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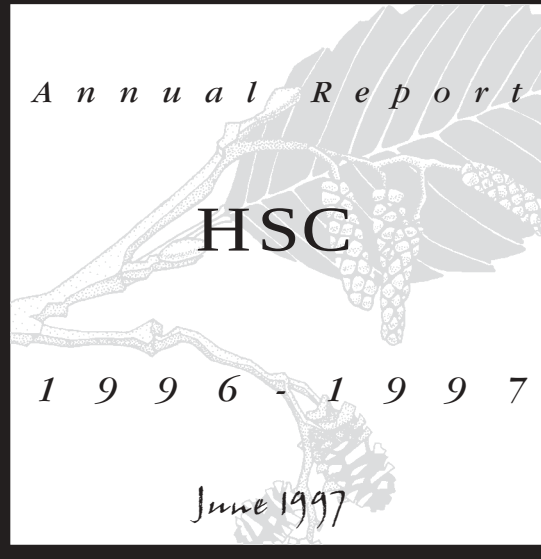

Annual Report

HSC

1996 - 1997

June 1997

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Highlights of 1996-1997

- We have completed installation of our Type 2 (variable density) installations, with three new ones this past winter. This brings our total to 26, less than our original target but a more-than-adequate number for our purposes. We also put in another Type 3 (mixed alder - Douglas-fir) installations, bringing the total to 7. We already have four Type 1 (thinning natural stands) installations.

- Third-year measurements and permanent plot installation was completed on five Type 2 sites; two sets of 6th year measurements were also done. Standard measurements were also made on two Type 1 and three Type 3 installations.

- Thinning and pruning was completed at three Type 2 sites.

- Two years after outplanting, the biggest lesson in the bigleaf maple regeneration study is the importance of browse control. After a slow first year, second-year growth at most sites was quite good.

- On a mixed note, Karl Buermeyer, the head research assistant for the HSC, has moved on to bigger and better things. His years of excellent service are appreciated and will be missed. Alison Luckett, who has been working part time for the HSC, will move into Karl's position.

Contents

Introduction

This report summarizes the activities of the Hardwood silviculture Cooperative during its 10th year. Emphasis of the Cooperative continues to be on the management of red alder for timber production, biodiversity, nitrogen fixation, and as an alternative species to conifers in areas infected with laminated root rot. We have also completed a two year study of bigleaf maple regeneration.

The Red Alder Stand Management Study continues to be our highest priority project. In 1990, we planted our first three Type 2 (variable density) installations. This past winter, we planted the last three Type 2 (variable density) installations we have planned. This brings our total to 26. Counting the few failed installations over this 7 years, we averaged almost 4 per year, an impressive number. Over this time, we have greatly improved seedling quality, site quality characterization, and plantation establishment practices.

Our study of bigleaf maple regeneration is almost complete. As of this writing, two years of data are being analyzed to determine predictors of outplanting performance from seedling characteristics at time of planting. We will also develop guidelines for nursery grading of bigleaf maple. As expected at the beginning of the study, elk browse was heavy. An encouraging observation is that, contrary to most maple planting experience, our seedlings grew well in diameter the second year and would have grown several feet in height if not for the elk.

On a less bright note, Weyerhaeuser / Northwest Hardwoods have dropped from the HSC. While we have enjoyed and greatly benefitted from their participation, we must find a way to maintain the installations on their lands while working with a reduced budget. We are in the midst of an analysis of what kinds of reductions in activities we might make while maintaining the basic integrity of our research.

The following report reviews in more detail the activities of the Coop and the progress with these major projects, as well as related research by HSC staff on alder and other hardwoods.

Organizational Activities

Summer Management Committee Meeting - July 1996

The Management Committee met on July 16 and 17, 1996 in Campbell River, BC, with field trips in the two afternoons, and an optional field trip on the morning of July 18.

The meeting on the 16th began with introductions. Karl Buermeyer gave an update on the Red Alder Stand Management Study. A list of activities through the winter of 1997/98 was distributed, and enclosed with the minutes.

The loss of potential sites through loss of memberships was discussed, as well as the resulting need to scale back the matrix of Type 2 (variable density alder plantation) sites from 30 to 28 sites. While additional sites were welcomed, the last planned installations were to be planted in the spring of 1997.

It was agreed that we need to adjust site index figures for each of the sites based on the actual growth we observe.

A number of new and adjusted data collection protocol for the Red Alder Stand Management Study were discussed and amended. These were further adjusted at the winter meeting, and subsequently in response to further membership losses and budgetary concerns.

Alison Luckett discussed the first year results from the Bigleaf Maple Study, and prospects for year two. On the following day, the discussion continued with setting priorities for future research on the reforestation and management of Bigleaf Maple.

Tuesday's field trip began with a stop at a McMillan-Bloedel hybrid poplar plantation, where vegetation management strategies were being tested. Bob van den Driessche and Kevin Brown of the BC Ministry of Forests discussed poplar nutrition studies, and Brenda Callen, also of the Ministry, discussed poplar diseases.

The group then visited a HSC Type 2 site in its fourth growing season. The primary focus was on alder diseases, with a presentation by Eric Allen. We also observed some unidentified stem disease symptoms on the planted alder.

On Wednesday, following the completion of the Bigleaf Maple Study discussion, Dave Hibbs updated the group on the Alder Genetics Study

(being funded by the Tree Improvement Coop and the Oregon Department of Forestry). There was also a discussion of the funding of the modeling work that is needed to obtain results from the Red Alder Stand Management Study. It is hoped that the Washington Hardwood Commission will provide this funding.

The past and proposed budget, as well as the probability of a dues increase were presented by Dave. The meeting wrapped up with the proposal of a semi-annual newsletter to provide an update on coop activities and information pertinent to the upcoming meeting.

Wednesday's field trip visited an alder provenance trial near Fanny Bay, led by Chen Ying of the BC Ministry of Forests. Differences in height growth were already evident in its second year, with the Gulf Islands and Port Alberni seed sources looking best.

The final stop of the day was at another HSC Type 2 site. While site quality appears rather poor, the excellent stock planted there seems to be doing well.

The field trip on Thursday visited a mixed alder / conifer site near Cowichan Lake where the performance of alder and control of sprouts were the major topics of discussion. A plantation of bigleaf maple was also visited that day, where the lack of browse was a major point of interest.

Winter Management Committee Meeting, January 1997

The meeting began at 8:30 AM on January 7 with introductions. Karl discussed ongoing and planned activities supporting the Red Alder Stand Management Study. Progress in filling the Type 2 installation matrix was reviewed, with 26 or 28 committed, depending upon Coast Mountain Hardwoods' ability to install two sites.

Karl reviewed data collected on pruned plots. Based on five sites that have had their first pruning lift, it appears that in order to keep the Diameter Over Stubs (knotty core) at 4 inches, trees need to be pruned at around 3 inches DBH. This has occurred after the 4th or 5th growing season in our sites.

Dave Marshall from the Stand Modeling group at OSU gave a brief overview of the ORGANON stand model and the most important variables we will need to develop an alder stand growth model.

Karl reviewed our progress in updating our field measurements to better facilitate the development of an alder stand model. Based on discussions at this time and in our subsequent field trip, these proposed data protocol were further refined. A summary of these measurements is presented in the following section on the Red Alder Stand Management Study.

On Tuesday the group visited a six year old Type 2 site (variable density alder plantation) where we observed the damage from a severe fungal infection in the 4th growing season, and how trees are recovering. It was hypothesized that forage seeding of grasses may be partially responsible for overall slow tree growth on this site.

Being in the field provided an opportunity to test and refine some of the new data protocol after trying them out on actual trees.

A new Type 3 installation (alder / Douglas-fir replacement series) was visited, where we observed some alder seedlings in Vexar tubes.

The following morning after the group confirmed the changes to the measurement protocol based on the previous days' field trip, Alison updated the group on the progress in the Bigleaf Maple Study. Since the two year preliminary study was scheduled to end the summer of 1997, it was decided to continue to monitor the five sites, rather than to set up a browse recovery study. Should the trees recover in the future, we can resume measurements if appropriate.

Dave Hibbs discussed budget shortfalls left by the withdrawal of Weyerhaeuser / Northwest Hardwoods and International Paper. With the increase in field work because of an increasing number of study sites, and a decreasing membership, it was predicted that a budget increase will be needed in the upcoming fiscal year. Work continues on trying to lower the workload to minimize a dues increase.

Wednesdays field trip was to Cascade Head Research Forest, where we visited an old mixed alder / conifer study, stand origin around 1930. The group then observed red alder Nelder plots and alder / Douglas-fir replacement series. Obvious results were the high incidence of multiple stems in widely spaced alder, and the advantage to the Douglas-fir of delaying alder planting to minimize overtopping by the alder.

COOPERATIVE RESEARCH

RED ALDER STAND MANAGEMENT STUDY

The last planned Type 2 installations (variable density alder plantations) were planted in the spring of 1997. Due to membership losses and limits on the time and resources of remaining members, we have planted only 26 of the 30 Type 2 installations originally planned. Table 1 is the final matrix, each site being identified by the owner and year planted. Note that those sites identified by "Diam" or "WeyCo" are now the responsibility of the Coop, as Diamond Wood Products was acquired by Weyerhaeuser / Northwest Hardwoods, which subsequently dropped out of the Coop.

The seventh Type 3 (Douglas-fir / alder replacement series) site was planted this spring. Alder seedlings were extremely large, so success of this site depends on how much rain falls during the growing season.

Table 1: Matrix of planted Type 2 installation sites, July, 1997.

Region	Site Quality		
	Low	Medium	High
	SI_{50} :23-27 M SI_{20} :14-17 M	SI_{50} :28-32 M SI_{20} :18-20 M	SI_{50} :33+ M SI_{20} :21+ M
1) Sitka Spruce North	—	DNR 91	BCMin 94 DNR 96
2) Sitka Spruce South	SNF 91 SNF 95	Diam 92 SNF 94	WeyCo 90 Diam 94
3) Coast Range	SNF 92 BLM 95	WeyCo 90 ODF 92 BLM 94 ODF 97	Diam 92 WeyCo 93 OSU 97
4) North Cascades	BCMin 94	GYN 90 BCMin 93 DNR 95	GYN 89
5) South Cascades	GPNF 97	BLM 92 WeyCo 93	—

During the fall and winter of 1996-97, we installed plots and conducted 3 year measurements on five Type 2 sites, 6 year measurements on two Type 2 sites, and thinned and pruned plots on three Type 2 sites. In addition, we conducted periodic measurements on two Type 1 sites (thinned natural alder stands), and three Type 3 sites.

The following list describes the new data and protocol developed at the winter meeting. Implementation of these new measurements is on hold until we identify data critical to the red alder growth and yield models and streamline data collection. This evaluation is necessary in light of the recent membership withdrawal and reduced budget.

Stem and Crown Form

# of installations:	3 (High, Medium and Low site quality)	
# of trees/ installation:	33	
Frequency:	Years 6, 12, 18	
Measurements:	Total height	
	Height to live crown	
	DIB and DOB at	-1.5, 2.5 3.5 and 4.5 feet
		-10 equal increments from 4.5 feet to the top of the tree, plus .95 distance to the top (Only trees greater than 5 inches DBH will be measured for taper)
	Crown diameter at	-base of live crown
		-widest point in the crown
		-1/4, 1/2 and 3/4 distance from the widest point to the top of the tree

Limb Death, Shedding and Occlusion

# of installations:	6 (High, Medium and Low site quality in Type 2 and Type 3 installations)	
# of branches/ installation:	9-12 per treatment in all treatments except pruning (dominant branches 5-10 feet above ground)	
Frequency:	Yearly from year 6 - 18	
Measurements:	after branch death	- branch diameter
		- height to branch
		- trunk diameter below branch
	after branch occlusion	- trunk diameter below branch

Age at Breast Height

# of installations: all Type 2
# of trees/5 plots in location of treatment block: largest 13
Measurement: full years plus fraction of internode below breast height (office exercise with existing survival data)

Index of Sinuosity

# of installations: all
# of trees/installation: all, when measuring installation
Measurement: deviation from straight in the section between 1 and 9 feet (maximum distance to the nearest inch between the tree and a straight pole leaned against the tree)

Crown Diameter

# of installations: 6 (2 each high, medium and low site quality)
# of trees/installation: 20/treatment (160 - 220 total)
Frequency: during measurement in years 3, 9 and 14
Measurement: crown diameter along radius from plot center and at a right angle

Bole Infections

# of installations: all
# of trees/installation: all, when measuring installation
Measurements: presence or absence of-

1 - sooty appearance on bole or branches
2 - red blisters on bole
3 - rough and black around knots and branches
4 - death of cambium (canker)

Regeneration of Bigleaf Maple - *Acer macrophyllum* (Pursh.)

Improved seedling production and animal damage control is necessary to successfully establish bigleaf maple. The Bigleaf Maple Regeneration project was started in 1995 to compare several approaches to producing maple seedlings and answer some specific questions about seedling quality and performance:

1. Are there specific morphological characteristics of vigorous, fast growing seedlings?
2. Do seedling with these characteristics do better across sites with variable environmental conditions?
3. What is the comparative success of nursery techniques under which seedlings are grown?
4. Does animal control contribute significantly to seedling survival?

In February 1995, 1600 seedlings were randomly selected from 5 nursery lots. Growing protocol for the five tree lots is in the June 1996 annual report. A series of measurements was taken on each tree to record root and stem characteristics at the time of lift from the nursery beds.

Trees were then planted at 5 sites. Planting spots were randomly assigned and nursery lots were interspersed. Each trees_ growth was tracked for two years. The following is a summary of five installation sites:

1. BLM508 - Cascade foothills, Mt. St. Helen WA. Seed zone 430.
2. BLMc200 - West-side Coast Range, Raymond, WA. Seed zone 030.
3. BLMceres - East-side Coast Range, Cere Hill, WA. Seed zone 241.
4. For Grove- North Oregon Coast Range, Apiary Rd, OR. Seed zone 052.
5. Pioneer - Central Oregon Coast Range, Pioneer Mt., OR. Seed zone 061.

In the first growing season, trees grew very little. The mean change in height was negative due to dieback from frost and other environmental conditions. Most trees did not make it above the 36” protective vexar tube until the second year, at which time they were severely browsed. Browse occurred at all sites except Forest Grove where few trees reached tube height even in the second year.

It was unfortunate that browse impact was so severe, but it did tell us that effective elk and deer control is necessary. Vexar tube 36” x 3.5” with one bamboo stake is not adequate. Height of 36” appears to be buffet height. The tubes actually bowed out from the elk repeatedly stuffing their noses down into them. A minimum of two bamboo stakes with wire

attaching the tube is required to keep the tubes on the trees. Anything less substantial is pulled off. Bigleaf maple planted in elk habitat might have a better chance of survival if interplanted with other species. A plantation of maple is an abundant food source to which elk repeatedly return. Interplanting was not tried in this study and therefore its efficacy is uncertain.

Because of browse damage, tree height is not an appropriate measure of performance. Therefore, survival and change in stem basal diameter are the performance measures available for comparison. Three characteristics, of the ten measured, significantly predict a tree's chance of survival two years after planting. They are stem diameter, root volume and number of first order lateral root 1 millimeter or larger (rt1mm). Diameter and root volume explain the most variation between dead and alive trees. Root volume is the best predictor of survival overall, but it is impractical as a grading standard. Diameter is correlated to root volume(R=0.78) and is easier to measure. Therefore, a grading standard based on diameter is suggested. Most Seedlings in this study had diameter between 3 and 10 mm. Survival was better for seedlings with diameters larger than 5 millimeters. Seedling grading standards and growing protocol are being developed out of information gathered during the two years of this study, and will be available summer 1997.

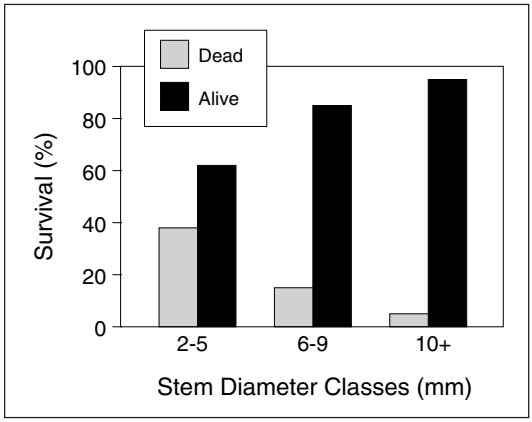

Figure 1 . Percent survival by stem diameter class. Stem diameter measured in the nursery was correlated to tree survival two years after outplant (Pr>Chi=0.0001). There is a significant decrease in mortality when stem diameter is larger than 5 millimeters.

Stem diameter and root volume were significantly different between nursery tree lots. AFT survived the best with only 07% mortality and also had

largest mean stem diameter and root volume. EOFD had 14% mortality and AWFD had 17% mortality, but there was no statistical difference in their mean stem diameter or root volume. AOFT and ASWD had 30% mortality. It is interesting to note that AWFD and AWSD were the same seed, but AWFD was sowed in the fall directly after collection and AWSD was stored and spring sown. The AWSD lot had poor germination and initial growth in the nursery. At the time of lift AWSD had larger mean stem diameter and smaller mean root volume than AWFD. Two years after outplant, survival of AWFD seedling was significantly better than AWSD seedlings. The discrepancy in survival for these 2 tree lots emphasizes the importance of proper seed storage. This is consistent with Zasadas finding that Bigleaf Maple seed viability can decline by 60% to 90% during 1 year of storage (Zasada, et al. 1990, *Western Journal of Applied* Forestry, Vol. 5, No. 2). Figures 2a and 2b show Ryan Q least significant difference between tree lots for mean initial stem diameter and root volume.

A

RyanQ Test for Significant Differences On Ranked Mean Diameters

Grouping	True Mean	N	TreeLot
A	8.5	312	AFT
B	7.3	320	EOFD
B			
B	7.1	320	AWSD
C	6.3	321	AWFD
D	4.7	320	AOFD

B

RyanQ Test for Significant Differences on Ranked Mean Root volumes

Grouping	True Mean	N	TreeLot
A	27.2	312	AFT
B	15.2	321	AWFD
B			
B	13.6	320	EOFD
C	12.5	320	AWSD
D	9.2	320	AOFD

Figure 2. (A) mean stem diameter and least significant differences in stem diameter between the five tree lots at the time of nursery measurement. Means with the same grouping letter are not significantly different from one another. (B) mean root volume and least significant differences in root volume between five tree lots. Means with same grouping letter are not significantly different from one another.

Due to extensive browse, stem volume and tree height are not useful measures of growth. Therefore, change in diameter is used to define growth. Mean stem diameter growth in year one was 0.74 mm at all five sites. This is too small to be considered biologically significant. Mean stem diameter growth in year two was 4.83 mm and differed significantly between sites, but not between tree lots. Stem diameter growth was correlated to initial stem diameter (R= 0.53) more so than initial height (R= 0.33). Stem diameter growth was not correlated to initial root volume. Figure 3 shows the second year stem diameter vs. initial stem diameter for all live trees. Trees that have a smaller Diameter 2 than Diameter 0 are trees that sprouted after being browsed to the ground, or trees that were planted in slash.

Sites had significantly different survival. BLMcere had the lowest mortality; 10 percent of the trees died. This site is in seed zone 241 which is the same zone as three of the nursery tree lots. Figure 4 shows the percent survival at each site.

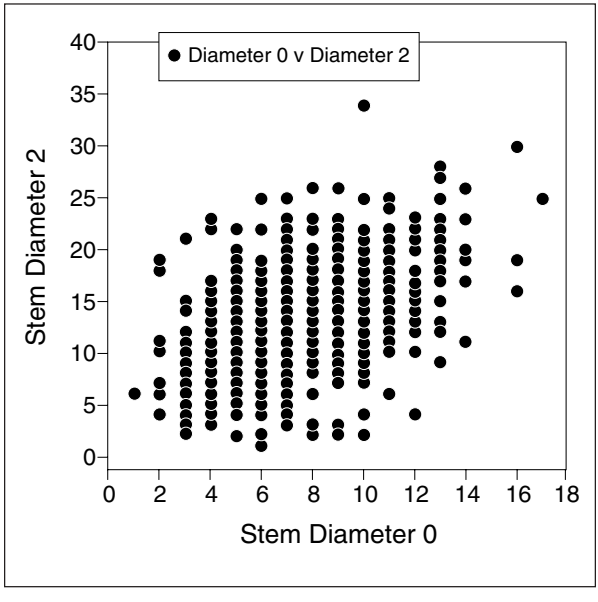

Figure 3. Stem diameter of bigleaf maple at time of nursery lift (Diameter 0) and after 2 years of growth (Diameter 2).

Environmental data was not collected for statistical analysis, but observation indicates that planting in duff, competition from weeds, and frost may have contributed to differences in growth and survival at the five sites. Maximum allowable cover from weeds on a site was 30 percent; however, the level varied considerably between

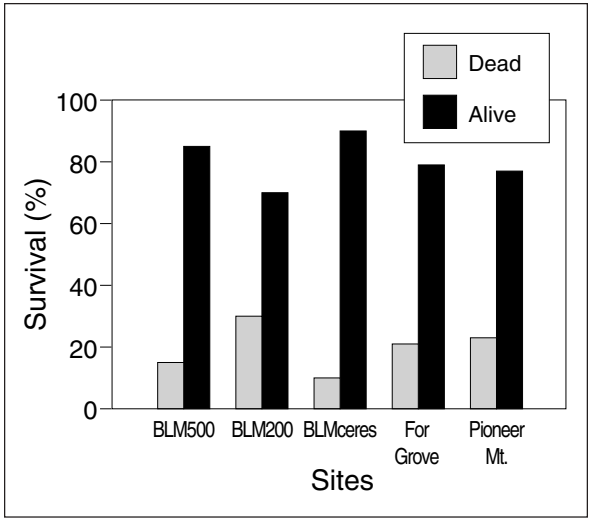

Figure 4 . Percent survival of bigleaf meple at five sites two tears after planting.

sites. BLM508 and Forest Grove had greater than 30 percent weed cover. Herbicide application hurt the trees at Forest Grove.

The best site, BLMceres, is located just west of Centralia, Washinton in seed zone 241. It is on a hill top and receives sun most of the day. Slope is zero. This was a mixed conifer stand prior to harvest. There is less than 30 percent cover from competing vegetation such as: grass, thistle, foxglove, and sword fern. Competition was of minor consequence to the maples at this site.

The worst site, BLM200, is in the heart of the Washington Coast Range on a predominantly south-facing slope. It sits in a slightly concave toe slope which is highly susceptible to frost. Frost damage was visible on almost every tree. Browse impact was also severe at this site. Few seedlings remained tubed, and the unprotected were browsed to the ground. This was a mixed conifer stand prior to harvest. Thistle and other annuals occupied about 10 percent of the site. Competition appeared to have minimal impact on the maples at this site.

Other Applied Research

Other applied research includes projects conducted by or in association with HSC staff and of likely interest to HSC cooperators, but not funded by the HSC.

Hybrid Poplar Production in the Willamette Valley

As mentioned in last year's Annual Report, work continues on the hybrid poplar project in the Willamette Valley. Despite very low pulp prices and high ryegrass seed returns, interest in growing hybrid poplar continues to increase. Whether for pulp, high-value wood products, such as veneer, oriented strand board or particle board, or for environmental remediation, hybrid poplar plantations are appearing all over the region. We have estimated that over 3000 acres of hybrid poplar are planted in the Willamette Valley. While interest remains high within the general public, support from the forest industry is uncertain. There is a profitability analysis trend within the forest industry that is pushing the industry to cut marginal programs. Unfortunately the infant hybrid poplar effort falls into this category, with the effect that James River Corporation's 11,000 acres of hybrid poplar lands along the Columbia River are for sale, and their grower's assistance program has been curtailed. Additionally, Georgia-Pacific Corporation's grower's assistance program has been canceled. While this instability in the market creates a lot of anxiety, surely common sense tells us that consumer's needs for wood products are not waning. The effect of this industry downsizing seems to move the leadership role for hybrid poplar research and education to the university level.

The focus of the hybrid poplar project at OSU is directed at education and applied research. Educational programs that we conduct all over the state of Oregon serve a vital need to growers interested in hybrid poplar. Whereas growing hybrid poplar is neither pure forestry nor pure agriculture but a blend of both, most potential growers need a certain amount of cross discipline training. We have also been involved in establishing demonstration plantings in Madras, La Grande, and Klamath Falls. Research efforts include continued expansion of our growth and yield database, with 19 stands measured this winter to be included in our growth and yield curves, a site preparation study to determine the preferred pre-plant cultivation practices for hybrid poplar, and an herbicide selection trial to determine the safest and most effective weed control chemicals.

Last year we began a site preparation study with five cultivation treatments applied to a Dayton silty clay loam near Tangent, Oregon. The five

treatments are: (1) simple ripping - use of a heavy, rigid tine to break up compacted layers to a depth of 18"-22"; (2) cultivation - plowing and rolling, combined with ridging - creation of a 10" high planting “hill”; (3) cultivation combined with ripping and ridging; (4) winged sub-soiling - commonly used in breaking up deep (down to 30"), compacted layers at landings following forest harvesting operations; and, (5) no-till - a control with no mechanical site preparation. During the growing season soil moisture content and temperature measurements were made biweekly during May and June, and monthly through October, to evaluate the effects of the applied treatments. Both measurements were made at three depths: 6", 15", and 22". Following the first year of growth, tree height was measured in late winter.

Analysis of the soil moisture content and temperature data revealed a few minor significant ($p = 0.05$) differences between treatments, but with no clear pattern to the results. Examination of the height data indicated no significant ($p = 0.05$) differences between the five site preparation treatments. Therefore, we can conclude that during the first year of growth, no meaningful differences in soil moisture content or soil temperature existed between the five tillage practices, and that at the end of that first year of growth, no differences in tree height existed between the five treatments. At this stage in the study, the recommendation would be to select the most cost effective site preparation method of no-till with only chemical weed control. However, we will measure height and diameter at the end of this year’s growing season to determine if any differentiation has occurred. In addition, we have added another site with the same five treatments, also on a Dayton soil, in Halsey, Oregon. The Halsey site was planted in April, 1997, and will be monitored for the first two growing seasons.

Finally, we have begun a series of herbicide selection trials. When growing hybrid poplar in an intensively cultured plantation system, aggressive weed control is absolutely essential to insure that the unrooted cuttings achieve their maximum growth potential. However, in many cases improper chemical selection or over application has led to serious impacts to tree health and thereby to tree growth. To get a baseline of information for later comparisons, we have started our selection trials with five of the most commonly used poplar herbicides along with an experimental product from

Du Pont. These six herbicides were then dosed each at two different rates to make twelve treatments. The twelve treatments were applied to four of the five site preparation treatments at the Halsey site in April, 1997. Treatment plots will be monitored for effectiveness of the weed control action, phytotoxicity to the trees, and tree growth at the end of the growing season. We plan to install similar trials on several different soil types next year.

Educational Activities

Presentations

Managing Hybrid Poplar. Dina Brown delivered presentations in Linn and Polk Counties to local farm groups. David Hibbs delivered presentations and led tours in Klamath, Polk and Benton Counties.

HSC tours included older mixed alder / Douglas-fir studies, alder diseases, and hybrid poplar research in British Columbia.

Directions for 1997-1998

The coming year will present some new challenges and some good opportunities. The challenges are in maintaining the quality of our work through a lean time. Some of the upgrading plans, like the new stem and crown form protocols, will have to be postponed. This is not a lost opportunity, just a postponed one. In addition, we will be looking at all of our activities and looking at what can be reduced while keeping a central core of critical data. For example, we are considering reducing the quantity of treatments and measurements on some installations.

Our Type 2 installations are now getting old enough that we have clearly demonstrated effects of spacing on growth for up to 7 years. As resources allow, we will begin analysis of these data.

We continue to pursue opportunities to begin the next step in the alder stand management study: a model of growth and yield. We have developed a basic working plan and proposal for this and have presented this to two

possible funding groups.

A regional study of alder genetics enters its second year. This study involves some HSC members but is not funded by the HSC.

As always, the primary focus of our resources will be on the measurements and treatments of the alder stand management study.

Appendix 1. Publications

Knowe, S.A. and D.E. Hibbs. 1996. Stand structure and dynamics of young red alder as affected by planting density. Forest Ecology and Management 82:69-85.

Hibbs, D.E. and P.A. Giordano. 1996. Vegetation characteristics of alder-dominated buffer strips in the Oregon Coast Range. Northwest Science 70:213-222.

Knowe, S.A., G.R. Ahrens, and D.S. DeBell. In Press. Comparison of diameter-distribution-prediction, stand-table-projection, and individual-tree-growth modeling approaches for young red alder plantations. Forest Ecology and Management.

Appendix 2. Financial Support Received in 1996-1997

Cooperator	Support
B.C. Ministry of Forests	$8,500
Bureau of Land Management	8,500
Gifford Pinchot National Forest	7,500
Goodyear-Nelson Hardwood Lumber Company	4,500
Oregon Department of Forestry	6,500
Siuslaw National Forest	8,500
USDA Forest Service PNW Station[1]	-
Washington Department of Natural Resources	8,500
Subtotal	$52,500
Forestry Research Laboratory	48,605
Total	$101,105

[1] In-kind contributions