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A Method for Assessing the Silvicultural Effects of Releasing Young Trees From Competition

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Abstract

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Systematic, long-term measurements of the survival and growth effects of releasing crop trees from competing vegetation are important for evaluating vegetation management treatments in forest plantations. This report details field-tested procedures for use in any type of release treatment—mechanical, manual, biological, or chemical. The basic concept is to delineate one untreated plot within each plantation to be monitored and to compare survival and growth on that "control" plot with survival and growth on a treated plot that is similarly delineated. Each installation should be examined periodically for a 5- to 10-year period. Sample data forms with partially completed examples are included.

Keywords: Vegetation management, plant competition, plantation release.

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Introduction

Thousands of acres of forest land are treated each year to release young conifers from competing vegetation. This practice is based on the ecological principle that resources such as moisture, sunlight, and nutrients will support only a specific amount of plant growth. Competition for these resources can result in reduced survival, growth, and vigor of desired plants.

Numerous studies, as reviewed by Stewart and others (1984), support the idea that selective control of less desirable species can result in greater production of more desirable species. Unfortunately, most of this research has been for limited sets of conditions and for short periods of observations. The true benefits of crop-tree release—increased yields or higher product values—however, are not realized until the timber is harvested many years after treatment (Stewart and Row 1981). Thus, measuring the long-term growth effects of release is important to ensure that programs are achieving their silvicultural objectives and are cost effective. In addition, local data on growth impacts after treatment are also important in convincing a concerned public that sound vegetation management programs are in their best long-term interest.

The procedures described in this publication are designed primarily for land managers who wish to monitor the long-term effects of their operational treatments. It is, in essence, a quality control program to let managers know if treatments are accomplishing their objectives. Scientifically sound procedures are needed to assure the validity of results. Step-by-step procedures for selecting areas, installing plots, and gathering and summarizing data are included. The procedures are being pilot tested on the Siskiyou National Forest in southwestern Oregon for evaluating treatments applied aerially or on the ground. The plan is not designed to answer research questions and is not suitable for comparing different types of treatments.

The most efficient way to conduct such a program is to enlist the efforts of silviculturists, technicians, and scientists. Silviculturists with knowledge of management goals and local forest conditions should take prime responsibility for establishing specific objectives and for selecting plantations to be monitored; technicians trained in standard forestry field procedures can perform the plot-establishment and measurement tasks; scientists can be enlisted for general consultations and for assistance with data analysis and interpretation, and they can provide continuity to the program. Land management organizations without direct access to scientists can obtain the needed help by contracts or cooperative agreements.

Nonresearchers interested in general background information about the principles and techniques for simple administrative studies should read LeBarron (1962), Stafford (1985), and White (1984), who clearly and concisely discuss statistical topics such as replication, randomization, and design simplicity. For further, more detailed description for establishing and maintaining silvicultural plots, read Curtis (1983). Although his paper deals primarily with stands of larger trees, many of the ideas are applicable to plots in young plantations. He covers such topics as buffer strips, equipment checklists, and data management.

The basic concept of this plan is to delineate two plots in each plantation to be monitored, to include one in the operational treatment and to leave the other untreated, and to measure survival and growth of crop trees and other vegetation on the plots periodically until a consistent trend develops—usually in 5 to 10 years. Each set of two plots in a plantation is a replicate for statistical analysis. Installing three or four sets of plots in a single plantation provides more reliable data for that particular unit because more of its variability can be sampled, but that intensity of sampling is beyond the scope of a monitoring program.

Objectives

The primary objective of the procedures to be described is to determine if plantations treated for release from plant competition have higher survival and grow faster than if they are not treated. For interpreting the survival and growth results, it must also be determined if release treatments alter the species composition or reduce the amount of noncrop vegetation (that is, decide if the treatments were effective in controlling the target species).

Procedures Plan Development

Determine the scope of the program. This could vary from seeking answers for one type of site, vegetation type, plantation age, or treatment to wanting information for an entire release program of a large ownership. The scope will determine a population of plantations. Deciding which of these to monitor and how many is discussed in the next section.

Write a specific plan for each monitoring program. The plan should include such details as specific objectives, a list of plantations to be monitored, procedures, time schedule, estimated costs and work force needs, and how the data will be analyzed and used.

Plantation Selection

List all the potential plantations that define the sampling population for a given period. This might be for 1 year or for the length of a planning cycle.

From these, draw a random sample for monitoring. For programs designed to answer questions for a specific type of site or treatment, four replicates (hereafter termed plantations) constitute a practical minimum for a reasonably sensitive statistical analysis. Broader objectives require more samples because variability tends to be greater on a wider range of sites and situations. At this point, consultation with a statistician is helpful.

Spread the installations over time to lessen the work load in any one year and to sample a variety of weather conditions. For example, if 15 plantations are considered adequate for a particular objective, establish five per year for 3 years or three per year for 5 years.

Visit each selected plantation to confirm the feasibility of installing monitoring plots in it. Reasons for rejection are poor stocking or terrain in which a plot could not possibly be left untreated (for example, a small unit to be aerially sprayed in which it would be physically impossible to leave a plot unsprayed). Since rejection of a randomly selected plantation would introduce a sampling bias, rejections should be made only as a last resort.

Plot Selection and Layout

Select two plot areas within each plantation prior to treatment. The plots in plantations to be aerially treated should be at least 0.4 hectare (about 1 acre) in size. Plots about two-thirds that size are sufficient for units to be treated from the ground by any method. The plot areas should be relatively homogeneous internally, similar to each other, and representative of the plantation in terms of aspect, slope, soil type, and vegetation. The plots should be located away from timber edges, streamsides, till banks, and other features that are not typical of the plantation. Terrain should be such that either plot in a plantation could be left untreated.

Do not use buffer strips as no-treatment plots. These areas tend to be atypical of the plantation and violate the principle of random assignment of treatments.

Use a hand compass and chain tape to locate the boundaries of the plots. Square plots, 60 meters (197 ft) on a side for aerial treatments and 45 meters (148 ft) per side for ground applications, are convenient, but the shape can vary as long as both plots in any plantation are the same size and shape. The plots should be kept at least 30 meters (98 ft) apart in plantations to be aerially or broadcast sprayed so that the spray does not drift to the no-treatment plot.

Mark plot corners with steel fenceposts, reference one of them to a prominent landmark by azimuth and distance, and indicate locations on plantation maps.

Randomly select the no-treatment ("control") plot by flipping a coin.

Site Description and History

Record information about the site that will assist in interpreting the results. Records should include general information about the site—location, geology, soil, climate, vegetation, animal populations, aspect, slope, and other notable site features.

Record the history of the plantation—dates and types of harvest, site preparation, planting operations, and any survey data collected. Details of the release treatment(s) to be evaluated should be included.

Treatment

Mark the no-treatment plot clearly, and assign someone the task of assuring compliance with the plan.

Treat the plantation according to the operational plan. The plot to be treated should be included as part of this operation.

Use spray-deposit cards to confirm treatment patterns for aerial spray treatments.

If the pilot misjudges the plot boundaries somewhat but still leaves sufficient area untreated, move the plot boundaries accordingly as long as the site and conditions do not change. In the Siskiyou National Forest trials, we have had to move boundaries by as much as 15 meters (49 ft) on several occasions.

If the plantation becomes slated for retreatment during the study period, decide whether or not to analyze the long-term differences resulting just from the initial treatment or to keep the no-treatment plot untreated throughout the monitoring period. The latter choice seems the logical one for most situations. This will require good office records and coordination of activities.

Maintain uniform tree density within and around the plots at the level appropriate for your management regime (that is, thin as necessary). This will allow you to compare yields between treatments.

Selection of Trees To Be Measured

Establish 16 points on a grid within each plot. For square plots, a 4 by 4 grid of points at 10-meter (33-ft) intervals in the middle of the plot works well. This leaves a buffer of about 15 meters (49 ft) on all sides of the grid for 60- by 60-meter (197-ft) plots that were aerially sprayed.

Use a hand compass and chain tape to establish the grid, mark the grid points with cedar stakes or the equivalent, and attach a tag to each stake that identifies the point number (1 to 16).

Locate the three crop trees (healthy trees of desired species and spacing) nearest to each point, but do not go more than 8 meters (about 25 ft) for any tree (thus, some grid points may have fewer than three selected trees). Once a tree has been selected for one point, it should not be used for another.

Record the azimuth and distance from the point to each tree selected, and mark each tree with a numbered metal tag wired to a low side branch. To avoid confusion, it is best to use numbers 1 -96 so that each tree selected in a plantation has its own number.

Figure 1 is a schematic diagram of a plot installation.

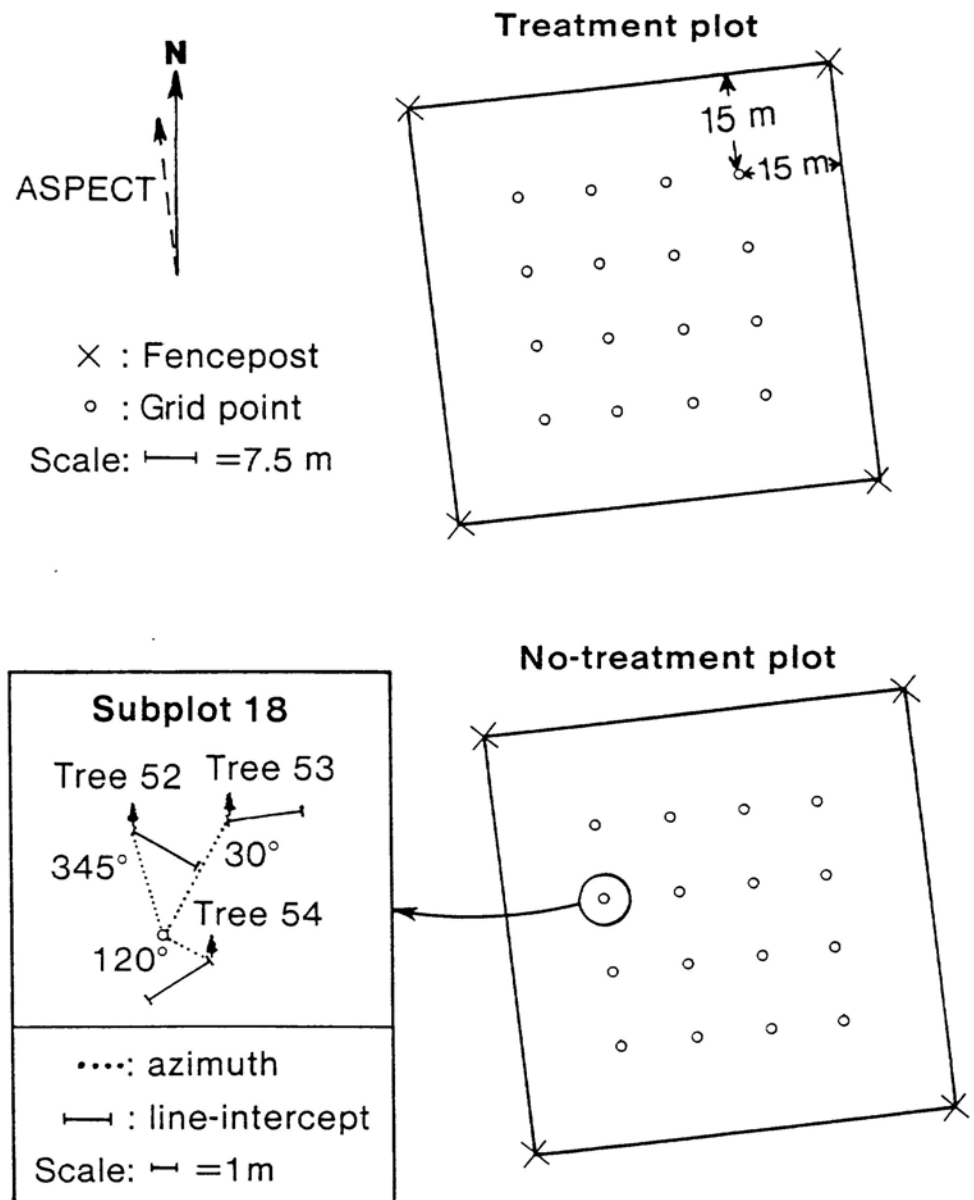


Figure 1 —Diagram of a typical plot installation. Small circles represent grid points. The detailed grid point is an example of the three sample trees and the line-intercepts for a point in either plot

Tree Measurements

Measure the selected trees during the dormant season after treatment and periodically thereafter. A reasonable schedule might be 1,3,5, and 10 seasons after treatment (plots and trees must be marked carefully when examinations are more than 2 years apart!).

At the first measurement, record total height to the nearest centimeter (preferable) or inch (from ground surface at midpoint of stem to the base of the terminal bud of the main leader or branch that appears likely to become the leader), height growth during year of treatment and, where possible, for each of the two preceding years. As minimum supplemental information, each tree should be coded as having normal or damaged leaders so that separate growth analyses can be done on undamaged trees. A more complete description of condition and causes of abnormalities will yield more precise analyses. A workable coding system adapted from the Siskiyou study follows in the next section.

Record the competitive status of each study tree at each examination in terms of crown position relative to nearby tree and shrub vegetation using the following definitions adapted from Baker (1950): dominant—trees with crowns above the general level of the canopy; codominant—trees in the main canopy level and receiving overhead light; intermediate—crowns subordinate to those in the general canopy and receiving overhead light only from holes in the canopy; suppressed—crowns entirely in lower layers of canopy and receiving very little light.

Measure stem diameter to nearest 1 millimeter (preferable) or one-sixteenth inch beginning the second examination after treatment and every other examination thereafter. Measurements should be taken with a caliper at 30 centimeters (1 ft) above the ground until the tree reaches breast height. When the first measurement at breast height is taken, the diameter at 30 centimeters (1 ft) should also be recorded.

Figure 2 is a partially completed data form organized so that it can be used for entering the data into a computer.

For additional information on the crop trees, we recommend that a stocking survey be made in each plot when the tree measurements are made. It is best to use whatever system is normally used by the organization conducting the program. For systems using circular plots, the grid points make convenient plot centers. Stein (1984) discusses fixed-plot methods for evaluating regeneration.

Conifer Data Form

Figure 2.—Conifer data form (partially completed).

Unit name: Siskiyou One Unit # 01 Treatment name: Control Treatment # 1

1st year: Date 9/21/82 Recorder P. Bear 3^d year: Date 10/10/84 Recorder M. Bear

Grid Pt.	Tree No.	Azimuth	Distance	Crp	Height		Stem diam	Injury			Crp	Height		Stem diam	Injury		
					Spring	Fall		Flg	Ldr	Stm		Spring	Fall		Flg	Ldr	Stm
1	1	104	310	1	31	44	4	HN	HN	HN	2	65		10	HN	HN	HN
	2	239	130	1	35	50	6	HN	BB	HN	1	76		14	HN	HN	HN
	3	26	200	1	27	46	6	HN	BB	HN	1	77		15	HN	HN	HN
2	1	180	180	3	25	30	2	YW	FB	HN	2	48		8	HN	HN	HN
	2	360	360	2	44	60	6	HN	FB	HN	2	72		12	HN	HN	HN
	3	210	210	4	40	45	3	YW	CW	HN	4	51		5	YW	HN	HN

Crp (crown position):

- 1 = dominant—crowns above the general level of the canopy,
- 2 = codominant—trees in the main canopy level and receiving overhead light,
- 3 = intermediate—crowns subordinate to those in the general canopy and receiving little overhead light,
- 4 = suppressed—crowns entirely in lower layers of canopy

Fig = foliage, Ldr = terminal leader, Stm = main stem below terminal leader

**Code for Recording
Conifer Injury^{1/}**

Symptoms:^{2/}

Foliage condition—

- H - Healthy
- Y - Chlorotic (yellow)
- N - Necrotic
- D - Defoliated
- B - Dead buds on lateral branches
- O - Other (specify)
- K - Specimen dead
- X - Specimen missing

Leader condition—

- H - Healthy
- C - Curled
- F - Forked
- B - Browsed
- D - Dieback (specify length (cm))
- T - Dead terminal bud
- S - Snapped, broken
- M - Missing
- O - Other (specify)
- K - Specimen dead
- X - Specimen missing

Main stem condition—

- H - Healthy
- P - Bark peeled or abraded
- B - Stem bent
- T - Stem toppled or lodged (that is, bent from base)
- S - Smashed, crushed, trampled
- C - Cut, clipped, broken
- O - Other (specify)
- K - Specimen dead
- X - Specimen missing

^{1/} Adapted from Walstad, J.D.; Wagner, R.G. CRAFTS experimental design manual for B-level studies: release of young conifer stands from uniformly distributed brush competition. Unpublished study plan, April 1982, on file in the Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon

^{2/} Enter code letter in the first column of Fig, Ldr, or Stm under "Injury" for the appropriate year as shown in figure 2

Cause:^{3/}

- N - None
- H - Herbicide
- E - Mechanical equipment
- T - Hand tools
- S - Falling slash
- X - Falling or sliding debris
- W - Weather, environment
- R - Rodents, small animals
- B - Big game
- L - Livestock
- F - Fire
- I - Insects
- D - Disease
- V - Damage from protection device (for example, shade card or bud cap)
- O - Other (specify)
- U - Unknown

Vegetation Assessment

Use measurements of the shrub and herbaceous vegetation to indicate the initial and subsequent levels of competition. These measurements indicate the effect of the treatment on target species, which will aid in interpreting tree responses. The measurements should be made each time the conifers are examined. A pretreatment examination would be useful for more precise judging of treatment effects on the vegetation, but it is not mandatory.

We use a line-intercept technique to measure noncrop vegetation because the method is relatively fast to use, provides consistent results between trained examiners, and can be analyzed quantitatively. In this method, a line of predetermined length is stretched over the vegetation, and the length of line intercepted by the canopy is measured by species or type of vegetation. We recommend the metric system, and we use a line that is 240 centimeters long. For the English system of measure, a line 100 inches long is convenient. The measurement pole is a rigid plastic pipe with a steel measuring tape attached along it with strapping tape to provide the scale. A line-intercept is established at each crop tree selected for measurement, and the main stem of the tree is used as the beginning of the line. Data are summed and expressed as a percent of the line occupied, which is roughly equivalent to percent cover.

This optional line-intercept technique is conducted as follows: *To eliminate bias, locate each line along a random azimuth (for convenience, randomly choose the azimuth from the set of 35 that fall at even 10-degree intervals). To collect the data, place the zero end of the pole at the main stem of the sample tree at a height most convenient for measuring the vegetation on that particular transect—usually on the ground. Extend the pole on or parallel to the ground at the selected azimuth. Mark the ground at the far end of the pole with a stake or pin to facilitate accurate relocation in subsequent years.*

^{3/} Enter code letter in the second column of Fig, Ldr, or Stm under "Injury" for the appropriate year, as shown in figure 2

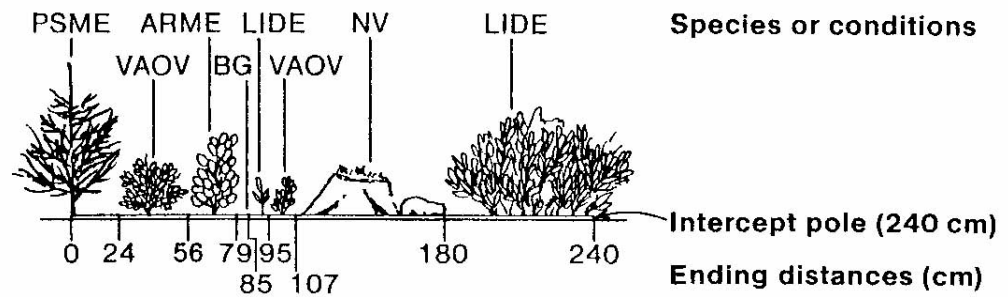


Figure 3.—Diagram of a typical line-intercept. Species and conditions depicted are PSME—Douglas-fir seedling, VAOV—evergreen huckleberry shrub, ARME—Pacific madrone seedling, BG—bare ground, LIDE—scrub tanoak, and NV—nonvegetated area (stump, rock, etc.)

Figure 3 depicts a typical line-intercept; the numbers show end points of the measurement segments along the 240-centimeter pole.

*Record the dominant vegetation or ground condition that intercepts (crosses) the plane of the pole (that is, the pole defines an imaginary plane from the ground to the sky). The species notation system described by Garrison and others (1976) is recommended; that is, an acronym is created by using the first two letters of the genus name plus the first two letters of the species name. Thus, Douglas-fir (*Pseudotsuga menziesii*) is shown as PSME.*

Record only species or conditions that occupy 5 centimeters (2 in) or more of the line. Distinguish and record species of woody plants, types of herbaceous vegetation, bare ground (BG), and nonvegetated areas (NV) that cannot support plant growth (stumps, logs, rocks, etc.).

For ease and accuracy in recording, note the ending point (centimeter or inch) of each segment. Lengths of the individual segments can be calculated later, as described under "Vegetation Assessment," p. 14).

For additional information, record the maximum heights of the three most dominant species of plants along each line.

Record injuries to the vegetation and their cause as shown under "Damage Code for Recording Brush Injury/Control."

The line-intercept survey can be as general or as detailed as is deemed necessary by individual silviculturists. The term "dominant" is key, however—there should be only one entry for any given segment of line. For example, when there is live vegetation, the dominant species is the one that a trained observer estimates to be the most competitive for site resources. Thus, a thick, low cover might dominate over a few taller but sparse branches. When determining dominance, the plane from the ground to the sky should be considered—tall, overhanging branches should not be overlooked. Dead herbaceous plants should be included in fall examinations under the assumption that they were alive during the growing season. An estimator may want to clump several small groups of the same species into one reading to speed the procedure.

Figure 4 is a partially completed data form. Tree number 01 applies to the line-intercept illustrated in figure 3. As recorded, each data entry in the "distance" column represents the end point of each measurement segment.

Vegetation Data Form

Unit name: Siskiyou One Recorder: S. Bear Date: 9/21/82
 Unit # ☒ 1 Treatment # ☒ 2 Exam year ☒ 1

Tree #	Species	Dist	Height	Damage		Tree #	Species	Dist	Height	Damage	
				Flg	Stm					Flg	Stm
01	PSME	24		HN	HN						
	VAOV	56	80	YW	HN						
	ARME	79	25	HN	HN						
	BG	85									
	LIDE	95		HN	HN						
	VAOV	107		AH	PH						
	NV	180									
	LIDE	240	111	NW	HN						
02	PSME	26	52	HN	HN						
	PTAQ	59	57	YW	HN						
	LIDE	96		HN	HN						
	BG	217									
	LIDE	240	120	HN	HN						
03	ARCO	49	145	HN	HN						
	NV	69									
	ARCO	81	59	HN	HN						
	NV	104									
	BG	145									
	LIDE	240	88	HN	HN						

Dist = distance from zero point (tree stem), Flg = foliage, Stm = stem.

Figure 4.—Vegetation data form (partially completed). Species and conditions listed are PSME—Douglas-fir, VAOV—evergreen huckleberry, ARME—Pacific madrone, BG—bare ground, LIDE—tanoak, NV—nonvegetated area, PTAQ—bracken fern, and ARCO—hairy manzanita

Summation and analysis of line-intercept data are described later.

A variety of other techniques can be used for vegetation measurements. These range from visual estimates of cover density on milacre plots to detailed measurements of individual plants. Selection of the method depends on factors such as type of cover, skills and continuity of the field crew, and time available. Chambers and Brown (1983) present a good synthesis of different methods.

Growth of the crop trees is the response of most interest in this type of program, so the vegetation measurements should not be made in such detail that the monitoring program bogs down.

**Damage Code for
Recording Brush
Injury/Control**
(see footnote 1, p. 8)

Symptoms:^{4/}

Foliage condition—

- H - Healthy
- E - Enlarged leaves
- D - Deformed leaves
- R - Reduced leaf size
- Y - Chlorotic
- N - Necrotic
- A - Leaves absent (defoliated)
- B - Browsed
- O - Other (specify)
- X - Specimen absent

Stem condition—

- H - Healthy
- S - Shortened internodes
- P - Partial topkill, vigorous stem sprouting
- W - Partial topkill, weak sprouting
- T - Complete topkill, vigorous basal sprouting
- B - Complete topkill, weak basal sprouting
- D - Dead (no visible living parts)
- R - Browsed, removed
- O - Other (specify)
- X - Specimen absent

^{4/} Enter code letter in the first column of Fig or Stm under "Damage," as shown in figure 4

Cause:^{5J}

- N - None
- H - Herbicide
- E - Mechanical equipment
- T - Hand tools
- S - Falling slash
- X - Falling or sliding debris
- W - Weather, environment
- R - Rodents, small animals
- B - Big game
- L - Livestock
- F - Fire
- I - Insects
- D - Disease
- O - Other (specify)
- U - Unknown

Data Analysis Conifer Performance

Calculate average survival percents, heights, and diameters (and the standard deviations) of the crop trees for each plot each time an examination is made. Standard statistical packages available for programmable calculators or microcomputers are recommended for this task. The differences between the treated and untreated plots on a harvest unit can then be used to assess the effectiveness of the release treatment. The differences can be calculated in terms of all crop trees, those in specific crown classes, and those in specific damage or condition classes. Plotting curves of height over age for individual units or averages of groups of units is a good visual means of seeing differences between treatments if they exist.

Analyze differences by standard analysis of variance procedures. Each set of two main plots (that is, the treatment and control plots in one plantation) can serve as a replicate in a randomized block experiment when two or more sets are available in a planned, representative sample of a population for which you want to make management inferences. Three sets of plots—that is, three plantations—is a practical minimum for reasonable statistical sensitivity. When the replication (plantation) = r :

<u>Source of variation</u>	<u>df</u>
Replications	$r-1$
Treatments	1
Error	$r-1$
Total	$2r-1$

Guidelines cannot be given for judging the biologic or economic significance of the results and differences between treatments. This must be done within the context of time, place, and situation for each particular program.

^{5J} Enter code letter in the second column of Fig or Stm under "Damage," as shown in figure 4

Vegetation Assessment

Compare the vegetation data between treated and untreated plots to help interpret the crop tree results as well as to evaluate the effectiveness of the release treatments) on the target vegetation. For example: If crop-tree response did not differ between treatment and no-treatment plots but vegetation was significantly reduced on the treated ones, the treatment may not have been necessary; if the growth of competing vegetation did not differ between plots, the treatment was probably not effective in reducing competition; if crop trees on the treated plots grew better, the treatment was probably biologically effective. Economic and environmental analyses are necessary to complete the evaluation.

To summarize and analyze the line-intercept data, convert the "distance" or end-point numbers into segment lengths and total the lengths by the species or other categories recorded for each line-intercept. After that, the information can be converted to percent cover, summarized by plots, and compared by treatments—including statistical analyses when treatments are replicated and randomized.

A microcomputer is useful for doing the summary. The steps enumerated below are written in a logical sequence for a computer programmer to follow in developing a program. The steps can also be followed for summarizing the data by hand:

1. The first entry in the distance column for a line-intercept equals the length of the first segment (24 centimeters in the example in figs. 3 and 4).
2. *Subtract that distance (termed "current") from the next distance to determine the length of the next segment* ($56 - 24 = 32$ cm in the example).
3. That next distance (56 cm) becomes the current distance. *Repeat step 2 until the current distance equals 240 centimeters.* That completes one line-intercept (in the example, $79 - 56 = 23$; $85 - 79 = 6$; $95 - 85 = 10$; $107 - 95 = 12$; $180 - 107 = 73$; and $240 - 180 = 60$).
4. *Repeat steps 1 through 3 until all line-intercepts in a plot are summarized.*
5. *Sort lengths by species or condition categories in individual line-intercepts, and add like ones together to give total coverage per line* (in the example, Douglas-fir (*Pseudotsuga menziesii*) (PSME) = 24, evergreen huckleberry (*Vaccinium ovatum*) (VAOV) = $23 + 12 = 35$, bare ground = 6, tanoak (*Lithocarpus densiflorus*) (LIDE) = $10 + 60 = 70$, nonvegetated area (NV) = 73).
6. *Sort lengths by categories within each plot, add and count like categories to give total coverage per plot and the number of line-intercepts in which a category occurs per plot.*
7. *Sort categories in order of decreasing length to indicate relative abundance in a plot.*
8. *Calculate percent cover for each category in a plot by dividing length of the category by total line-intercept length in the plot and multiplying the quotient by 100.*

Height data collected on the line-intercepts should be averaged by species in the same way as is done for the crop tree data. Data collected on vegetation damage should be summarized by the number of occurrences of each condition per species or type per plot.

Equipment, Supplies, and Work Force

Equipment needs:

- Hand compass
- Chain tape
- Fencepost driver
- Hand tape
- Caliper
- Rule or pole for measuring trees
- Intercept pole for measuring vegetation

Supplies:

- Steel fenceposts
- Cedar stakes
- Numbered tags
- Spray deposit cards (for aerial applications)
- Materials for marking plots (as appropriate)
- Data forms (blank forms suitable for photocopying are in the appendix)

Work force needs for installing two plots in one plantation (does not include time needed for plot selection, data analysis, and interpretation of results):

- Establishment of main plots—two people for one-half day.
- Layout of grid and selection of study trees—two people for 2 days.
- Tree and vegetation measurements—four person-days per *examination*.

Acknowledgments

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Conifer Data Form

Unit name: _____ Unit # Treatment name: _____ Treatment #

_____ year: Date _____ Recorder _____

_____ year: Date _____ Recorder _____

Grid Pt.	Tree No.	Azimuth	Distance	Crp	Height		Stem diam	Flg	Injury		Crp	Height		Stem diam	Flg	Injury		
					Spring	Fall			Ldr	Stm		Spring	Fall			Ldr	Stm	
☐																		
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Crp (crown position):

1 = dominant—crowns above the general level of the canopy;

2 = codominant—trees in the main canopy level and receiving overhead light;

3 = intermediate—crowns subordinate to those in the general canopy and receiving little overhead light,

4 = suppressed—crowns entirely in lower layers of canopy.

Fig = foliage, Ldr = terminal leader, Stm = main stem below terminal leader

Vegetation Data Form

Unit name: _____ Recorder: _____ Date: _____

Unit # Treatment # Exam year [illegible]

Dist = distance from zero point (tree stem), Fig = foliage, Stm = stem.

Owston, Peyton W.; Greenup, Mel; Davis, Valerie A. A method for assessing the silvicultural effects of releasing young trees from competition. Gen. Tech. Rep. PNW-191. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station; **1986.** 18 p.

Systematic, long-term measurements of the survival and growth effects of releasing crop trees from competing vegetation are important for evaluating vegetation management treatments in forest plantations. This report details field-tested procedures for use in any type of release treatment—mechanical, manual, biological, or chemical. The basic concept is to delineate one untreated plot within each plantation to be monitored and to compare survival and growth on that "control" plot with survival and growth on a treated plot that is similarly delineated. Each installation should be examined periodically for a 5- to 10-year period. Sample data forms with partially completed examples are included.

Keywords: Vegetation management, plant competition, plantation release.

The **Forest Service** of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

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