew, the tree transportation and handling of the trees; - gather the equipment required to co-ordinate, assess and maintain records for the duration of the plant * see page 1-7
4. Contract/Work Spec. Review	<ul style="list-style-type: none"> - review the specifications in the contract of work description highlighting: <ol style="list-style-type: none"> 1) the important dates; 2) the details of the planting itself (species, size, spacing, microsite description, method, equipment); 3) quality assessment; 4) penalties and bonuses; 5) contact persons; 6) invoice procedures <p>* see page 1-8</p>

TREE PLANTING

B-1: Site Inspection

Map Sample - Base 213 W61 N595



Brinkman & Associates Reforestation Ltd. -- 1987

Equipment List for Tree Planters

You Supply:

1. tent with rain fly
2. sleeping bag
3. foamie/or sleeping cot
4. eating utensils : (plate, bowl, mug, fork, spoon, knife)
5. lunch kit or day pack
6. thermos
7. insect foamy (see addendum)
8. work-pants (at least 3 pairs)
9. shirts (long-sleeved that button up at the collar and cuffs)
10. rain hat (you can use a hard hat, but the hood doesn't work.
11. hard hat (Ontario only, you must have your own)
12. toiletries (soap, shampoo, 2 towels)
13. socks (lots, you can't have too many!!)
14. bug dope

Suggested Extra Items:

1. tarp-plastic (orange or blue)
2. watch/or alarm clock
3. flashlight
4. moleskin (for feet)
5. jackets (both heavy/light)
6. apres-plant gear: bug proof
7. shorts
8. sun hat/glasses
9. bandannas
10. personal first-aid kit
11. warm hat
12. books/games for evenings
13. musical instrument
14. candles

Mandatory Work Gear YOU Supply:

- PLANTING BAGS - should have padded waist belt, shoulder strap, and have at least 3 bags.
- PLANTING SHOVEL - must be an official planting shovel, straight shaft, and *NOT* a garden shovel.
- WORK BOOTS - leather boots, and boot grease to maintain them.
- RUBBER BOOTS - you will need rubber boots (with insoles) for wet or muddy situations. If you buy them with steel toes, they you have fulfilled 2 purposes in one boot. We suggest a brand called NOKAI.
- CAULK BOOTS - they can be either rubber or leather. They should be of fairly high quality. (B.C. only). Don't forget extra caulks and a caulk wrench.
- STEEL-TOED (Ontario only) - you must have at least one pair of steel-toed boots. There may be situations where you will have to wear steel-toed boots. In those situations you will not be allowed to work without them. The first year some crews had to travel half-way across Ontario to buy steel-toed boots in the middle of the season. *Avoid the rush, get them now.*
- HARD HAT - the best color is white (neutral to bugs and cool). You will need a standard (Ontario only) helmet with a chin strap, not necessarily the best.

TREE PLANTING		B-3: Equipment Acquisition	
Equipment:			
<u>Planter:</u>	Planting Bags	Shovels	Dibble
	Container Carriers	Pottiputki	
	Hard Hats	Eye Protection	
	Gloves	Boots	
<u>Crew:</u>	Vehicles	(buses, trucks, ATV's)	
	Water Containers	Flagging Tape	
	Reflective Tarps		
<u>Storage/Handling:</u>			
	Refrigerator Van	(25' to 45' - self-defrosting)	
	Reflective Tarp		
	Vehicles	(trucks, ATV's)	
<u>Supervisors:</u>			
	Maps	Flagging Tape	
	Aerial Photos	Diary	
	Assessment Forms		
<u>Camp Equipment:</u>			
	Sleeping, cookery, eating, laundry, etc.		

Contract/Work Specification Sample

' contractor agrees to commence the said work not later than May 5, 1991, and to commence the said work on or before June 8, 1991.'

' contractor agrees to plant all trees in a manner as described in Appendix "A", and acknowledges that the seedlings are conventional white spruce bare-root seedling 3-0 (three years in nursery beds).'

' contractor will maintain a planting quality of at least 90 percent for the duration of the plant, based on the assessment procedures and calculations described in Appendix "B".'

' where the number of trees acceptable for payment is greater than 90 percent a bonus of.'

TREE PLANTING	C: Implementation:
1. Camp Layout	<ul style="list-style-type: none"> - camp is located based on pre-site inspection taking into consideration protection; central location; all weather access; sound ground conditions; and water availability; - the kitchen (eating), lavatory, and sleeping accommodations are laid out in such a manner as to maximize privacy, cleanliness, efficiency and comfort
2. Storage and Handling	<div>- Bareroot</div> <ul style="list-style-type: none"> - seedlings are delivered to the site in a refrigerated van and stored at a temperature of 2 to 3 degrees Celsius (trees packed in plastic bags in cardboard box) until the day of planting; - trees removed from the reefer van and delivered, are covered by a reflective tarp on the way to the field on the day of planting; - trees are stored under reflective tarps in the field, preferably out of direct sunlight until the planter removes them for planting; - when the planter removes trees from the field stash, they are dipped in water and placed in the planting bag which contains enough water at all times to cover the roots
	<div>- Container</div> <ul style="list-style-type: none"> - seedlings are delivered to the site on a tractor trailer, large flat deck truck, or pickup truck (protected); - the seedlings are stored on the ground in a main stash, in a site which has protection from the wind and extensive sunlight, close to a water source and all-weather access; - seedlings are watered daily to a degree as to moisten all of the container plugs; - after watering seedlings, they are moved to the field on the day to be planted; - seedlings are placed in planter carriers (tray intact) by the planter and removed one at a time for planting

TREE PLANTING	C: Implementation:
3. Crew Organization	<ul style="list-style-type: none"> - the crew foreman co-ordinates the crew's progression to allow for minimal daily movement; - each planter can be given a block to plant estimated to be approximately one day of planting or the crew could plant in a parallel formation leap-frogging at the end of each row; - a planter load of trees should be such as to allow the planter to access a tree stash when completing a bag or carrier of trees;
4. Planting Method	- Bareroot
<p>Tool: 6-8 inch (wide) planting shovel</p> <p>Bareroot seedlings will be planted using an L-slit which is completed in the following manner:</p> <ol style="list-style-type: none"> 1. Identify the planting location and remove duff and/or loose debris. 2. Push the shovel vertically into the soil parallel to the planter. 3. Remove the shovel and starting at the end of the first slit push the shovel in again perpendicular to the first creating an L-shape. 4. Pull up on the shovel until it is approximately six inches from the surface and pry back until the slit opens. 5. Flick the roots of the tree into the open hole and place the stem vertically at the apex of the two slits. 6. Remove the shovel and compact the hole. 	

TREE PLANTING	C: Implementation:
4. Planting Method	- Container
<p>Container seedlings are planted using the following methods:</p> <p><u>Method 1:</u> Tool - shovel</p> <ol style="list-style-type: none"> 1. Push the shovel vertically into the soil to about 15 cm (6 inches) in depth. 2. Lift slightly and twist the shovel to open a hole large enough to receive the seedling plug. 3. Place the seedling into the hole to a depth that allows the top of the plug to be covered by no more than 2 cm of the soil; remove shovel 4. Compact the soil around the tree. <p><u>Method 2:</u> Tool - pottiputki</p> <ol style="list-style-type: none"> 1. Push the pottiputki into the soil to stop the gauge. 2. Open the jaws of the pottiputki and drop the tree down the tube. 3. Lift the pottiputki off the tree (do not close jaws until clear of the tree) and compact the soil around the tree. <p><u>Method 3:</u> Tool - dibble</p> <ol style="list-style-type: none"> 1. Push the dibble into the soil to stop the gauge. 2. Remove the dibble. 3. Place the tree in the dibble hole and compact. 	
5. Quality Assessments	Procedures
<p>See following pages.</p>	
<p>See following pages.</p>	
<p>Tally Sheet</p>	
<p>See following pages.</p>	

Assessment Procedures

1. Assessments of planting quality will be carried out daily by the Contractee. Assessments will be carried out at a sample intensity of 0.5%.
2. Fifty square metre circular assessment plots will be laid out using a 3.99 metre sweep off a predetermined centre point.
3. Assessments will measure planting quality and stocking in the area.
 - a) Quality - minimum acceptable planting quality will be 85%. Individual trees will be assessed using the following criteria:
 1. Microsite quality
 2. Tree firmness
 3. Tree depth
 4. Stem angle
 5. Planting method
 6. Root placement
 - b) Stocking - minimum acceptable stocking will be 90%

- within each plot the number of plantable spots will be determined by identifying all plantable microsites located at 1.8 metre spacing along all planted rows. Stocking will then be determined by dividing the number of trees planted by the number of plantable spots, times 100.
4. Total planting quality and stocking will be determined by a weighted averaging of all plot calculations.

General

1. The tree planting contractor is responsible for the collection and/or disposal of all tree packing materials. In the case of returnable packaging, the contractor will ensure that all such articles are returned to the proper location.
2. The Contractee will inspect stock quality at the nursery previous to shipping. Questionable stock will be brought to the attention of the Department of Parks and Renewable Resources prior to field shipment.

[illegible]

INFRACTIONS

1-13

TREE PLANTING	C: Implementation:
6. Monitoring and Records	<ul style="list-style-type: none"> - mapping of planting progress; - daily record keeping of planter and crew production; - summarizing planter/crew quality; - monitoring reefer van inside temperature, fueling, etc.
7. Demobilization	<ul style="list-style-type: none"> - collection and cleaning of planting equipment; - removal of camp facilities; - collection and disposal of camp and field garbage; - final mapping of planting area completed.
8. Administration	<ul style="list-style-type: none"> - keeps track of personnel used during the plant; - maintains financial records of project; - daily cost monitoring.

TREE PLANTING	D: Planter Safety
1. Personal Equipment	<ul style="list-style-type: none"> - boots, pants, shirt, socks; - eye protection, gloves, hard hat (hat); - insect repellent, first aid kit.
2. Ergonomics	<ul style="list-style-type: none"> - heat, wet, blisters; - physical, mental; - meals, water accommodations.
3. Morale	<ul style="list-style-type: none"> - peer enthusiasm/pressure; - financial; - penalties and bonuses.

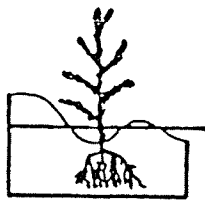
TREE PLANTING	E: Post-Planting
1. Permanent Sample Plots	* not always applicable
<ul style="list-style-type: none"> - plots are placed in the planting area to monitor the survival and growth of the seedlings; - 100 trees per 20,000 planted are used as the permanent sample plot; - plots of 100 trees are located lineally alternating rows to the right or left every five trees; - wooden or steel pegs are placed by each tree numbering them for future identification; - each tree in a plot is measured at the time of establishment and then once each year up to Year 5 of the plantation. 	
2. General Inspection	
<ul style="list-style-type: none"> - inspect plantation for visible insect damage; - observe general appearance of the seedlings at all times of the year. <p style="text-align: center;"><i>STAND BACK AND BE PROUD ! ! !</i></p>	

APPENDIX

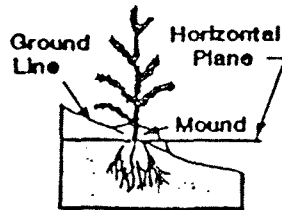
Approved Planting Methods

1. a) The trees will be planted at a spacing of 1.8 m by 1.8 m where a quality microsite is attainable.
b) The tree planting contractor will plant the seedlings in the site prepared area if made available by the Contractee.
2. a) Shovel or Planting Bars for bareroot seedlings (approved type) and the L-Slit planting method will be used to create the planting hole where possible and as directed by the Contractee.
 1. One cut perpendicular to planter;
 2. One cut parallel to planter;
 3. Pry back and twist on the shovel.
b) Planting dibbles for container seedlings (approved type) will be pushed fully into the soil, perpendicular to the ground surface and removed to create the planting hole.
c) Planting bars for container seedlings (approved type) will be pushed approximately five inches into the soil perpendicular to the ground surface and through a twisting of the bar a planting hole is created.
d) All trees will be planted in the apex created by the planting tool (shovel or planting bar).
e) Bareroot trees will be flicked into the apex L-Slit to allow even root spreading.
f) All trees will be planted vertical to the ground service.
g) All trees will be planted in the mineral soil to the depth of the upper root collar.
h) Only one tree will be removed from the planter tree carrier at a time.
i) Scalping will occur when loose duff and debris inhibit the exposed mineral soil.
 1. An area of .3 m x .3 m shall be scalped clear of debris;
 2. Scalping will occur when the duff and debris depth are less than 10 cm.
j) All planting slits or dibble holes will be compacted by stomping with the toe while not damaging the planted trees.

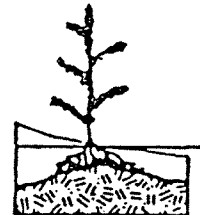
SOME COMMON PLANTING FAULTS



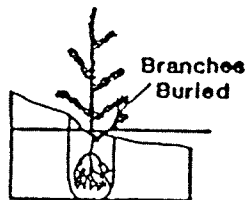
Planted in depression, could be excessive moisture
CODE-B6



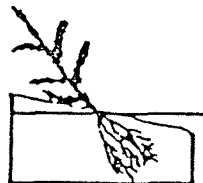
Planted on mound, roots apt to dry out
CODE-B5



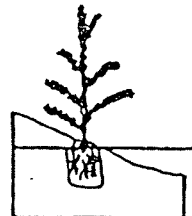
Planted in shallow soil above rock
CODE-B4



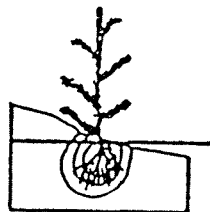
Tree planted too deeply
CODE-C12



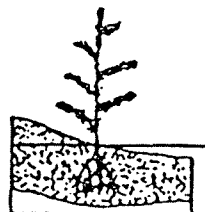
Tree not planted vertical to the Horizontal Plane
CODE-C7



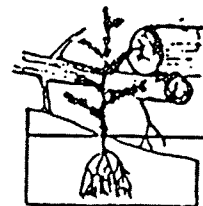
Too shallow, roots exposed
CODE-C11



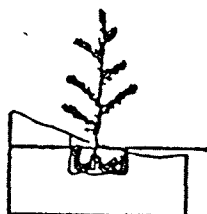
Planted in rotted wood, roots not in suitable medium
CODE-B8



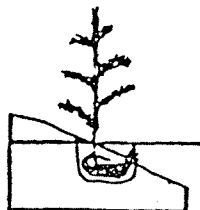
Roots in loose duff or debris, drying likely
CODE-B8



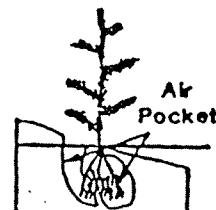
Overhead debris will restrict growth
CODE-B3



Roots jammed in J, L or U shape
CODE-C4



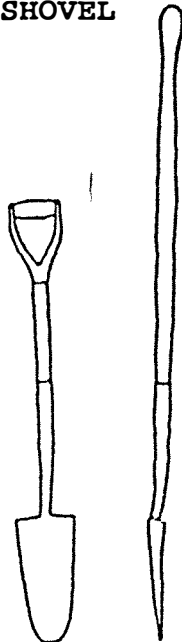
Too shallow, root end jammed often exposed to air
CODE-C5



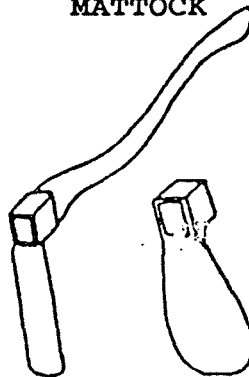
Poor back filling, improper tamping
CODE-C9

PLANTING TOOLS

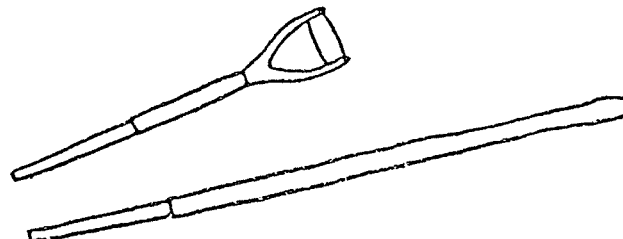
SHOVEL



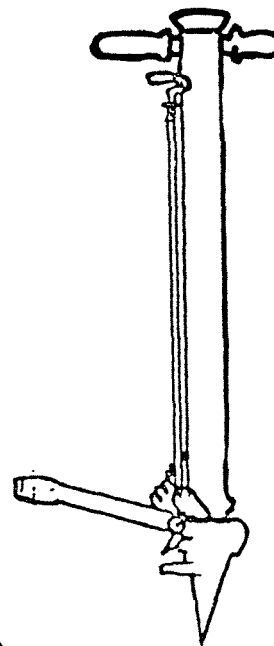
MATTOCK



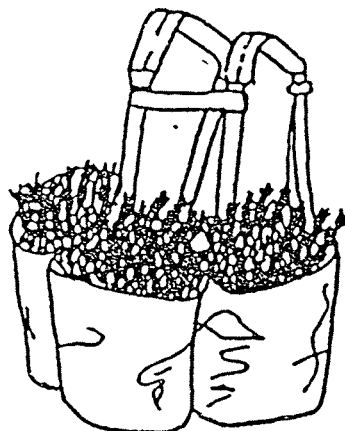
REPLACEMENT HANDLES



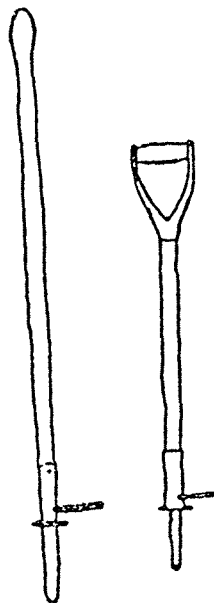
POTTIPUTKI



PLANTING
BAGS



DIBBLE



SPEAR



SITE
PREPARATION
- MECHANICAL -

SILVICULTURE OPERATIONS - FIELD SUPERVISOR COURSE
SITE PREPARATION -- MECHANICAL

DEFINITION

The act of preparing a forest site for renewal after harvesting or a natural disturbance using mechanical equipment.

A: Introduction	Site preparation is required to prepare a seedbed for natural seeding, artificial seeding or planting
B: Pre-Planning and Preparation	<ul style="list-style-type: none">- field inspection of site- resource requirements- contract/project review
C: Implementation	<ul style="list-style-type: none">- pattern of site preparation- equipment specifications- co-ordination- final map and summary

SITE PREPARATION

INTRODUCTION

Four Types:

1. Patch Scarification:

- small patch at regular intervals is created to plant on

2. Disc Trenching:

- continuous furrow made, trees planted along the berm

3. Ploughing:

- continuous bed created;
- trees planted within strip

Site Preparation done to:

- increase soil temperatures;
- reduce risk of frost;
- remove competing vegetation increasing light to seedlings;
- modify the soil drainage;
- reduce pine weevil infestations;

Wide Variety of Equipment Used:

- brake;
- disc trenchers: TTS-35 TTS Delta
 Wadell Grizzly
- ploughs: Martinni
- discs: Rome Eden Bedding Plow
- shearblade: KG Belse

Each site, depending on soil type, drainage, residual timber, topography, and access, will use a different type of site prep. tool to meet the reforestation objective.

SITE PREPARATION

1. The site preparation will be carried out in such a manner as to maintain adequate plantable spots in the case of site prep. for planting, and create adequate cone scattering and microsite mixing for site prep. for natural regeneration (Table 1.)
2. The recommended site preparation methods are as follows:
 - a) Site Preparation for Planting:
 - i) Furrow Type:
 - penetrate and align slash and ground debris exposing mineral soil
 - spacing between furrows = 2 metres
 - ii) Scalp Type:
 - penetrate and invert ground surface material intermittently exposing mineral soil on a profile covering varying depths
 - spacing between passes = 2 metres
 - iii) Blading:
 - penetrate humus to a degree as to minimize competition, maintain soil protection, and allow ease in tree planting
 - all ground surface debris is wind-along the bladed passes
 - spacing between passes should be as such to allow wind-rowed debris to be deposited while not interfering with the site prepared passes
 - b) Site Preparation for Natural:
 - i) Drag Type:
 - break up fresh slash and ground surface debris; as to expose mineral soil or mix mineral soil and humus, as well as scatter the conifer cones and seed
 - spacing between sets of drags = 2 metres
 - c) Site Preparation for Artificial Seedling:
 - * methods to be discussed if proposal arises *
3. The time scheduling of site preparation projects will be such as to:
 - maximize accessibility;
 - take advantage of natural seed sources;
 - achieve maximum quality;
 - maintain the status quo

SITE PREPARATION

B: Pre-Planning and Preparation

1. Site Inspection

- map of harvest area or salvage;
- access to site;
- topography;
- residual stems;
- slash;
- duff depth;
- stoniness;
- wet;
- swamp;
- steepness;
- direction of site prep.;
- goals;
- camp location

2. Resource Acquisition

- prime mover required;
- type:
 - skidder
 - tractor (rubber-tired)
 - crawler tractor
- size (hp);
- options:
 - winch
 - grapple
 - ice lugs
 - chains
- site preparation equipment;
- type to be used;
- maps of site (1:12,500);
- photo of the site;
- camp;
- fuel

SITE PREPARATION - MECHANICAL	C: Implementation
1. Pattern	
<ul style="list-style-type: none"> - rows straight, ease of planting; - effected by topography; - on slopes more than 10%, go up and down; - run in a north/south direction; - goal to achieve -- 2,000 plantable spots/ha; - effected by residual, slash, topography and drainage 	
2. Microsite Specifications	
<ul style="list-style-type: none"> - profile: <ul style="list-style-type: none"> - depth; - amount of slash; - amount of duff; - plantable spots; - exposed mineral soil; - inter-row spacing; - aspect (north/south); - drainage 	
3. Co-ordination of Equipment	
<ul style="list-style-type: none"> - mark block boundaries; - locate area to be avoided: <ul style="list-style-type: none"> - slash; - steep; - wet - daily production; - operators know where to go; - areas pre-located 	
4. Quality Assessment	Procedures
<p>* See following pages.</p>	
<p>* See following pages.</p>	
Tally Sheet	

SITE PREPARATION ASSESSMENT PROCEDURES

The plots for site preparation quality assessment will be laid out and assessed as follows:

- 1) Sample lines will be laid out perpendicular to the furrows at approximately 100 metre intervals.
- 2) Along these sample lines, plot centres will be located every 100 metres.
- 3) At these plot centres, a radius sweep of 3.99 metres will be made to measure the following:
 - a) furrow length in metres;
 - b) furrow length exposed in metres;
 - c) average exposed furrow width;
 - d) plantable spots along the furrow at a pre-determined spacing (i.e. 1.8 m)**
- 4) To assess coverage, a 200 metre line perpendicular to the furrows will be laid out. The number of furrows along the line will be equal to the percent coverage of the scarification equipment.

Using this sample procedure, a sample intensity of 0.5% will be reached during the trial operation. This sample will be sufficient for an analysis of the operational quality of the site preparation tool, and can be monitored on a short-term basis.

- ** The definition of what makes a 'Plantable Spot' will be determined previous to field assessment (ie. mechanically disturbed mineral soil greater than 15 cm in depth; exposed mineral soil greater than 15 cm in depth; mineral soil greater than 15 cm in depth covered by mechanically disturbed loose duff and litter greater than 10 cm in depth, etc.)

SITE PREPARATION QUALITY FIELD TALLY SHEET					
Project #			Equipment:		
Location:				Date:	
Furrow #	Length metres	ExpLength metres	Avg. Width metres	Area Exp. Sq.M	Plantable Spots
Total					

Gross Exposure % = $\frac{\text{Total Exposure (square metres)}}{\text{Plot Size (50 square metres)}} \times 100$

Net Exposure % = $\frac{\text{Total Length Exposed (metres)}}{\text{Total Furrow Lengths (metres)}} \times 100$

Plantable Spots = $\frac{\text{Average Plantable Spots per plot}}{\text{Per Hectare}} \times 200$

**THINNING
AND
RELEASING**

Using
Brushsaws

SILVICULTURE OPERATIONS - FIELD SUPERVISOR COURSE

THINNING AND RELEASING

DEFINITION

THINNING: The removal of several stems of a homogeneous species in a systematic manner to increase the health and vigor of the stand or individual crop trees.

RELEASING: The removal of undesirable trees, brush and vegetation competing with the desirable crop trees.

A: Introduction	<ul style="list-style-type: none"> - thinning - releasing
B: Pre-Planning and Preparation	<ul style="list-style-type: none"> - site inspection - resource requirements - contract/work spec's review
C: Implementation	<ul style="list-style-type: none"> - camp layout - crew organization - method (thinning & releasing) - quality assessment - monitoring & records

THINNING AND RELEASING	A: Introduction
1. Thinning	<p>Usually done with trees of the same species --</p> <p>Two Types:</p> <ul style="list-style-type: none"> - natural stands usually fire origin Jack pine; - plantation usually Jack pine from drag scarification; - some thinning white spruce and aspen but not very common <p>Thinning is done to reduce stands from 8,000 - 100,000 to 2,000 - 3,000 stems/ha with 2-3 m spacing:</p> <ul style="list-style-type: none"> - done when trees are less than 15 years old; - stand is less than 3 metres tall; - stand is uniformly dense; - objective is to reduce the number of trees; - to increase quality of stand by removing diseased, stunted, injured and deformed trees; - to allow the remaining trees more light, space and nutrients to grow
2. Releasing	<ul style="list-style-type: none"> - removal of undesirable trees, brush, and vegetation competing with desirable crop trees; - usually releasing white spruce from competing vegetation; - done when other plants are blocking the spruce from light, space, food; - treatment repeated until spruce can compete; - most effective when done in mid-summer (July); - most efficient when done in the fall season (Sept.-Nov.) when the leaves are off brush and the crop trees are more visible

THINNING AND RELEASING	B: Pre-Planning & Preparation
1. Site Inspection	<ul style="list-style-type: none"> - check access to the site; - area; - species to be thinned or released; - stocking - (continuous or varying); - height; - topography; - slash; - wet areas; - location of camp
2. Resource Requirements	<ul style="list-style-type: none"> - determine the size of area; - average production rate hectare per man day; - time required to complete contract; - man per day; - number of men; - one saw per man and spares; - gas; - oil; - spare parts; - flagging tape
3. Contract/Project Review	<ul style="list-style-type: none"> - project size; - project location; - start date; - completion date; - spec's; - penalties; - quality checking standards; - insurance; - Worker's Compensation Board; - safety requirements; - fire fighting equipment

THINNING AND RELEASING	C: Implementation
1. Camp Layout	<ul style="list-style-type: none"> - close to worksite; good access from camp to work site; - close to water; - co-ed tent/trailer; - maintenance shop; - sleeping facilities, tent/trailer (time of year); - food storage; - garbage / outhouse;
2. Crew Organization	<ul style="list-style-type: none"> - map of block; - mark out areas of difficulty; - crew blocks of 25/ha, 1 man, 1 week; - block crew day/space people 30 m; - start in less dense areas, easy access for training; - complete difficult areas mid-contract; - easy areas to finish contract; - flag blocks; - measure blocks; - transport crew to site; - spares on site; - give required/mix ratio; - soil for mix and lube saw; - tool kit for crew; - spare parts; (spark plugs, muffler, gas cap, bolts, harness)
3. Method	<ul style="list-style-type: none"> - space to 2 metres; - preferred species usually white spruce/Jack pine, aspen, balsam fir; - crew tree identification; - crop tree selected - (remove all others within 2 metre area); - crop tree <ul style="list-style-type: none"> - good form - no crooks/forks; - no disease (western gall rust); - insect damage; - scars

THINNING AND RELEASING	C: Implementation
3. Method	(* Thinning -- concluded)
<ul style="list-style-type: none"> - cut material falls into cleared areas--no leaners; - cut with prevailing wind, wind pushes trees in the right direction; - directional falling with blade; - cut parallel to slope; - cuts to be less than 15 cm in height; - below the last live branch; - no leaners; - trees flat on the ground; - avoid damage to crop tree; - saw; - avoid area 12 - 2 kickout; - Pages 26-29--location of cuts 	
Releasing	
<ul style="list-style-type: none"> - clearing 1 m radius around tree; - show crew location of crop tree and spacing; - strip clearing in the direction of planting; - release cutting - Page 23; - start left of the tree, right on to the next, push material falls away from tree; - avoid cutting, trampling or covering crop tree; - oil; - spare parts; - flagging tape 	
4. Quality Assessments	Procedures
<ul style="list-style-type: none"> - circular plot 3.99 m by 50 m² - .05% sample, plot 1, 2 ha; - number of trees per plot; - crop tree: <ul style="list-style-type: none"> - form - no crooks/forks; - no insect damage; - no scars; - no mechanical damage; - voids; - leaning; - hinged trees; - high stumps, live branches; - poor crop, tree selection. 	

**THINNING/RELEASING POST-ASSESSMENT
TALLY SHEET**

Project#				Organization:			
Location:					Date:		
Plot#	#stems	Created Voids	Stump HT. m	Saw Damage	Excess Remain.	Poor Select.	Quality %
Total							

**** Plot Size = 50 square metres**

$$\text{Quality Percent} = \frac{\text{Total Trees} - \text{Errors}}{\text{Total Trees}} \times 100$$

$$\text{Final Density} = \text{Average \# of trees in a plot} \times 200$$

THINNING AND RELEASING	C: Implementation
5. Maintenance of Equipment	
<ul style="list-style-type: none"> - daily maintenance; - crew individual tool kits; - check oil levels; - tighten bolts; - sharpen blades; - spare parts: <ul style="list-style-type: none"> - blades - spark plugs - muffler - gas caps - harnesses - fuel and oil sufficient, check on site 45 drums of gas; - crew 	
6. Monitoring and Records	
<ul style="list-style-type: none"> - daily production for crew; - daily quality plots on each crew member; - production per man; - set up time and days to meet contract supervisor; - map site as it is completed; - graph amount per day required, daily production times days remaining = total project amount; - will you finish the job on time; - take into account crew days off; - total of camp costs; - maintenance costs; - project within budget; - if not, reduction costs? 	

JUVENILE SPACING (PRE-COMMERCIAL THINNING)

Definition:

The reduction in density of young forest stands, to maximize long-term gain through controlled stocking.

- Why? |
1. Prevent stand stagnation;
 2. Improve crop quality;
 3. Manipulate growth for specified final wood product objectives;
 4. Maintain vigor in a stand:
 - minimize damage from insects and disease
 - maximize rotation

DATA COLLECTION

Pre-stand Tending Survey

Obtain specific stand and site information from which a treatment prescription can be written and prioritized --

The following information should be included:

- | | |
|-----------------------|------------------------------|
| 1. Stand Composition | 8. Age |
| 2. Origin of Stand | 9. Average Diameter |
| 3. Size of Stand | 10. Height Range |
| 4. Access | 11. Density no per ha |
| 5. Ground Impediments | 12. Stocking percentage |
| 6. Topography | 13. Major Influencing Defect |
| 7. Soil Type | |
- * Any other factors influencing the prescription or operation costs.

Sampling Method

Sample lines will be located perpendicular to topography while assessing all portions of the stand unit. Plots should be located along the lines systematically to minimize bias. Intensity of the assessment should vary with the uniformity of stocking and density within the stand.

Through this sampling, units within the sample boundaries will be identified for treatment on an individual basis (20 ha minimum).

JUVENILE SPACING (PRE-COMMERCIAL THINNING)
PRESCRIPTION SPECIFICATIONS

Crop Tree Criteria

- 1) Superior Size
- 2) Form
- 3) Vigorous Growth Characteristics
- 4) Self-Pruning, minimal lower branches
- 5) Spacing
- 6) Defects

Crop Tree Criteria

- 1) Species
- 2) Age
- 3) Height
- 4) Consistency
- 5) Bole shape
- 6) Crown size + % Living
- 7) Crown shape
- 8) Other acceptable species
- 9) Site limitations
- 10) Ground cover
- 11) Environmental factors
- 12) Wood product desired

Operational Goals

- 1) Minimize ground disturbance
- 2) Minimize crop tree damage
- 3) Minimize excess removal
- 4) Clean horizontal cutting
- 5) Minimize stump height
- 6) Removal trees must be completely dropped
- 7) Minimize cost
- 8) Safety

Product to be Enhanced

- 1) Pulpwood
- 2) Sawlog
- 3) Pole
- 4) Post

The above specifications should be included in all prescriptions written for Juvenile Spacing

Table 1.

Inter-Tree Spacing (m)		Density In Trees/Ha.	Allow. Range Per Ha. (+/- 10%)	Allow. Range Per 0.0025(0.0050)	
5'	1.5	4444(4400)	4004-4884	10-12	(20-24)
	1.6	3906(3900)	3516-4296	9-11	(18-21)
6'	1.7	3460(3500)	3110-3810	8-10	(16-20)
	1.8	3086(3100)	2776-3396	7- 8	(14-16)
7'	1.9	2770(2800)	2490-3050	6-8	(12-16)
	2.0	2500(2500)	2250-2750	5-7	(10-14)
	2.1	2268(2300)	2038-2498	5-6	(10-12)
8'	2.2	2066(2100)	1856-2276	5-6	(10-12)
	2.3	1890(1900)	1700-1906	4-5	(8-10)
	2.4	1736(1700)	1566-1906	4-5	(8-10)
9'	2.5	1600(1600)	1440-1800	3-4	(6-8)
	2.6	1479(1500)	1329-1629	3-4	(6-8)
	2.7	1372(1400)	1232-1512	3-4	(6-8)
10'	2.8	1275(1300)	1145-1405	3-4	(6-8)
	2.9	1189(1200)	1069-1309	3-4	(6-8)
	3.0	1111(1100)	1001-1221	2-3	(4-6)

SILVICULTURE OPERATIONS - FIELD SUPERVISOR COURSE
THINNING AND RELEASING

DEFINITION: The following is an explanation of specifications or infractions with respect to work quality.

1: Hinged Trees	- trees which have been cut, but where the tree is not completely severed from the stump
2: Leaning	- trees which have been cut, but are leaning against crop trees and not flat on the ground
3: Live Branches	- live branches must <u>not</u> be present on the remaining stump after the tree has been cut
4: Stump Height	- stump height must <u>not</u> exceed 30 cm in height
5: Crop Tree Damage	- any damage (e.g. saw cuts, broken tops, pruning with the saw, etc.) to the remaining crop trees. Any damaged tree(s) must be cut.
6: Unsatisfactory Trees Uncut	- all trees which exceed the specified number allowed as per the inter-tree spacing guide
7: Crop Tree Selection	- cutting of healthy, good quality stems and leaving those that are diseased, faked, etc.
8: Others include:	<ul style="list-style-type: none"> a) voids--overcutting creating man-made openings b) saw cutting-- must be horizontal. Stumps which are cut on an angle must be recut.