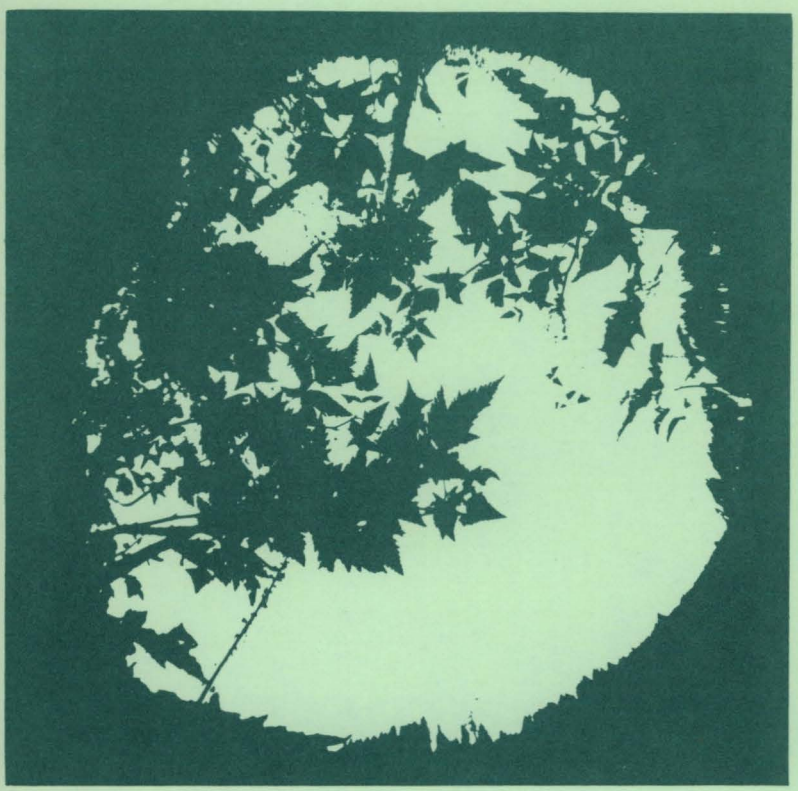

CRAFTS

Annual Report 1985-86

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CRAFTS

Coordinated Research On Alternative Forestry Treatments & Systems

JUNE 1986

Forest Research Laboratory
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CRAFTS HIGHLIGHTS

This report covers the sixth year of activity by the CRAFTS program on forest vegetation management. Highlights of this past year include:

- An annotated bibliography on prescribed fire for slash removal and site preparation is being prepared.
- A growth model for sprout clumps of bigleaf maple is being developed.
- Treatments for controlling sprout clumps of bigleaf maple were installed on six sites in Oregon and Washington. First-year evaluations will be made this year.
- Simpson Timber Company joined the cooperative this year, bringing CRAFTS membership to 19 forest management organizations.
- Two Technical Committee and three Technical Subcommittee meetings were held to develop several new CRAFTS research projects.
- An updated prospectus on the CRAFTS program was completed and distributed.
- Third-year data from the study on competition release in the Coast Range was analyzed, with interesting results.

INTRODUCTION

The purpose of the CRAFTS program is to provide leadership and direction within the discipline of forest vegetation management. The Cooperative also provides information to its members and others about such management in the Pacific Northwest. CRAFTS initiates research in young conifer plantations and conducts educational activities at Oregon State University. It also provides a forum for research coordination and information exchange among participating organizations.

The 1985-86 period was dynamic for CRAFTS as a cooperative. A new organization, Simpson Timber Company, joined the CRAFTS program, and our research efforts were assisted by the addition of several graduate students.

In 1984, the Policy Committee decided that the current CRAFTS prospectus should be revised to reflect the present concerns, priorities, and efforts of the Cooperative. Subsequently, a draft document was prepared and distributed to all members of the Policy Committee. The revised document was completed and distributed to Cooperative members in September 1985.

One of the ways the Cooperative accomplishes its informational and leadership goals is through research. This research is conducted under the guidelines outlined in the updated prospectus and through consultation with the Policy and Technical Committees of the Cooperative. The degree to which members participate in the research varies according to the type of study. The three types of studies in the Cooperative are *applied*, *adaptive*, and *basic*.

APPLIED RESEARCH

Applied studies are developed and funded directly by the Cooperative. These studies assess methods for suppressing competing vegetation through site preparation and competition release. The causes for the response of brush, trees, and herbaceous plants to these treatments also are determined.

Established Studies

Over the past several years the Cooperative has directed much of its effort to assessing various tools for managing forest vegetation. These studies focus on how each tool affects both vegetative competition and the growth of Douglas-fir seedlings.

STUDY ON COMPETITION RELEASE IN THE COAST RANGE

Three years have elapsed since treatments were applied in this study. A report on Douglas-fir growth and survival through 1985 is now available.

In both the second and third years since treatment, total diameter and diameter growth of Douglas-fir were significantly larger on areas where all competition was removed than on all other areas. No other treatment produced a significant increase in Douglas-fir diameter growth relative to the control. A regression analysis of the data demonstrated that stem diameter of Douglas-fir prior to treatment is the strongest predictor of stem diameter through the third year after treatment.

Current results demonstrate that the difference between post- and pre-treatment cover of shrubs and herbs has a strong influence on Douglas-fir diameter growth through the third year after release (Figure 1). In order to investigate how the levels of shrub and herb cover produced by the release treatments affect water stress of Douglas-fir, a pilot study was done in August 1985. At the Raymond, Tillamook, and Mapleton sites, pre-dawn xylem pressure potential of Douglas-fir was measured on the plots sprayed with Roundup®, those where competition was completely removed, and those with no treatment. Analysis of variance revealed that water stress varied significantly among the three release treatments. Values were lowest (-1.7 bars) on plots with complete removal of vegetation, intermediate (-3.2 bars) on those sprayed with Roundup®, and highest (-3.6 bars) on untreated plots.

Treatment differences and levels of water stress were not large, perhaps because an early August rainstorm in 1985 preceded all measurements of water stress. However, these data

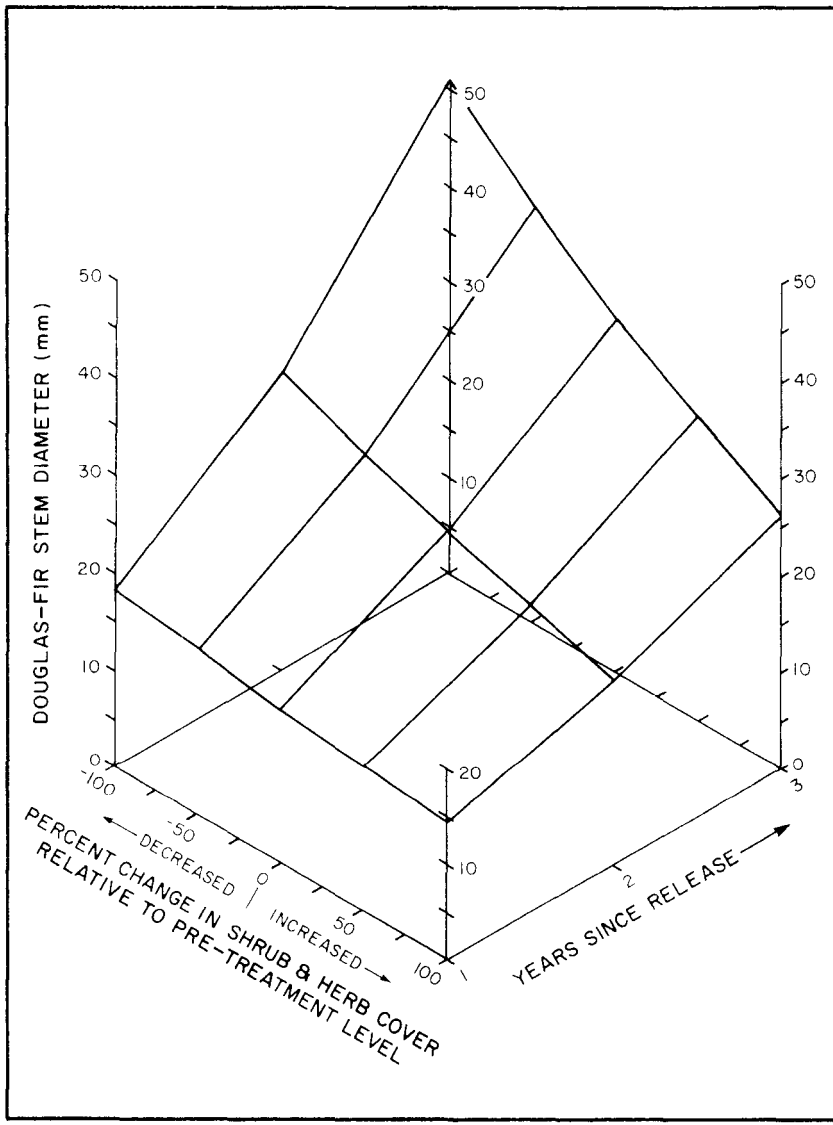

Figure 1. Diameter of Douglas-fir in relation to percentage of change in shrub and herb cover and years since release. Values are adjusted for an average pre-treatment diameter of 9.9 mm.

support the hypothesis that both shrub and herb cover should be reduced to change the level of water stress in Douglas-fir in the Coast Range. A prominent trend in the data from the three sites is an increasing level of water stress from northerly to southerly locations.

In 1986, predawn xylem pressure potential of Douglas-fir will be measured at all six study sites on the same three types of treated plots as those sampled in 1985. These more detailed data may help quantify the combined and separate competitive effects of herbs and shrubs on Douglas-fir. The data may also contribute to our understanding of soil water availability in the Coast Range.

SCREENING TRIAL OF TREATMENTS TO CONTROL SPROUT CLUMPS OF BIGLEAF MAPLE

The first screening trial was installed this year. The Bigleaf Maple Clump Screening Trial Subcommittee met on March 21, 1985, at Oregon State University to design and organize the trial. A formal work plan was prepared from the experimental design developed by the Subcommittee and distributed to all cooperators.

The trial was installed on six sites provided by CRAFTS cooperators throughout Oregon and Washington (Figure 2). It was designed to compare the efficacy of six herbicides (Garlon® 4, Garlon® 3a, Roundup®, Weedone® 170, Arsenal®, and Escort®), three timings (early foliar development, late foliar development, and dormant season), and four methods of application (foliar spray, basal spray, thinline—applied in a thin stream directly to the bark, and cut-surface—applied to the cambium of a freshly cut stem). Manual cutting at the three timings also was included. Effects of first-year treatment on the bigleaf maple and surrounding Douglas-fir seedlings will be assessed this summer.

Preliminary analysis of the early and late foliar treatments on two study sites indicated that the amount of herbicide delivered to each sprout clump of bigleaf maple varied according to the

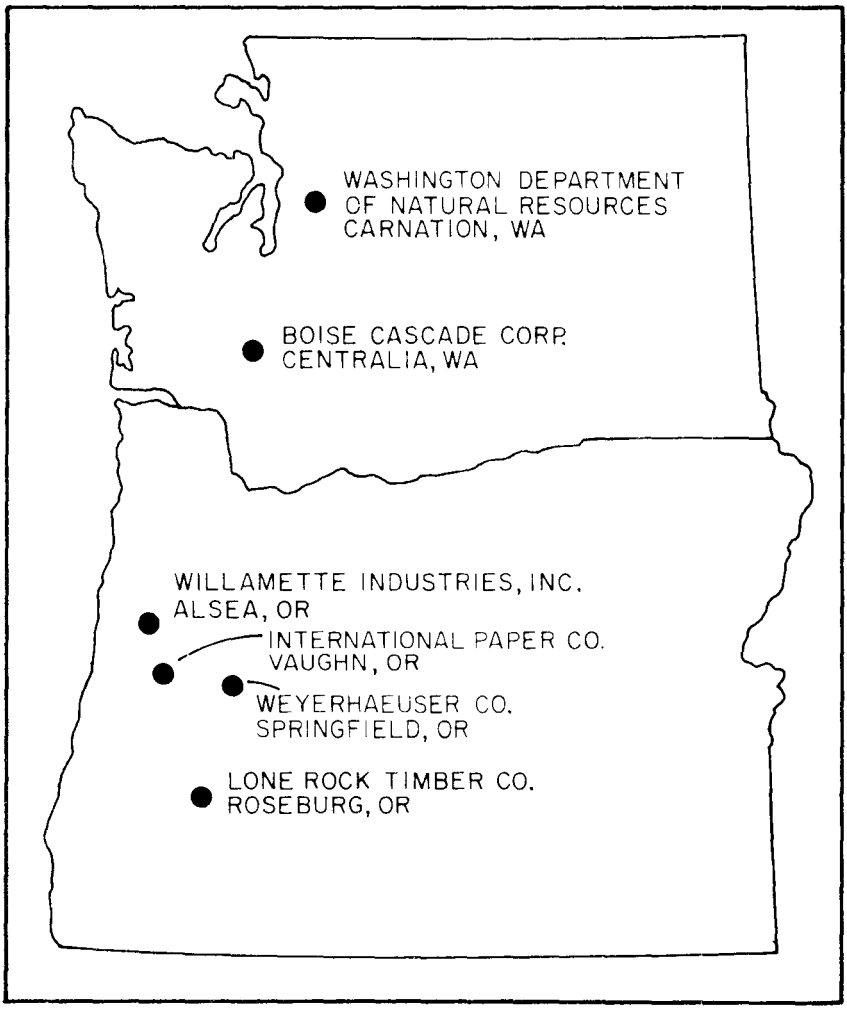

Figure 2. Study sites and participating cooperators for the CRAFTS screening trial of treatments for controlling bigleaf maple clumps.

method of application. Comparison of the four methods of applying triclopyr (Garlon®) to each clump indicated that the thinline method delivered more herbicide than did the other three (Figure 3). The cut-surface method delivered about three times more triclopyr than did the basal or foliar sprays, and less than half the amount of the thinline method.

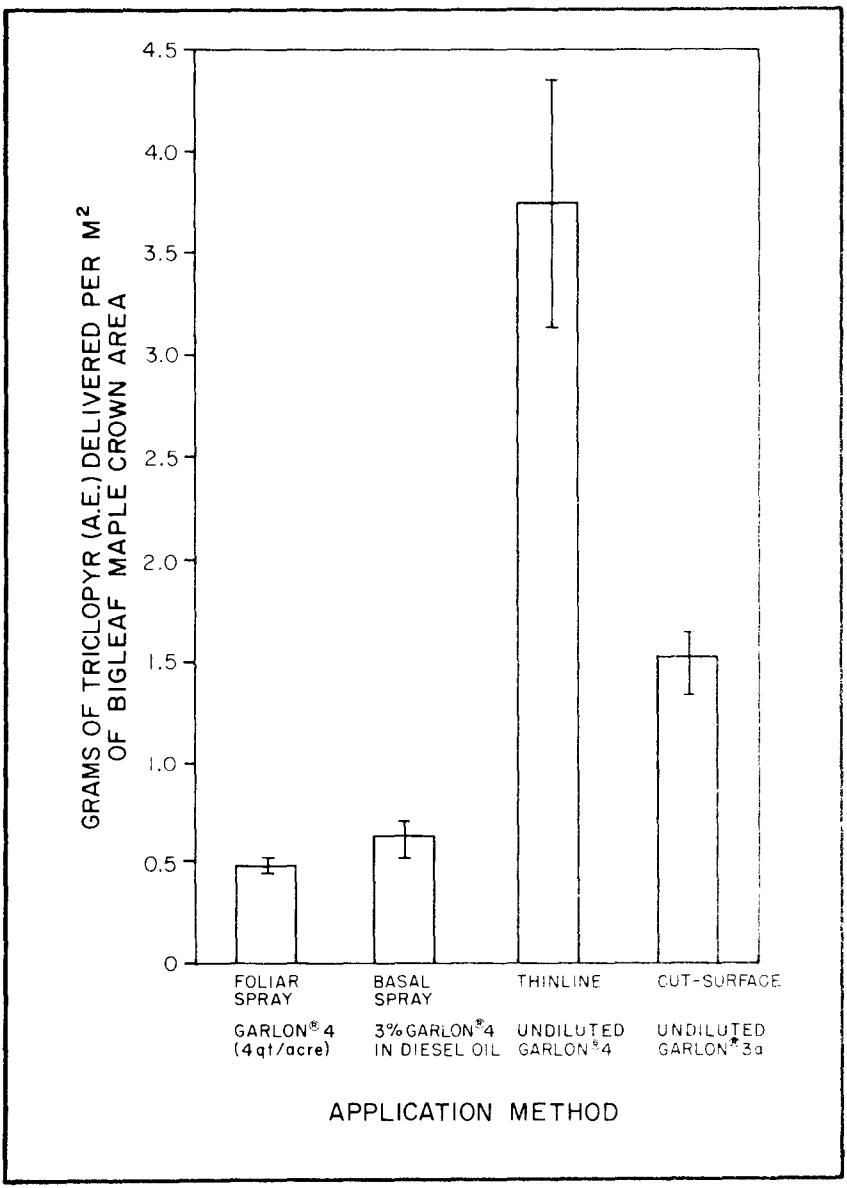

Figure 3. Grams of triclopyr (a.e.) delivered per square meter of crown area in bigleaf maple sprout clumps with four methods of application. Averages for early and late foliar treatments on two sites. Lines on bars represent one standard error around the mean.

The analysis also indicated that the amount of triclopyr delivered with the foliar and basal sprays generally increased as the crown area of the clump increased. However, the larger clumps tended to receive proportionally more triclopyr with the basal spray than with the foliar spray. There was apparently no relationship between clump size and the amount of triclopyr delivered with the thinline and cut-surface methods on these sites. The foliar spray was designed to deliver 4.0 lb (a.e.) of triclopyr/acre to each clump. The thinline, basal spray, and cut-surface methods were applied to meet standard operational specifications.

Further analysis of the results is underway and will be provided in a CRAFTS technical report later this year.

New Studies

A strength of CRAFTS is the ability of the cooperators to provide direct input into the development, planning, and implementation of new studies in applied research. Vigorous activity by the CRAFTS Technical Committee yielded two new projects that were implemented in 1986 and one to be developed further in 1987. The following is a summary of Committee actions during 1985-86 that led to the development of the new projects:

- The Cascades Research Subcommittee met to review current and past research on vegetation management in the Oregon and Washington Cascades. Recommendations for CRAFTS research in the Cascades were prepared (April).
- Prospectuses for three studies were prepared by CRAFTS staff from the recommendations made by the Cascades Research Subcommittee and presented to the Technical Committee (October).
- The Prescribed Fire Subcommittee met to review current and future restrictions on the use of prescribed fire in Oregon and Washington and to examine past and current research on prescribed fire in the Pacific Northwest. The Subcommittee recommended that an annotated bibliography on prescribed

burning be considered by the Technical Committee along with the Cascades research proposals (December).

The three studies selected by the Technical Committee for implementation during 1986 or consideration at a later date are as follows:

PRESCRIBED FIRE BIBLIOGRAPHY

A computer search of pertinent bibliographic catalogues is being conducted to obtain a listing of scientific literature related to the effects of prescribed fire. Key words descriptive of important issues in prescribed fire will be used to separate the retrieved citations and abstracts into useful categories. An outline was generated from a list of important issues in prescribed fire (see minutes from the 1985 Prescribed Fire Subcommittee meeting). This outline will be used to define the limits and criteria of the literature search. The bibliography will summarize the currently available literature on the use and effects of prescribed fire for both slash removal and site preparation in the Pacific Northwest. It may be used directly by the cooperators as an information source for management decisions or be provided to others interested in prescribed fire as a forest management tool.

GROWTH MODEL FOR SPROUT CLUMPS OF BIGLEAF MAPLE

Data collection for a growth model of bigleaf maple sprout clumps will begin in 1986. Seven cooperators are participating in site selection and data collection for this study: International Paper Company, Champion International Corporation, Oregon State Department of Forestry, Bureau of Land Management, Weyerhaeuser Company, Lone Rock Timber Company, and Washington Department of Natural Resources. The objectives of this study are:

- to develop a predictive model for the rate of crown width and height growth by bigleaf maple through age 10 years,
- to determine the age at which sprout clumps attain maximum crown width and area,

- by using data on crown widths of bigleaf maple from 10- to 50-year-old stands, extend and calibrate the growth model so that it adequately predicts maximum crown width and, hence, acreage dominated by bigleaf maple in mature Douglas-fir stands.
- by using a stand simulator such as DFSIM, determine cost effectiveness of controlling sprout clumps by evaluating the loss in stand volume of harvested Douglas-fir as a result of acreage dominated by bigleaf maple.

As suggested at the January meeting of the Technical Committee, much of the field data will be collected by cooperators. Methods of such collection will be standardized at a training session held near Corvallis. The study plan, including field techniques, is currently being reviewed by participating cooperators.

The older sprout clumps (10 to 50 years) that will be measured to calibrate the growth model will be from stands of known origin and management history. Tim Harrington and Bob Wagner will oversee collection of these data.

COMPETITIVE INTERACTIONS OF WOODY AND HERBACEOUS PLANTS WITH DOUGLAS-FIR

This proposed study will quantify the relative effects of woody and herbaceous vegetation on the growth and survival of Douglas-fir seedlings. Focusing on drier sites than those in the Coast Range release study, it will be concentrated in the foothills of the western Cascades and eastern Coast Range. Four treatments (woody and herbaceous vegetation, herbaceous vegetation only, woody vegetation only, and no competing vegetation) are proposed for permanently established plots containing operationally planted Douglas-fir seedlings. After reviewing the prospectus, the Technical Committee recommended that a subcommittee be formed to develop the study plan further. The subcommittee will meet in the coming year to refine a proposal after a thorough examination of existing competition studies is made and the Policy Committee clarifies the short- and long-term directions for the Cooperative at the June 1986 meeting

ADAPTIVE RESEARCH

Adaptive studies are designed to explore new or improve existing approaches for managing forest vegetation. Although usually funded from outside sources, these studies have direct management implications of interest to the Cooperative membership. Members participate at their discretion, through the donation of land, labor, or facilities. Examples of such studies conducted by CRAFTS include the following:

Interspecific Competition Index for the Siuslaw National Forest

Assessing the need for treatments that release young forest plantations from competition requires an understanding of how woody and herbaceous vegetation affects the survival and growth of young trees. This 5-year study, directed by Bob Wagner and Steve Radosevich, will provide the Siuslaw National Forest with an interspecific competition index that will quantify competing vegetation in young Coast Range plantations and thus predict survival and growth of Douglas-fir. The study is in its second year and is being accomplished in two concurrent phases.

PHASE I

The first phase utilizes two site preparation experiments previously established by the Pacific Northwest Forest and Range Experiment Station. When sampled, the sites ranged in age from 4 to 9 years and included as many as six site-preparation treatments. Data collected are being used to develop a regression model that predicts the growth of 4- to 9-year-old Douglas-fir on the basis of the best interspecific competition index.

Initial results indicate that height and stem diameter of Douglas-fir are reduced as the index values increase. The preliminary model also suggests that slope and aspect, previous

animal damage, method of site preparation, and size of the tree during the first year after planting may influence the growth of young Douglas-firs. Results from this analysis will be summarized in an annual project report for the Siuslaw National Forest in September.

A second objective for phase I is to develop growth models for the major shrub and hardwood species encountered on the Siuslaw National Forest. These models will provide a means to predict future growth of competing vegetation on the basis of its condition in young plantations. These models will be developed during the coming year.

PHASE II

In the second phase, the interspecific competition index developed in phase I is being refined for salmonberry-dominated plant communities. Four study sites were established on the Siuslaw National Forest this year for that purpose. They are on north and south slopes in the *Picea sitchensis* zone and *Tsuga heterophylla* zone and provide a range of environments where salmonberry is a major component of young Douglas-fir stands. On each site, established salmonberry was cut at ground level and 2-0 Douglas-fir seedlings were planted. During the growing season, five levels of salmonberry recovery (100, 75, 50, 25, and 0 percent) are being maintained by manual methods on plots where no herbaceous vegetation is removed; in addition, 50 and 100 percent of herbaceous vegetation are being removed manually on plots where salmonberry is eliminated. First-year growth and survival of Douglas-fir under the seven treatments was measured this winter and will be remeasured in the coming year.

The interspecific competition index is also being correlated with soil moisture (30, 60, 90, and 120 cm below ground) and light availability (50 and 100 cm above ground) during the growing season. A report on the establishment of phase II will be made to the Siuslaw National Forest in September 1986. First-year results from this study will be analyzed this year.

Red Alder/Douglas-fir Replacement Series

The study of red alder and Douglas-fir interactions is now in its second year. Directed by Dave Hibbs and Steve Radosevich, this is a long-term investigation of both intra- and inter-specific interactions between the two species.

One objective is to determine if growth of Douglas-fir increases when that species is interplanted with a low proportion of red alder on low-fertility sites. The study is therefore replicated on three sites with varying levels of fertility (Table 1).

Table 1. Characteristics of the three experimental sites

Characteristic	Belfair, WA	H.J. Andrews Exp. Forest, OR	Cascade Head, OR
Longitude	122°53'W	122°10'W	124°00'W
Latitude	47°26'N	44°14'N	34°05'N
Elevation (m)	120	800	330
Annual precipitation (cm)	110	230	250
Avg. min. temperature (°C)	3.3	-8.5	2.2
Avg. max. temperature (°C)	18.3	36.9	20.9
Growing season (days)	135	134	180
Soil (parent material)	glacial till	andesite	basalt
Douglas-fir site class	IV	III	II

The study employs two designs. Information on intraspecific competition will come from circular Nelder plots of pure red alder planted at densities ranging from 100,000 trees/ha to 350 trees/ha. Half of each plot is fertilized with triple superphosphate to determine if that compound may become limiting for this nitrogen-fixing species. A replacement series is being used to investigate interspecific interactions. This is a sequence of plots of constant total density (435 trees/ha) in which the proportions of each species vary from 0 to 100 percent.

At the Belfair site, which was planted in 1985, initial measurements of the study trees and the site have been completed. Included were a soil survey (soil nutrients, bulk

density, rock content, water content, soil profile), a survey of the background slash and vegetation (including an analysis of nutrients stored in those components), and pre-dawn moisture stress of the study trees. The sites at the H.J. Andrews Experimental Forest and at Cascade Head were planted this winter; initial measurements will be taken this year at those sites.

Pinegrass/Douglas-fir Interactions

Native grasses present a serious problem to foresters in the southern interior of British Columbia. Pinegrass—the dominant understory species in these interior Douglas-fir forests—increases dramatically on clearcut and burned sites. This species is thought to compete with conifer seedlings for water, a significant growth-limiting resource in the region.

In summer 1985, a study of the interaction between pinegrass and Douglas-fir was begun near Williams Lake, British Columbia, Canada, by Allison Nicholson and Steve Radosevich. It consists of (1) a replacement series designed to determine the effects of intra-and inter-specific competition on survival and growth of Douglas-fir seedlings and pinegrass and (2) measurements of microclimate and physiological processes that affect water use of the two species throughout the growing season. Analysis of data collected in 1985 is currently underway.

Collection of data will continue during the 1986 field season. In addition, a study of how neighboring species affect individual Douglas-fir seedlings will be established. In this study, individual seedling performance (as indicated by height, stem diameter, and canopy volume) will be correlated with abundance and proximity of neighbors (as indicated by leaf area index, distance, and angular dispersion). Together, these two studies will provide insight into the threshold levels of interspecific competition that affect survival and growth of Douglas-fir in interior British Columbia.

Tanoak and Douglas-fir Competition

This cooperative study with the FIR (Forestry Intensified Research) program is being conducted in southwest Oregon by Tim Harrington and John Tappeiner. Third-year results indicate that competition from tanoak sprout clumps can reduce diameter growth of Douglas-fir seedlings by as much as 80 percent. Current-season results suggest that tanoak competition can also reduce the length of Douglas-fir's growing season.

Beginning in 1986, the phenology and timing of Douglas-fir's cambial and shoot growth will be studied to determine how it is affected by tanoak competition. Differences in photosynthesis by Douglas-fir under various levels of soil-water availability will be assessed to discover how this species is affected by tanoak competition. The significance of carbon assimilation by Douglas-fir in winter will also be investigated. The purpose of these studies is to determine which growth and physiological mechanisms account for the observed variability and suppression of growth when Douglas-fir is associated with tanoak.

BASIC RESEARCH

Basic studies explore fundamental principles important to the science of vegetation management. They provide the basis for innovative technology and, ultimately, better management. They also trigger future adaptive and applied research. Basic studies are usually conducted by graduate students (often Ph.D. candidates). Funding for such projects is always from sources outside the Cooperative, although cooperator participation is encouraged. Topics include:

Population Growth and Demographics of Salmonberry and Thimbleberry

Salmonberry and thimbleberry are major components of the regenerating vegetation on clearcuts in the Coast Range. Bruce Maxwell and Steve Radosevich have initiated demographic studies to clarify the population dynamics of each species. Population simulation models have been developed for both species from data obtained in the literature. Sensitivity analysis of the salmonberry model indicated that the fraction of buds that become aboveground sprouts is the most important demographic parameter for determining stand density and population growth rate of this species. Therefore, research will emphasize factors that may affect bud growth.

Germination experiments with both species indicated that the percentages of germination are initially very low but increase after 6 months of dry storage. Scarification of the seeds with concentrated sulfuric acid stimulated germination in both species, whereas mechanical scarification had no effect. These experiments will be repeated, and stratification requirements will be clarified further.

Interactions Between Douglas-fir and Red Alder Seedlings

Laura Shainsky and Steve Radosevich are using a new experimental design to explore theoretical and mechanistic aspects of the interactions between Douglas-fir and red alder seedlings. They will also examine how plant density affects soil moisture and light and how limitations in these variables affect tree growth. Physiological variables such as leaf water potential and leaf nitrogen will also be measured in an effort to link key resource limitations to the observed growth responses.

Comparative Physiology, Growth, and Biomass of Douglas-fir and Red Alder

This experiment, conducted by Sam Chan, Steve Radosevich, and Jack Walstad, is tied closely to the study on competitive interactions being conducted by Laura Shainsky and Steve Radosevich. The hypothesis explored is that the availability of resources (i.e., light and soil moisture) and the relative ability of red alder and Douglas-fir to use these resources ultimately affect tree physiology, growth, and yield. Information from this study is useful in understanding the mechanisms and tactics employed by these species for competitive success. Outplanted 1-0 trees are subjected to two levels and four combinations of light and soil moisture. Light level is regulated with shade tents, and soil moisture is maintained with a drip irrigation system. Morphological, physiological, and biomass responses of the trees are being collected. Listed below are trends observed during the first year of study:

- Diameter growth of red alder and Douglas-fir is significantly reduced by low levels of light
- Diameter growth of red alder is also adversely affected by low levels of soil moisture
- Height growth of both species has not been significantly affected by varying the level of light or water. However, shaded alder and Douglas-fir appear etiolated, with weak, thin branches
- Leaves or needles of shaded trees are larger and spaced farther apart that are those of unshaded trees
- Red alder has higher photosynthetic rates and stomatal conductances than does Douglas-fir
- Photosynthesis and stomatal conductance for both species are reduced in midafternoon, but the rates for Douglas-fir are more depressed than those for red alder

- Vapor pressure deficit may depress photosynthesis in midafternoon even though soil moisture is at field capacity
- Photosynthesis by Douglas-fir is apparently minimal during cold winter months (Nov.-Feb.) such as prevailed in 1985
- Red alder depletes soil moisture more completely and to a lower depth than does Douglas-fir.

Activities for the second year of this study will include intensive sampling of physiological response on a diurnal basis and harvesting of selected trees to determine partitioning of biomass and leaf area in relation to resource levels and physiology.

Species Proportions: Effect on Biomass Allocation in Red Alder and Douglas-fir

Pamela Bold, Steve Radosevich, and David Hibbs are using replacement series to determine how various species proportions affect plant biomass. However, when plants cannot be destructively sampled, allometric equations must be used to approximate biomass from other measured parameters. Commonly, the same allometric equation is used for a species regardless of its proportions. The question arises: Can a single equation be used regardless of species proportion or is proportion itself a significant variable in the equation? This study is designed to answer that question as well as to develop allometric equations for Douglas-fir and red alder seedlings on poor sites. The seedlings were planted near Belfair, Washington, in February 1985 at three proportions (100:0, 50:50, and 0:100), each at three densities. First-year growth was measured in October 1985. In October 1986 the seedlings will be measured and destructively sampled for biomass. At that time the allometric equations will be developed and species proportion will be tested as a significant variable.

Interaction with Alder and Genotypic Variation: Effects on Structure of Douglas-fir Stands

A hierarchy of tree sizes is established very quickly in stands of forest trees. The position an individual tree occupies in this hierarchy is strongly influenced by such factors as environmental conditions and proximity of neighboring plants. Much less is known about the importance of genetic variation in determining the survival and growth of individual trees in crowded environments.

Terry Petersen, Steve Radosevich, and Mike Newton are conducting two experiments in which genetics will be integrated with the study of interactions between Douglas-fir and red alder. The first will examine variation between half-sib families of Douglas-fir and alder seedlings in their response to intra- and inter-specific neighbors. The goal will be to evaluate differences between families in germination and early growth traits that might influence performance in crowded environments. The second will use genetic markers (isozymes) to determine if interaction with alder causes a change in genotype frequencies in mature Douglas-fir stands. An affirmative answer would support the hypothesis that there is a genetic basis for the interaction between the two species. The results of these experiments will have practical implications for tree breeding, management of vegetation in progeny test plantations, and maintaining improved yields in plantations of selected trees that interact with other plants.

AUXILIARY RESEARCH

In addition to the three types of research described earlier, CRAFTS also attempts to encourage research being conducted by other scientists. In this way, information is made available on topics of interest to the cooperators but for which funds or expertise is lacking within the organization itself.

Screening Trials

The evaluation of Arsenal® and Escort® on several forest sites in the Coast Range has shown these herbicides to be highly effective for suppression of certain plant species. Both are broad-spectrum, foliar-applied herbicides that exhibit some soil activity. Mike Newton and his associates initiated a study to determine whether these compounds are effective in site preparation and competition release of mixed stands of conifers and deciduous trees in the Coast Range.

One experiment was installed in 1984 near Eddyville, Oregon, in a mixed stand containing Douglas-fir and sprout clumps of bigleaf maple. First-year data were collected in late June 1985. Both rates of Arsenal® (1 and 2 lb/acre) caused nearly 100 percent defoliation of the sprout clumps. New leaf formation was inhibited, and current foliage exhibited chlorosis and stunting similar to symptoms associated with glyphosate injury. The highest rate of Arsenal® resulted in significantly greater stem mortality than did the lower rate. Stem mortality of 37 to 54 percent occurred after Escort® application. Most treated clumps had some crown reduction, but the lower portions of the crown recovered and exhibited little herbicide injury. All treatments of Escort® caused injury to Douglas-fir at the time of application, presumably through foliage activity.

Another experiment was installed near Toledo, Oregon, in 1984 in a 3-year-old Douglas-fir plantation. The site contained large numbers of red alder seedlings, salmonberry, Himalaya blackberry, and evergreen blackberry. Vegetation was visually evaluated in June 1985 for herbicide injury. Suppression of red alder was more effective after July treatment (90 percent control) than after August treatment (40 percent control). Such suppression after Escort® treatment was not significantly different from the non-treated control. Escort® treatments were highly effective against salmonberry—100 percent control on all plots, regardless of dosage. Arsenal® at 2 lb/acre was also effective for this purpose, but lower rates produced less control. Himalaya and evergreen blackberry seedlings were severely damaged by all rates of Escort®. Conifers received severe injury ranging from terminal dieback to mortality from both herbicides.

Competitive Interactions Among Western Hemlock, Red Alder, and Salmonberry

A 5-year study of how western hemlock performs in competition with red alder and salmonberry in riparian zones of western Oregon was funded recently by the USDA Competitive Grants Program. Mike Newton, Liz Cole, and Steve Radosevich will test the interaction among those species on sites with an established history of failure as Douglas-fir plantations. Nelder plots that include replacement series will be established. Nelder designs permit a test of competitive interaction over a continuous range of densities.

The researchers' hypothesis is that a range of high-density spacings exists at which hemlock cannot dominate alder and that, at any wider spacing among alders, hemlock will become increasingly dominant over time. They expect to determine alder and salmonberry densities that are not compatible with hemlock, as well as the range of densities at which hemlock can be expected to dominate in the future. The relative growth of alder and hemlock with and without salmonberry will be used as an indicator of the long-term prospects for hemlock's development.

The experiment is designed so that, with minimum maintenance, data on long-term growth will be obtainable in the future for more precise measurements and for validation of short-term findings. Pooling of these data with those from on-going studies of how Douglas-fir interacts with red alder should reveal how competitive ability and dominance of conifers are influenced by growth habit.

EDUCATIONAL ACTIVITIES

Cooperative Technical Reports

Five CRAFTS technical reports on studies now in progress were distributed to all cooperators in 1985-86. These include

two master's theses partially funded by CRAFTS, listings of second- and third-year treatment means by site from the study on competition release in the Coast Range, and an update on screening experiments conducted by Mike Newton.

Several technical reports are in preparation. One discusses the regression analysis in the Coast Range release study. Two others will update findings from the screening trial for control of bigleaf maple sprouts. The first of these summarizes the general characteristics of the sprout clumps themselves; the second details methods of applying herbicides to such clumps.

Presentations by Invited Speakers at Technical Committee Meetings

In addition to receiving technical reports on the status of CRAFTS research throughout the year, cooperators can also hear technical reports on other topics related to forest vegetation management. These reports are provided by invited speakers at Technical Committee and Technical Subcommittee meetings. Invited technical reports at CRAFTS meetings during the past year have included:

- Results of basal spraying of bigleaf maple clumps: a joint effort of the Wilbur Ellis Company and Starker Forests. Ken Seppa, Wilbur Ellis Company, Portland, Oregon. March 1985.
- Controlling sprout clumps of bigleaf maple with basal sprays. Bruce Kelpsas, Forestry Consultant, Corvallis, Oregon. March 1985.
- Relationship between timing of manual cutting and sprouting of red alder. Dougl Belz, Washington Department of Natural Resources, Olympia, Washington. October 1985.
- Technology of applying herbicides with electrodyns. Steve Radosevich, CRAFTS program, Oregon State University, Corvallis, Oregon. October 1985.
- Current and future restrictions on prescribed fire in Oregon's forests. Tom Lane, Oregon Department of Forestry, Salem, Oregon. December 1985.

- Trends in smoke management in the state of Washington. Bill Williams, Washington Department of Natural Resources, Olympia, Washington. December 1985.
- Past and current research on prescribed fire by the Pacific Northwest Forest and Range Experiment Station. Dave Sandburg, Pacific Northwest Forest and Range Experiment Station, Olympia, Washington. December 1985.
- Past and current research on prescribed fire by the FIR program in southwest Oregon. Dave McNabb, FIR program, Oregon State University, Medford, Oregon. December 1985.

Presentations by CRAFTS Personnel at Meetings

CRAFTS personnel are frequently called upon to speak at meetings, symposiums, workshops, and college classes on forest vegetation management. Presentations by CRAFTS personnel during the past year included:

- Oregon State University's CRAFTS program. Steve Radosevich. Invited presentation. British Columbia Ministry of Forests, Victoria, British Columbia, Canada. March 1985.
- Plant competition. Steve Radosevich. Invited lecture. Montana State University, Bozeman, Montana. May 1985.
- Objectives of vegetation management and the implications for fire, chemical, mechanical, and manual tools. Bob Wagner. Invited presentation. Forest Advisors Workshop, Washington State University Cooperative Extension, Olympia, Washington. October 1985.
- Prescription forestry. Steve Radosevich. Moderator. Oregon Weed Conference, Oregon Society of Weed Science, Salem, Oregon. October 1985.
- Effects of herb and brush competition on Douglas-fir growth in the Oregon and Washington Coast Range. Tim Harrington. Invited presentation. Oregon Weed Conference, Oregon Society of Weed Science, Salem, Oregon. October 1985.

- Mechanical and manual site preparation in reforestation. Bob Wagner. Invited lecture. Graduate reforestation class, College of Forestry, Oregon State University, Corvallis, Oregon. November 1985.
- Methods for studying plant interference. Steve Radosevich. Invited lecture. Agronomy Department, Washington State University, Pullman, Washington. November 1985.
- New developments in forest vegetation management. Steve Radosevich. Invited presentation. Western Society of Forestry and Conservation, Spokane, Washington. December 1985.
- Principles and problems of forest vegetation management. Steve Radosevich. Keynote address, Forest Vegetation Management Symposium, Association of British Columbia Professional Foresters, Kamloops and Vancouver, British Columbia, Canada. January 1986.
- Thresholds of interspecific competition: the implications for fire and mechanical, manual, and chemical tools. Bob Wagner. Invited presentation. Forest Vegetation Management Symposium, Association of British Columbia Professional Foresters, Kamloops and Vancouver, British Columbia, Canada. January 1986.
- Third-year results from the CRAFTS Study on Competition Release in the Coast Range. Tim Harrington. Invited presentation. Mid-Columbia Vegetation Management Committee, Hood River, Oregon. January 1986.
- Competition between conifers and associated shrub species. Steve Radosevich. Invited presentation. Mid-Columbia Vegetation Management Committee, Hood River, Oregon. January 1986.
- Manual vs. chemical weed control in forest vegetation management. Bob Wagner. Invited presentation. Weed Control Shortcourse, Jackson County Extension Service, Medford, Oregon. February 1986.
- Tools and techniques in forest vegetation management. Bob Wagner. Invited presentation. Forest Vegetation Management Workshop, Oregon State University, Corvallis, Oregon. March 1986.

- Principles of sprayer calibration. Bob Wagner. Invited presentation. Forest Vegetation Management Workshop, Oregon State University, Corvallis, Oregon. March 1986.
- Technology of herbicide application. Bob Wagner. Organizer and moderator. Forest Vegetation Management Workshop, Oregon State University, Corvallis, Oregon. March 1986.
- Effects of herb and shrub competition on Douglas-fir growth in the Oregon and Washington Coast Range. Tim Harrington. Invited presentation. Forest Vegetation Management Workshop, Oregon State University, Corvallis, Oregon. March 1986.
- Survival and growth of conifers 6 years after application with foliage-active herbicides. Steve Radosevich. Invited presentation. Forest Vegetation Management Workshop, Oregon State University, Corvallis, Oregon. March 1986.

Workshop on Vegetation Management

The Forest Vegetation Management Workshop was divided into two sessions this past year in an effort to meet different needs of the audience. Emphasis the first day was on common principles, tools, and techniques used for forest vegetation management. On the last two days, the biological and economic efficiency of various vegetation management practices was examined. Also included in the program was an update on current research and a half-day session on non-chemical techniques for vegetation management.

David Hibbs coordinated the entire program. Various CRAFTS personnel also participated. Steve Radosevich discussed some long-term responses of conifers to herbicide injury. A summary of herb and brush competition on Douglas-fir growth was given by Tim Harrington. Bob Wagner organized and moderated a section on vegetation management tools and techniques.

Text on Forest Vegetation Management Nears Completion

The CRAFTS-sponsored compilation of the lore and literature of forest vegetation management is nearing completion. This nation-wide project will culminate in a textbook edited by Jack Walstad and Peter Kuch and published by John Wiley and Sons. The anticipated publication date is early 1987. All 14 chapters have been drafted, undergone technical peer review, and are in the final stages of editorial revision. The chapters cover such topics as ecological principles, vegetation problems, treatment alternatives, growth and yield, costs and economics, and silvicultural prescriptions. Several of the chapters have been authored by specialists at Oregon State University (Doug Brodie, Mike Newton, Steve Radosevich, John Tappeiner, Bob Wagner, and Jack Walstad).

APPENDIX 1

CRAFTS Publications 1985-86

Harrington, T.B. 1985. Douglas-fir treatment means by site for the CRAFTS Coast Range Release Study. CRAFTS progress report. Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon.

Harrington, T.B. 1985. Douglas-fir treatment means by site for the CRAFTS Coast Range Competition Release Study: three years following treatment application. CRAFTS progress report. Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon.

Lanini, W.T., and S.R. Radosevich. 1986. Response of conifer species to site preparation and shrub control. Forest Science. *In press.*

McHenry, W.B., and S.R. Radosevich. 1985. Forest vegetation management. *In* California Weed Conference. Principles of Weed Control in California. Thompson Publications, Fresno, California.

Newton, M., E.C. Cole, and D.E. White. 1985. First year evaluation of Arsenal® and Escort® herbicides in the Oregon Coast Range. CRAFTS progress report. Department of Forest Science, College of Forestry, Oregon State University, Corvallis, Oregon.

Paley, S.M., and S.R. Radosevich. 1985. Herbicide tolerance in relation to growth and stress in five coniferous species. Weed Science 33:472-478.

Radosevich, S.R. 1985. CRAFTS (Coordinated Research on Alternative Forestry Treatments and Systems) Annual Report. Forest Research Laboratory, Oregon State University, Corvallis, Oregon.

Radosevich, S.R. 1985. Form and function of plants. *In* California Weed Conference. Principles of Weed Control in California. Thompson Publications, Fresno, California.

Radosevich, S.R., R.G. Wagner, and D.R. Orcutt. 1986. Predicting effects of modified cropping systems: forestry examples. Horticultural Science. *In press.*

Radosevich, S.R., J.D. Walstad, and M. Newton. 1985. CRAFTS: A revised prospectus. Forest Research Laboratory, Oregon State University, Corvallis, Oregon.

Ross, D.W. 1985. The effects of mechanical and chemical site preparation on ponderosa pine and lodgepole pine performance, associated vegetation, and soil properties in southcentral Oregon eight years after planting. M.S. thesis, Oregon State University, Corvallis, Oregon.

APPENDIX 2

Financial Support Received in 1985-86

Cooperators	Financial support	
Boise Cascade Corporation	$ 4,500	
British Columbia Ministry of Forests	4,500	
Bureau of Land Management	4,500	
Champion International Corporation	4,500	
Crown Zellerbach Corporation	4,500	
International Paper Company	4,500	
Lone Rock Timber Co.	2,250	
ITT-Rayonier, Inc.	4,500	
Longview Fibre Company	4,500	
MacMillan Bloedel Limited	4,500	
Oregon State Department of Forestry	4,500	
Publishers Paper Company	4,500	
Rex Timber	4,500	
Simpson Timber Company	4,500	
Starker Forests, Inc.	2,250	
USDA Forest Service, Pacific Northwest Forest and Range Experiment Station	(1/)	
Washington Department of Natural Resources	4,500	
Weyerhaeuser Company	4,500	
Willamette Industries, Inc.	4,500	
Subtotal		$ 76,500
Forest Research Laboratory, Oregon State University		94,850
Subtotal		171,350
Other sources[2]		
USDA, Siuslaw National Forest[3] (Radosevich, 1985)	27,441	
USDA, Forest Service NAPIAP Program (Radosevich, 1985)	30,338	
USDA Competitive Grants: Biological Stress[3] (Hibbs and Radosevich, 1985 and 1986)	80,000	
USDA Competitive Grants: Biological Stress[3] (Radosevich, 1986 and 1987)	65,800	
USDA Competitive Grants: Biological Stress[3] (Newton, Cole and Radosevich, 1986-1991)	134,000	
Subtotal		337,579
Total		$508,929

[1] Support given by in-kind contributions.
[2] Leader for project funded shown in parentheses.
[3] Includes university overhead.

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Address Correction Requested

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