IFTNC FIELD DESIGN, METHODS AND ESTABLISHMENT

SEEDLING ESTABLISHMENT / NUTRITION

Intermountain Forest Tree Nutrition Cooperative
University of Idaho

April, 1997

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Objective

Establish experimental areas to study the effects of mineral nutrition on tree health and vigor within seedling establishment stands on different mineralogy ("good and bad") of underlying rock.

DESIGN

Treatments

Slow release fertilizers (Osmocote®) with a 9 month release rate will be used as the fertilizer source and will be supplied by the Scotts Company. Table 1 shows the nutrient treatments.

Table 1. Nutritional regimes consist of 6 treatments:

TREATMENTS	PRODUCT	ANALYSIS	RATE G / TREE	PRODUCT G / TREE
Control				
N	Osmocote - Urea	39-0-0	16.0 N	41
N+K+S	Osmocote - Urea	39-0-0	16.0 N	41
	Osmocote - K_2SO_4	0-0-44-18	12.0 K	27.2
			4.8 S	
N+S	Osmocote - Urea	39-0-0	12.4 N	31.8
	Osmocote - $(NH_4)_2SO_4$	18-0-0-20	3.6 N	24
			4.8 S	
K+S	Osmocote - K_2SO_4	0-0-44-18	12.0 K	27.2
			4.8 S	
Balanced	Osmocote - Urea	39-0-0	6.7 N	17.1
	Osmocote - K_2SO_4	0-0-44-18	5.8 K	13.2
			2.37 S	
	Osmocote - $(NH_4)_2SO_4$	18-0-0-20	1.1 N	6.0
			1.2 S	
	Osmocote 160812	16-08-12	8.3 N	51.7
	+ minors		4.1 P	
			6.2 K	
		1.2	0.61 Mg	
		2.4	1.24 S	
		0.02	0.01 B	
		0.05	0.03 Cu	
		0.5	0.26 Fe	
		0.07	0.04 Mn	
		0.02	0.01 Mo	

Plot Layout

A randomized block design with two replicates of each species and each treatment combination will be used, requiring a total of 24 plots (2 reps x 2 species x 6 treatments). One species will be randomly assigned to each block and within each block the treatments will be randomly assigned to the plots. The plot consists of a central block (7 x 7 central) of 49 trees (❁) surrounded by two rows of plot buffer trees, all of which will receive a fertilizer treatment. The inner row of buffer trees consists of 32 sample trees (⊗) used for destructive sampling, while the outer row of buffer trees consists of 40 trees (✣) and will serve as a treated buffer. Plot layout design is shown in Figure 1.

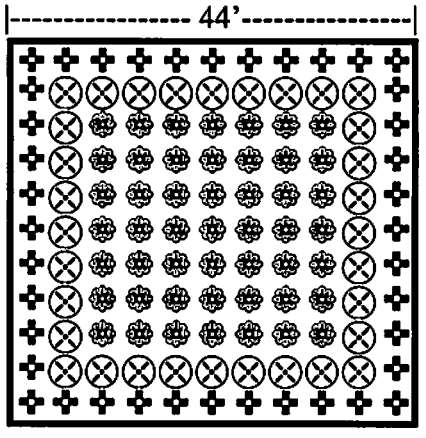

Figure 1. Schematic of plot layout: central block (❁), destructive sample (⊗) and treated buffer (✣).

A total of 1452 Douglas-fir and 1452 ponderosa pine trees planted at a 4 'x 4' spacing will be required per site (1176 measurement trees, 768 inner buffer trees and 960 outer buffer trees). A 10' untreated and unplanted strip will be used between plots and exterior boundaries, using 5'per plot for each common interior plot boundary and 10' for exterior plot boundaries. Each block with buffer strip will be 172' x 118'. Figure 2 shows a block schematic with six treatment plots plus unplanted and untreated 10' buffer strip.

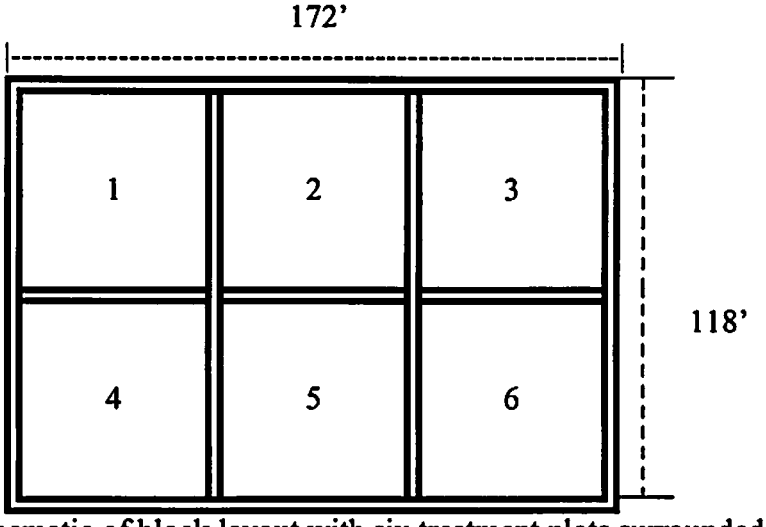

Figure 2. Schematic of block layout with six treatment plots surrounded by 10' unplanted and untreated buffer strip.

Each installation with 10' untreated plot buffers will be 334' x 226' and require 75,484 ft^2 or 1.73 acres to accommodate the four blocks on each site. Figure 3 shows installation layout.

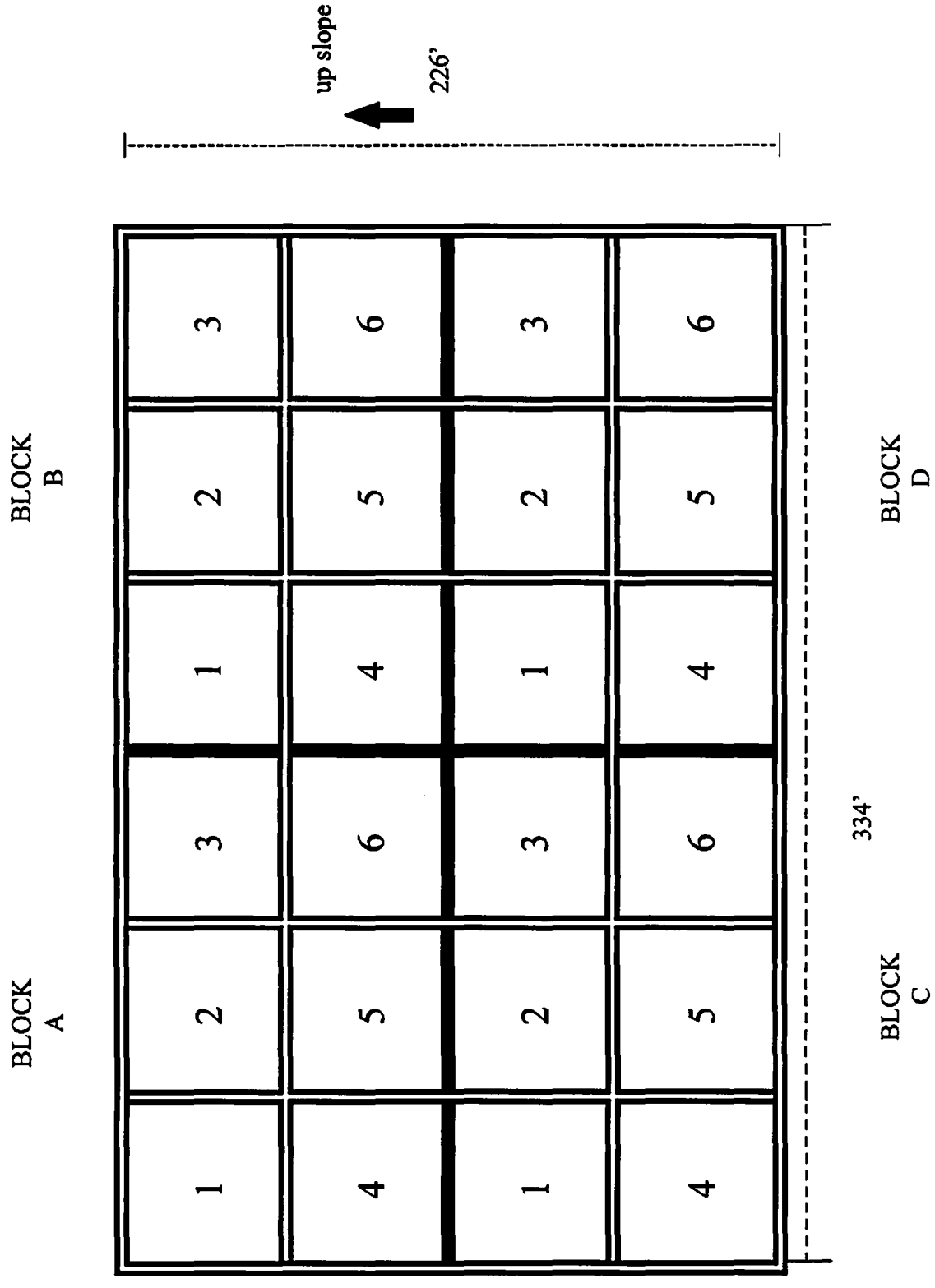

Figure 3. Schematic of installation layout with four blocks and 24 treatment plots surrounded by 10' unplanted and untreated buffer strip.

METHODS AND ESTABLISHMENT

Projected Time Schedule

**** Denotes cooperator responsibility! (IFTNC will assist and advise as much as possible)**

YEAR	WORK ACTIVITY
1996	Geologic research and mapping Reconnaissance and site selection Douglas-fir and ponderosa pine seed at U of I Nursery
1997	
Spring	Site selection with initial set-up Seed Sowing and germination **Site preparation (logging, slashing , burning, fencing etc.)
Summer	Initial set-up Establishment (corners, lines, plantable spots) **Site Preparation (logging, slashing, burning, fencing etc.)
Fall	Establishment (corners, lines, plantable spots) **Site Preparation (logging, slashing, burning, fencing etc.)
1998	
Spring	Establishment (finish site set-up and coordinate with cooperator on seedling outplanting. **Seedling establishment (planting research area) **Vegetation and pest management (herbicide and gopher baiting) Fertilization Initial measurements
Summer/Fall	**Vegetation and pest management (herbicide and gopher baiting) **Fence maintenance
1999	**Vegetation and pest management , fence maintenance
Fall	Foliage collection 1st year remeasurement Refertilization
2000	**Vegetation and pest management, fence maintenance
Fall	2nd year remeasurement
2001...	**Vegetation and pest management, fence maintenance... Remeasurement...

Site Selection

Site selection is divided evenly between two geologic rock types that appear to have "good or bad" influences on tree growth and development. Sites selected for establishment will have a paired design with one study site on "bad rock" and one study site on "good rock" for each stand type within a local geographic area. Preliminary selection can be accomplished by using geologic maps to locate rock types of interest on Cooperative ownership. It should be noted that this stage of the selection process can only be accomplished through active communication and cooperation between Coop members and IFTNC staff. Table 2 lists six preliminary sites, by IFTNC region and rock type comparisons, chosen for this study.

Table 2. Preliminary selected rock types by region to be used for Seedling Establishment / nutrition study.

Region	*Ownership*	*Rock Type # 1*	*Rock Type #2*
N. Idaho	Potlatch	Metasedimentary	Basalt
C. Idaho	Boise Cascade	Granite	Basalt
N.E. Washington	Wash. DNR	Metasedimentary	Granite
C. Washington	Boise Cascade	Sandstone	Basalt
S.C. Washington	Champion	Basalt	Andesite
N.E. Oregon	Boise Cascade	Basalt	Basalt

After preliminary geologic map selection has been accomplished, stand selection must be made in the field with positive identification of parent material, with one site on "bad rock" and one site on "good rock". In addition, both sites within each local geographic area must have the following uniform and common characteristics :

1. Geographic characteristics.
    a. Aspect
    b. Slope
    c. Elevation
2. Climatic conditions
3. Vegetation types
    a) Series
4. Soil conditions
    a) Depth
    b) Bulk Density
5. Management History
    a) Silvicultural treatments
    b) Historical management

Planting Stock

Douglas-fir and ponderosa pine seedlings will be grown at the University of Idaho Forest Nursery in 5.5 cubic inch (160/90) copper block containers. Appropriate high quality local seed for both species will be supplied by the cooperators. Table 3 lists seed selected for the six IFTNC regions active in this project.

Table 3. Douglas-fir and ponderosa pine seed listing by region and ownership

Region	*Ownership*	*Seed Lot / Elevation Douglas-fir*	*Seed Lot/ Elevation Ponderosa Pine*
N. Idaho	Potlatch	91.8 Camas / 3,400'	91.16 Maple Cr. / 2,800'
C. Idaho	Boise Cascade	Paddy Flat 5.1 / 5,100'	Paddy Flat Ridge 5.7 / 5700'
N.E. Washington	Wash. DNR	233-00-78, S.Z. 804/ 4,000'	002-0-89, S.Z. 804/ 4,000'
C. Washington	Boise Cascade	631-30-82 / 3,000'	632-30-85 / 3,000'
S.C. Washington	Champion	2,500'	2,500'
N.E. Oregon	Boise Cascade	862-40-80 / 4,000'	861-45-94 / 4,500'
		863-48-80 / 4,800'	863-45-94 / 4,500'

Harvesting and Site Preparation

After site selection is finalized IFTNC staff will set-up initial installation boundaries. Paint, flagging and 4 ' pvc pipe stakes will be used to establish boundaries that will help guide cooperators in establishing boundaries during the site preparation process. Method of harvesting and site preparation will vary by site and is the responsibility of each cooperator to accomplish. General guidelines for this study are:

1. Uniform treatment over entire area.
    a. harvesting
    b. mechanical
    c. burning
2. Treatment area should be large enough to accommodate study area (Figure 3.) plus one tree length to the nearest timber.
3. Sufficient plantable spots for 4' x 4' spacing.
    a. vegetation control (brush, regeneration etc.)
    b. minimize woody debris
    c. minimize compaction
4. Common treatment for both paired sites ("good rock - bad rock").

Animal Control

To increase plantation success it is imperative that intensive steps be taken to reduce animal impact. As in site harvesting and preparation, animal control objectives will require unique management practices and will be the responsibility of each cooperator involved in the study. Livestock, big game and gophers are the most common animal pests in plantations. To control animal activity fencing and rodent extermination practices should be used.

Fencing - A 10' high "New Zealand " style electric fence would be the most effective barrier against livestock and big game activity. Unfortunately, the high financial investment, time involved to construct and high maintenance of this type of fence system is beyond most cooperators resources. To meet our exclosure objectives we suggest a 5'-6' (six-strand) barbed wire fence be constructed. At a minimum, fence dimensions should follow the circumference of the schematic in Figure 3 (334 x 226). Fence construction should take place after site preparation and before or immediately after plantation establishment.

Rodent Control - Porcupines, gophers, mice and hares can severely damage or destroy seedlings in a conifer plantation. This is especially true in research plantation areas where every seedling represents a significant amount of the study results. Cooperators should use all rodent control resources available and practice an intensive program to control rodent damage in the research plantations. Generally, gophers are the main rodent source of seedling damage and mortality. Gopher activity in a plantation can easily be controlled through a poisoning or trapping program. Poisoning with strychnine oats is generally the most effective way to control gopher activity, but requires a licensed pesticide applicator. Treatment for gopher control can begin any time after plantation establishment. Research areas should be monitored regularly for reoccurring or increased activity.

Establishment

Establishment of research plantations will follow guidelines outlined in the design section of this text. IFTNC staff will begin establishment as soon as site preparation has been completed in summer/fall 1997.

Installation layout will be accomplished by establishing a grid-line system. Staff compass, 300' nylon tapes, 4' pvc pipe, and wire flagging will be used to set-up corners, plantable spots and plot lines. Four foot pvc pipe will be used to monument the four corners of the installation. Each corner shall intersect at right angles. To increase efficiency and aid in establishment, the longest side of the installation (334', Figure 3) should "preferably" run horizontal across the slope. Corner stakes will be painted yellow at the time of establishment.

Once corners are established, one corner will be chosen to serve as a reference point and respective right-angled baselines (226' parallel to slope and 334' horizontal across slope, Figure 3) for installation of the grid-line system. To increase installation efficiency, an additional baseline should be established at installation center (172') and should run parallel with the slope but perpendicular to the 334' foot baseline. Center baseline will be 5' off-set from true center to account for the buffer distance between treatment plots. Flagging pins will be used to establish the center baseline. Center baseline pin placement will follow pin placement outlined in the following paragraph on line establishment. Care should be taken to match flag color patterns with appropriate colors of lines to be established. Note: installation corners may need to be adjusted ("Scooched") to accomplish the "best fit" between corners and baseline boundaries.

Line establishment can best be accomplished using a three person system. One person to hold and stretch (holders) each end of the of the nylon tape and one person setting pins (setter) at the appropriate spots. The objectives of line establishment are to install buffer boundaries between treatment plots and position spots for seedling establishment. The staff compass will not be needed for line establishment. All alignment will be accomplished by tape measurement and by visually siting down tape lines. The first line will run parallel with the baseline boundary horizontal across slope and will account for the unplanted and untreated buffer, thus, the starting point will be 10' in from both the horizontal and parallel slope (right-angled) baselines (Figure 4). A measurement tape will be stretch between the starting point and a centerline point located 10' in and perpendicular to the baseline horizontal to the slope. The pin setter will start by placing a flagging pin at the 10' buffer corner. Pin placement will continue on line every four feet for a total of eleven pins, then a 12th pin will be placed after 10' more feet. This will complete a treatment plot with a shared 10' buffer and begin a new treatment plot Figures 3 and 4). Note: Interior plot boundaries will share a common 10' buffer. This pattern will continue

(one 10'buffer pin with ten 4' spaced pins) for three complete treatment plots (total of 34 pins with 10' buffers) until center baseline is reached. It is the responsibility of the tape holders to keep the pin setter in alignment. Flagging pin color should change every 12 pins, with the 12th pin signifying the start of a new plot (Figure 4). Two flagging pin colors will be used per plot in a alternate pattern, which will create a checker board appearance upon completion of each installation grid-line system. Each completed line should be checked for alignment and accuracy. Continue the line from center baseline to opposite boundary baseline using the same pin placement pattern. If 334' long lines are used to complete the grid system, a total of 44 lines @ 66 (11 pins x 6 plots) pins/line will be needed to complete a installation (2904 total pins). After all installation lines have been completed, adjust (scooch) "out-of-line" pins by visually aligning them along horizontal and diagonal rows. Figure 4 shows line layout for plot establishment.

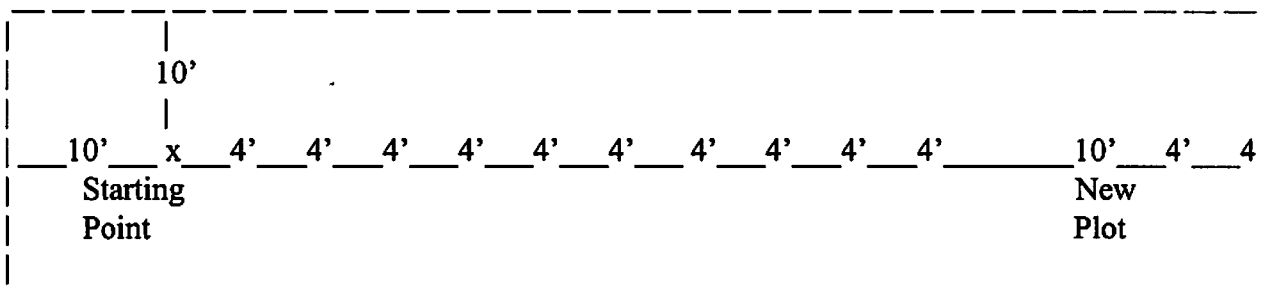

Figure 4. Line layout for plot establishment.

Planting

Plantation success will greatly depend on high quality planting practices. Planting shall take place in spring of 1998 and will be performed by cooperator personel. IFTNC staff will bring seedlings to sites for planting. Douglas-fir and ponderosa pine seedlings will be randomly assigned by block and planted on a 4' x 4' spacing. Each planting spot will be marked by flagging stakes that were previously established by IFTNC staff in summer/fall 1997. IFTNC staff will be present to monitor planting technique and procedures.

Fertilization

IFTNC staff will fertilize seedlings in spring/1998, immediately after the seedlings have been planted. Within each block, one of the six treatments will be randomly assigned to one of the six plots per block. Two treatment replications per species will be established. Treatment rates are shown in Table 1.

Fertilizer placement will be accomplished with the use of a dibble bar. Fertilizer will be placed in a 6 " deep dibble hole 3" on the up-hill side of each seedling. Each dibble hole should be covered with soil after fertilizer placement. Treatments will be measured by volume with a metered cylinder. The volume of each cylinder will equal each treatment rate in grams.

Retreatment - A second fertilization will be done in the fall of 1999, two years (two growing seasons) after establishment. Preliminary discussion on treatment design calls for a spot broadcast application of nitrogen, with the exception of the control plots.

Vegetation Management

Vegetation control will be conducted when needed for 3 consecutive growing seasons and will be the responsibility of each cooperator involved in the study. The goal for this study is to provide a level of vegetation control that will enable the seedlings to grow and survive without influences of competing vegetation. The best strategy for successful plantations is to establish seedlings in a vegetative free environment before competition captures site resources. The application of herbicides is the most effective way to control competing vegetation. The type of herbicide, application rate and application time are important factors to successful removal of competing vegetation. Cooperator's will need to appraise each site to evaluate herbicide needs. General guidelines for this study are:

1. Application of herbicides should not effect the growth of the seedlings. Great care should be taken to avoid direct herbicide contact with the seedlings.
2. Use of soil active herbicides should be avoided.
3. Use of foliar active herbicides is recommended.
4. Spot application or broadcast application is acceptable.
5. Treatment should be uniform for each seedling and entire research area.

Measurement and Data Collection

Initial Measurements - Stem caliper and total tree height will be recorded in spring/1998 by IFTNC staff for all central block (Figure 1) seedlings (49) in each treatment plot. A total of 98 trees per treatment per species or grand total of 1176 (98 trees x 12 treatment plots/species) trees will be measured per installation. Stem caliper will be taken at ground level and will be recorded to the nearest 100^{th} inch while total height will be recorded to the nearest 10^{th} of a foot. Defect and causal agent will also be recorded at time of the initial measurements. Information will be recorded on data recorders using IFTNC software.

Tree Numbering - Each seedling in the plots central block (Figure 1) per plot will be numbered consecutively by block and plot. For example, the first tree in block 1 and plot 1 will be labeled 111 while the last tree (49) in block 1 and plot 1 will be labeled 1149. The first number signifying the block the second the plot and the last number the tree. Tree numbering will begin at 1 and end at 49 for each plot. Orientation for block, plot and tree numbering will always begin at the upper (slope) left corner of each installation and run from left to right. Figure 3 shows block and plot numbering in relation to slope orientation. Fourteen inch "pig-tail" pins with numbered aluminum tag will be placed on the uphill side of each seedling. Placement of numbered pins will be completed with initial measurements.

Remeasurement - Stem caliper, total tree height and current leader growth will be measured from the central block (Figure 1) at the end of the first and second growing seasons, then every other year to project completion. Mortality and defect by causal agent will be recorded at this time. Information will be recorded on data recorders using IFTNC software.

Foliage Collection - Current foliage will be collected at the end of the first and second growing seasons. Five sample trees per plot of will be randomly collected from the inner destructive sample buffer. Samples will be composited by species, treatment and block for chemical analysis. Dry needle counts (3 reps of 30) of composited needles will also be performed. Drying and needle counting procedures will follow IFTNC standards given in Appendix A.

Rock Collection - Base rock will be collected from each site for geochemical analysis. Rock will be collected from rock outcrops located in the vicinity. Two samples from each rock outcrop will be sampled (1 weathered, 1 fresh). Dependent upon base rock variability per site, more than one outcrop may need to be sampled.

Site Characteristics - Aspect, slope, elevation, vegetation habitat type, soil profile description and surface soil samples will be collected for each site during the establishment period. Habitat type and vegetation determination will be made using manuals specific to the region. Soil profile description and surface soil sampling will follow IFTNC guidelines given in Appendix A.

In addition, detailed notes and sketch will be made on site of pertinent site information and installation layout (plot and block orientation, landmarks, insect and disease activity, stand information, site conditions etc.). Written directions to the site from a prominent place in the area and legal description will be provided. Each installation will be well monumented with IFTNC research area tags.

APPENDIX A

IFTNC
SEEDLING FOLIAGE COLLECTION PROCEDURE

Time of Sampling

Collection shall take place after dormancy begins in the fall (Sept., Oct., Nov...). An entire installation should be completed during one continuous time block. If time schedules permit, collect samples for each installation during the same time of the day (ie. morning or afternoon).

Seedling Selection

Randomly select five seedlings from the destructive sample buffer for each plot.

Foliage Collection

Foliage is collected from the current years growth. The entire seedling current year growth will be sampled and composited in a labeled bag.

Foliage Sample Storage

Immediately place foliage in roomy plastic bags (ziplocks) and store in an iced cooler. Imprint each sample bag with date, installation name and number, plot number and tree identification number. Samples should not be stored in field coolers over three to four days. Bring samples in from the field for processing as soon as possible! Note: Samples may be stored for longer periods (months) as long as storage temperatures are below freezing.

NEEDLE DRYING AND GRINDING PROCEDURE

1. Remove green foliage samples from the cooler or freezer. Foliage samples should not be taken out of cold storage unless they are to be dried or processed immediately. Only remove enough foliage from cold storage that can be processed within a couple of hours. Green foliage samples should be stored at 1° c or colder while awaiting the drying process. Ultra-cold (-30° c) storage should be used if samples are to be in prolonged storage.

2. Carefully strip needles from stem at the base of the needle where attached to the stem, making sure not to damage or break needles. Extreme care should be used if sample quantities appear to be small. When stripping pine spp. needles the stripped needle should include the fascicle bundle containing the needles.

3. Place stripped needles into marked paper bags by installation, plot and tree. Dry in a forced air oven for 24 hours at 70° c.. Larger samples may need longer drying periods and should be mixed periodically to achieve unifrom and proper dryness.

4. After drying the needles place 2-3 grams (1/2 cup) into coffee grinder and reduce to a fine dust. This process can be expedited by shaking the coffee grinder. To prevent a spill make sure the coffee grinder lid is secure or that lid is held on tightly.

5. After grinding carefully brush contents into small plastic bags. Extra care should be used not to spill ground sample when removing the lid of coffee grinder or while brushing out material. Any spilt ground foliage material is considered contaminated and should be discarded. Between each sample processed clean coffee grinder, brush and work area by blowing out excess material with a air hose and then wiping clean with a alcohol soaked towel.

6. Record full tree number (includes installation, plot, and tree number, whorl number (if given), species, date and your initials on each bag with a permanent marker.

Ex. (Inst) - 242*
(Block) - 2*
(Plot) - 6*
(Tree) - 193*
(Whorl) - 4W
(Species) - DF
(Initial) - MM
(Date) - 9/10/92

*242-2-6-193

NEEDLE COUNTING PROCEDURE

1. From each bag (which represents one sample from one tree) 3 replications of 30 needles are to be counted. Use a sequence of 3 weighing tins (i.e. 25, 26, 27) for each sample.

2. Wipe out residue from weighing tins if necessary.

3. Count needles for each installation in order, plot 1 first, plot 2 next, etc.

4. Record full tree number (includes installation, block, plot, and tree number, whorl number (if given), initials of counter, date counted, and the 3 corresponding tin numbers. Leave a space between entrees.

		(Tin #)
Ex.	(Inst) - 242	25
	(Block) - 2	26
	(Plot) - 6	27
	(Tree) - 187	
	(Whorl) - 4W	
	(Initial) - MM	
	(Date) - 9/10	
	(SPACE)	
	242-6-193	28
	JMM 9/10	29
		30
	(SPACE)	

5. Shake bag of needles to mix samples thoroughly.

6. Take out bunch of needles and spread out on desktop. A white background is helpful.

7. Count out needles in 10 groups of 10. Start counting from one side of pile (right side for right-handed persons). Do not count diseased, broken, or abnormally small needles.

8. Put 30 needles in tin, making sure not to lose any.

9. Mix up pile of needles and repeat steps 7 & 8 until 3 tins of 30 have been counted. Note: some samples may need to be composited. Consult project design or check with supervisor before processing.

10. Record % of disease incidence.

11. Tins may be stacked (in 3's) on tray to facilitate transfer to oven.

12. Place tins singly (unstacked) on oven trays. Dry the needles at 68°C (check thermometer on top of oven, not the dial on front of oven) for at least 12 hours (overnight). Put clamps, pliers, or whatever next to outside row of tins to keep them from being blown around by fan.

13. After 12+ hours, turn oven off and wait until the fan stops completely before opening - otherwise the samples may be blown around. Open door very slowly.

14. Take samples out of oven, stack 3 tins from each sample, and place immediately in desiccator to prevent trees absorbing moisture from the air. Place tins on only one tray of desiccator.

NEEDLE WEIGHING PROCEDURE

1. Zero the scale before each use. Use knob on back right-hand side of scale. Thereafter, rezero the scale every 6 weighings.

2. Open desiccator door, remove one tin with needles, close desiccator door, open scale door, place tin (with needles) on pan, close scale door, weigh sample to 4 decimal places (i.e. 2.4132 grams).

3. Record weight - make sure it is recorded in the right spot in data book.

4. Turn off balance (arrest lever in "up" position).

5. Remove tin and place in lower tray in desiccator.

6. Repeat steps 2-5 for remaining two tins. Tins can be stacked on lower tray indesiccator. Continue until all samples weighed.

7. When done weighing all tins with needles:
   a) Label zip-lock bags (use Sharpie pen) with: installation, block, plot, tree # and needles in bag (#90).

   Ex. 242-2-6-198
   #90

   b) Take all 3 stacked tins from desiccator and put needles in labeled bag. Do this on, or over, a tray so spilled needles will not drop to floor. Close opening on whirly bag.
   c) Replace stack of 3 tins in desiccator (upper tray).
   d) Repeat steps a-c until all samples are bagged.
   e) Place all the samples from one installation in large (1-gallon) zip-loc bags with installation # and supervisors name written on it.

   Ex. Installation 247
   Joe Needlehead

8. After all samples are bagged, reweigh the empty tins (which have been in the desiccator), again making sure weights are recorded in the correct spot in the data book.

Soil Sampling and Description

Surface Soil Sampling

One sample will be collected from each plot using the soil auger. The sample will be taken from the upper 10" of mineral soil near each plot center. Before taking the core sample, remove any litter or duff from the soil surface. Avoid taking the sample where trees are decaying or any other irregularities. Composite all sample by plot for the installation in a plastic bucket and mix. Remove a sample from the bucket and place it in a single zip-lock bag. Label the bag with installation number and name and date of sample.

Soil Pit Sampling

At each site, dig a pit down to bedrock, hardpan, restrictive layer or to unaltered parent material, whichever comes first. Using the Soil Profile Description form, describe the soil horizons present, the depths of each, and the characteristics of the peds in each horizon. Note any soil characteristics that may be pertinent to understanding the quality of the site. Include any surface ash layer in the comments.

Sample No.

SOIL PROFILE DESCRIPTION

Series and Surface Texture | Date | Stop No.

Classification | County

Location | Section | Township | Range | Photo | Elevation

Native Vegetation (or crop)

Habitat Type

Parent Material and Geology

Land Form: | Position | Macrorelief

Microrelief | Slope: Percent | Length | Position | Aspect

Climate

Drainage Class | Runoff (infiltration) | Profile Permeability

Ground Water | Erosion | Stoniness | Salt or Alkali

Remarks

Described by

Sample no.	Horizon	Depth	Boundary	Color		Texture	Structure	Consistence			Clay films	Pores	Roots	Lime	Special features
				Dry	Moist			Dry	Moist	Wet					

Remarks