CFRU Information Report 15

1986 Annual Report of the Cooperative Forestry Research Unit

Miscellaneous Report 323

July 1987

TABLE OF CONTENTS

ADVISORY COMMITTEE CHAIRMAN'S REPORT

The year of 1986 could be characterized as a year of change for the Cooperative Forestry Research Unit (CFRU). Dr. Greg Brown, who has been the Dean of the College of Forest Resources as well as the Direct or of the CFRU scientists, staff, and programs, since August 1, 1983, was appointed on November 1, 1986 to serve as the Acting Vice President for Academic Affairs. In the interim, Dr. Fred Knight agreed to serve as the Acting Dean of the College as well as to direct the CFRU activities.

The Advisory Committee will certainly miss the guidance provided over the past three years by Dr. Brown, but at the same time feel we are fortunate in having Dr. Knight available to us.

Dr. Max McCormack resigned his positio n as Leader of the CFRU in September, 1986, a position he has held since March, 1984, in order to be able to devote more time toward his research activities. Max has been extremely helpful to the Advisory Committee and to the Dean in dealing with many of t he administrative duties of the Unit, and the resignation was accepted with regret. The Acting Dean will be assuming these responsibilities in the absence of a new leader.

A Research Priority Task Team was appointed in January, 1986 to review and evaluate research priorities for the next five-year period (1986-1990), and to report back to the Advisory Committee. The Task Team, consisting of Bart Harvey, Ron Lovaglio, and Oscar Selin, solicited ideas and suggestions from both cooperators and scientists, and submitted their findings to the Advisory Committee in April. Major areas of interest for research were identified along with areas of secondary interest. This list of priorities should serve as a guide to research scientists over the next five-year period. One result of this effort was the decision to discontinue funding the Forest Protection Program at the end of 1986, and to place increased emphasis on other areas of research.

Another of the challenges we have faced over the past several years was to restructure the CFRU budget in order to better reflect current and projected contributions. This challenge has been met, and I feel the Unit is now much better positioned for the future as we enter the third 5-year period for the CFRU.

We are fortunate to have a very dedicated and highly qualified CFRU staff and on behalf of the CFRU Advisory Committee I wish to express our thanks to them for their efforts toward solving some of the forest management problems we face. The following scientist reports in this publication will highlight many of their accomplishments over the past several years.

Robert V. Withrow, Chairman
CFRU Advisory Committee

MSN'S REPORT

I shall make very brief Garments on the 1986 report of accomplishments because of my limited association with CFRU during that year. I became the Acting Dean on November 1, 1986 and with that appointment became the designated leader of CFRU. I welcomed the opportunity to become involved once more with the scientists and cooperators associated with the Unit. I expect our group of scientists will continue to be highly productive as in the past.

I am pleased to note that the CFRU is on a solid financial basis as the third five -year research effort commences. I commend the efforts of the advisory committee and the scientists of CFRU for bringing this about. Maxwell McCormack resigned as le ader of CFRU before I was appointed Acting Dean. I appreciate his efforts in developing the support of cooperators during most of the past year. As a result of the joint efforts of all, we have started (on Oct. 1) the five years with a well planned researc h effort directed at priorities developed by our cooperators.

We shall miss Dr. Mark Houseweart; he was an extremely productive scientist. We wish him good fortune as he continues his professional career. I thank Robert Withrow, Chairman; Clifford Swenson, Vice Chairman; Bart Harvey, Financial Officer, and Robert Gardiner for their sendee on the executive catmittee during 1986. Their efforts were critical as leadership changed during the final months of 1986. We shall miss the guidance of D r. Gregory Brown as the program continues.

I have asked our scientists to be brief in describing their accomplishments in this report. The details of their findings are available in other publications. I am impressed by the work accomplished during a year of low funding and planning for the future. We have a group of very capable scientists who have again shown their dedication to the basic objectives of CFRU.

Thanks to the advisory comnittee, the membership at large, and all faculty and staff for their ser vice and for high productivity during 1986. You are the reason that CFRU has continued its well deserved reputation for excellence in research.

Fred B. Knight, Acting Dean
College of Forest Resources

LIST Of TABLES

LIST OF FIGURES

SILVICULTURE

Dr. Maxwell L. McCormack, Jr.

At the 40th Annual Meeting of the Northeastern Weed Science Society, Boston, Maxwell McCormack advanced from Vice President to President Elect. At the presentation of awards, David Santillo, wildlife graduate student with supplemental funding from Great Northern Paper through CFRU, received second place in the research posters for Glyphosate and Wildlife Habitat in Maine. The second place in research papers was awarded to Peter D'Anieri, University of Maine Honors Program student, for his paper authored jointly with Drs. McCormack and Leslie which evaluated the small mammal community in a glyphosate conifer release treatment.

Several personnel changes took place in the silviculture research program. Dr. McCormack resigned as CFRU Leader in October to devote more time to field research, and Frank Spizuoco left the position of Research Associate. It is planned to fill the Silviculture Research Associate vacancy in early summer of 1987. R. A. Lautenschlager, Ph.D. cand idate supported through a fellowship from Boise -Cascade, maintained his research on forest vegetation dynamics and life history of common red raspberry. A new M.S. student, Patrick Strauch, formerly a forester for USG Industries, began preliminary work to develop a thesis project on relative development of red spruce and balsam fir reproduction after overstory removal. G. R. Schaertl, Field Representative, Monsanto Agricultural Company, initiated a Ph.D. program.

Intensive Forest Harvesting

The evaluations following harvesting in the paired watershed study at Weymouth Point, T4R12 WELS, have continued. During 1986, the seventh year of soil solution and stream water sampling was completed. Intensive survey of regrowth vegetation, under directi on of C.T. Smith, Jr., of the Univ. of New Hampshire and C. W. Martin of the U.S.D.A. Forest Service, has been maintained since August 1983.

Sampling for analyses of the triclopyr application to the treatment watershed which was made in August 1985 was co mpleted in August 1986. When complete, these samples will provide data on the distribution and fate of triclopyr across the watershed. A series of samples at two soil depths, with and without the organic pad in place, across three drainage classes was part of the triclopyr residue evaluation. Soil solution nutrient data since the aerial treatment indicate interesting responses in the nutrient cycle.

Precommercial Thinning

Studies, initiated in July 1982, of an aerial herbicide treatment for precontnercial thinning of conifer regeneration continues. Evaluations indicate a consistent pattern of most effective treatments:

(1) picloram + 2,4-D (1 + 4 and 1.5 + 6 Ibs ai/ac)
(2) dicamba + 2,4-D (2 + 3.8 and 3 + 5.7 Ibs ai/ac)
(3) dicamba + 2,4-D + picloram (4 + 4 + 1 Ibs ai/ac)

Treatments were continued in June 1986 through a small operational program conducted by Great Northern Paper. The 1986 operation incorporated trials of added surfactants for efficacy enhancement, and blue colorant to assist with navigation. Lack of success with the colorant has resulted in considering navigational aides which can be installed in the application aircraft. Meetings initiated in 1986 with John Waldrum and Roy Joh nson of Waldrum Specialties, Inc., have significantly advanced utilization of the TVB™ (THRU VALVE BOOM™) SYSTEM for application of a variety of strip spacings. The TVB™ provides a higher level of precision for the strip applications while allowing applica tion aircraft speeds of approximately 50 mph rather than the 25 mph required with the equipment used in earlier trials. This work is planned for continuation during 1987.

Interests, based on this application technology, are increasing in other silviculture

treatments. Strip applications to hardwood stands are a possibility for modifying their densities. Also, a new term, "bandaid release" where strip applica tions of traditional release herbicides are made in mixed growth, is being discussed as such treatments are being tried.

Thinning Spruce and Spruce-fir Stands

The long -term thinning study has been monitored with some trees lost from windthrow and delayed mortality from spruce budworm. This study will be maintained for remeasurement and evaluation at the completion of ten growing seasons after treatment in summer 1988.

Management of Undesirable Vegetation with Herbicides

Research for development of herbicide technology continues to be a significant component of the silviculture program. Cooperative efforts are underway to evaluate glyphosate enhancement with surfactants and tank mix possibilities. Of major interest in perfecting treatments are total spray volumes, particle sizes, and timing of applications.

New materials have become available for testing. Three are receiving special attention. Oust® (sulfometuron methyl) is especially effective on grasses and provides residual activity. Escort® (metsulfuron methyl) shows promise in tank mixes with Roundup (glyphosate). Preliminary evaluations of 1985 aerial applications of Arsenal® (imazapyr) were conducted in August 1986. Rates of 0.75 Ib ai/ac were very effective on high biomass of difficult species such as red maple. There was sortie injury to conifers, but it does not appear to be serious on the spruces. Following appraisal of the 0.75 Ib ai/ac rate, interest in study of lower rates prompted establishment of ground-applied small plots to evaluate rates of 0.3, 0.4, 0.5, and 0.6 Ib ai/ac.

The Austin Pond Study Site, treated in August 1977, was originally established for three-year efficacy data of a variety of treatments including 2,4,5 -T, triclopyr, and glyphosate. However, evaluations of growth responses continue and portions of each treated block were precommercially thinned with spacing saws in late 1985. During a sabbatical leave visit by Dr. Michael Newton of Oregon State University, an intensive remeasurement w as conducted. During 1986 data evaluation has summarized such characteristics as woody vegetation cover development, crown changes, heights and height growth, stocking levels, and tree volumes. Plans are underway to initiate a similar study in 1987 on a di fferent site to evaluate a series of treatments representing the current herbicide technology so that data similar to those obtained from Austin Pond will be available in future years.

FOREST PROTECTION Dr.

Mark W. Houseweart

Because of the program elimination of Forest Protection no new field work was initiated in 1986. Most activities involved inventorying and transferring equipment to other CFRU personnel and the Department of Entomology. Insect collections and literature files on white pine weevil and regeneration weevils went to Dr. Eben Osgood of the Entomology Dept. at the University of Maine and to Mr. Richard Bradbury, Maine Forest Service, Augusta.

Mr. Lee Eavy continued to analyze the tamarack seed and cone mortality data for his Ph.D. thesis research. He has three manuscripts in preparation and one manuscript in press from his research.

The remainder of the time in 1986 was spent completing manuscripts already in progress at the time of the program elimination.

SILVICULTURAL TECHNIQUES FOR THE IMPROVEMENT OF TIMBER QUALITY

Dr. William D. Ostrofsky

Monitoring Vigor of Thinned Hardwood Stands

In 1984, a study was conducted which evaluated residual stand damage resulting from thinning two northern hardwood stands using whole-tree harvesting technology. Immediate impacts from the harvesting operation have been reported (Ostrofsky, Seymour, and Lemin 1986). The study was also designed to monitor the growth response and vigor of permanent sample trees in plots representing all treatments: 1-chain spacing of skid trails, mechanical harvest (1); 2-chain spacing of skid trails, mechanical harvest (2) ; 2-chain spacing of skid trails, chainsaw-winch harvest (3); no trail layout, mechanical harvest (4); unthinned control (5). The stands included a paper birch stand, and a beech-red oak stand.

To objectively evaluate tree vigor, the Shigometer© was used to measure cambial electrical resistance (CER) of the sample trees annually. Comparison of 1984 (preharvest) CER data with 1986 (2 years post-harvest) CER data was made to determine if any growth or tree vigor trends could be related to treatment, species, and/or tree condition (degree of wounding). CER values for paper birch, red oak, and beech were used in the analysis. Other species which were measured for CER were not included because of the small sample size.

An analysis of variance indicated that the preharvest CER of trees in all treatments (within species) were the same (P = 0.05), with the exception of red oak. Red oak trees in treatments 4 and 5 were significantly smaller (and CER was higher) than those in treatment 2 at the start of the experiment.

A quadratic model for preharvest CER was determined for the four major species (Table 1). Several other relationships were examined. No relationship was found between two-year diameter growth (1984-1986) and the variables of damage type, damage severity, treatment, initial diameter, and initial CER. However, there was a relationship between basal area growth and CER for paper birch and red oak. While the model is not a predictive model, the difference in two-year basal area growth is strongly related to initial diameter and initial CER. These relationships will be reexamined as additional annual data become available.

Evaluation of Red Spruce Vigor

Remeasurements

The Maine Forest Service provided funding to continue work on use of the Shigometei® for rating vigor of red spruce stands. Remeasurements of cambial electrical resistance

Table 1. Models of the Cambial Electrical Resistance/Diameter relationship of four northern hardwoods.[3]/

Species	Equation	$J?^2$-46".	_SE_	NO. 248
Paper Birch	CER = 33.692 - 4.0384 (DBH) + 0.1860 (DBH^2)	6	'2.68	90
Yellow Birch	CER = 28.969 - 3.6855 (DBH) + 0.1763 (DBH^2)	52.0	2.45	83
Beech Red Oak	CER = 36.313 - 3.7388 (DBH) + 0.1426 (DBH^2)	69.8	2.51	120
	CER = 23.326 - 3.2665 (DBH) + 0.1810 (DBH^2)	37.8	1.75	

[a]/ R^2 = Correlation coefficient
SE = Standard Error W0.= Number sampled

(CER), and internal electrical resistance were taken on 200 sample trees in the six townships studied in 1985. An additional 100 trees in each of two stands in the townships were also remeasured for CER, providing stand averages for comparison with the 1985 data (Figure 1). All stands affected by spruce budworm in the recent past were found to have higher CER's in 1986 than in 1985, indicating that tree vigor is declining. The control stand located at Grafton, in which no recent budworm defoliation has occurred, changed the least. Stands other than the control stand were ranked identically in 1986 a s they were in 1985. This appears to support the Shigometer® vigor rating technique as being quite consistent from year to year

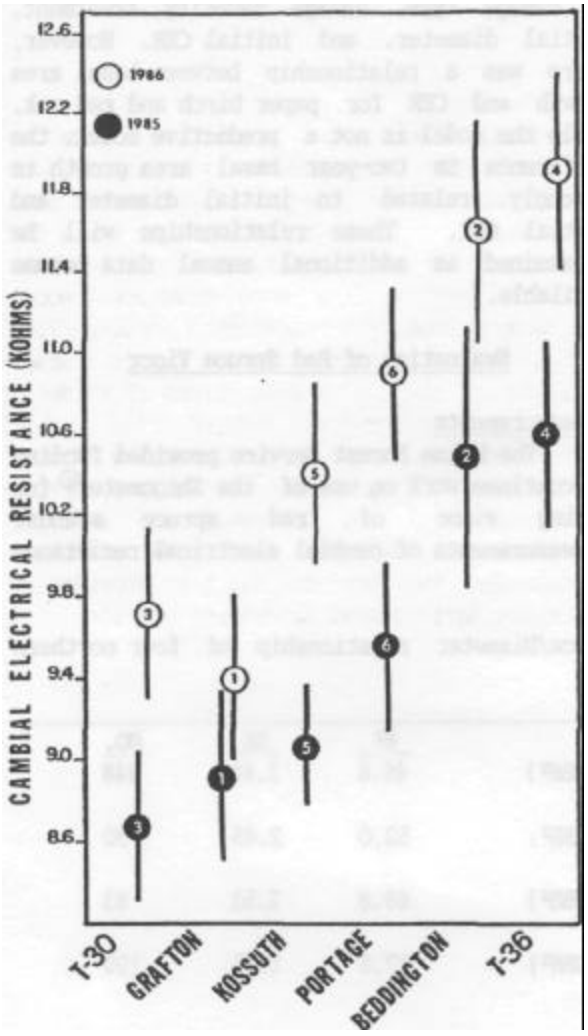

Figure 1. Cambial electrical resistance of red spruce stands in 1985 and 1986. Bars represent 95% confidence interval.

and from crew to crew. Tree ring measurements will be used to corroborate CER changes in these trees after they have been monitored for an additional two or three years.

Stand ranking by CER also generally reflected mortality levels from 1985 to 1986 (Table 2). If future trends are consistent with these early results, the basic information will be available for making objective mortality predictions.

Site Influences

An attempt was made to determine the contribution of site differences to stand CER for red spruce located in western Maine. Six stands were located in which there was no known evidence of budworm defoliation from, the most recent (1970-1985) epidemic. CER measurements were made on 100 trees at each site. The six stands were subjectively rated for local soil moisture conditions (moist, moderate, dry), so that each moisture class was represented by two stands.

No apparent relationship was evident between drainage class and stand CER (Table 3). These results are likely a consequence of the relatively few stands remaining which have been unaffected by spruce budworm. Only two stands were sampled in each moisture class, and only a limited range of drainage classes could be represented. Data will continue to be collected in appropriate red spruce stands, as they are located during the next several years, in an effort to clarify the siterCER relationship.

Table 2. Relationship between the cambial electrical resistance (CER) of red spruce stands, and percent mortality occurring over a one-year period.

Location	1986 CER	Percent Mortality 1985-1986
Grafton	9.4	0 0
Township 30	9.7	1.5
Kossuth	10.4	0.5
Portage	10.9	1.5
Beddington	11.6	2.0
Township 36	11.9	

Table 3. Relationship between cambial electrical resistance (CER) of red spruce stands, and site soil characteristics.

Location	1986 CER	Relative Rating Of Soil Moisture	Drainage Class
Mott Steam	11.5	Moist	Moderately Well Drained
Andover Lower	9.5	Moist	Moderately Well Drained
Grafton Swift	9.7	Moderate	Moderately Well Drained Well
River Andover	8.1	Moderate	Drained Well Drained Somewhat
Gravel Andover	10.9	Dry Dry	Excessively Drained
Upper	11.3		

Defects and Decay of Birches

The spatial distribution of the pathogen obliguus (Pers. ex. Fr.) Pilat. within a mature stand of paper birch has been determined. Infected trees were determined by the presence of one or more sterile conks on the main bole. The portion of the stand surveyed, approximately 1.8 ha, contained 23 infected paper birch out of 345 (6.67%). A survey of the apparently uninfected trees will be conducted in 1987, using the Shig ometer* to detect decay. The distribution of infected trees within the stand now appears to be random.

The distribution of decay columns within individual stems was studied by locating and harvesting 10 infected trees in the same stand, but outside the surveyed area. Stem discs were cut from ground level to where the bole was 8 cm in diameter, at .5 m intervals. Areas of bark, healthy wood, discolored wood, and decayed wood were traced onto acetate film, and volumes were then calcu lated. An average of 26.8% of the total stem volume of infected trees was discolored or decayed. In order to better understand the disease, samples of wood and bark from the naturally -occurring infections will be processed and analyzed microscopically over the next several months.

Funding for this project has been provided by the Maine Agricultural Experiment Station.

TIMBER MANA&MENT Dr.
Robert S. Seymour

No major new field studies were begun in 1986. Work was concentrated on completing publication of past research projects and several review papers on harvesting and silviculture. In response to the research priorities task team recommendations, new research was initiated in two areas: financial analysis of intensive silvicultural practices, and growth and yield modeling for Maine forest types.

Financial Analysis of Silvicultural Treatments

A new model, SISTIM (Simulating Silvicultural Treatments in Maine) was developed to predict future costs (including logging) of spruce-fir grown under a variety of silvicultural systems. The model was programmed by Ronald C. Lemin, Jr., CFRU Research Associate, and is based on yield tables developed by R. E. Bailey and R. D. McNally of the Nova Scotia Dept. of Lands and Forests. It determines the minimum total wood cost (logging and silviculture) of any silvicultural strategy (Figure 2), based on uses input of these factors:

Site index, stocking, initial density (planting or after spacing), interest rate,harvesting cost, timing and cost of silvicultural treatments (including site preparation) herbicide application, and spacing.

The model runs interactively on both the University IBM mainframe and on IBM -compatible PC's.

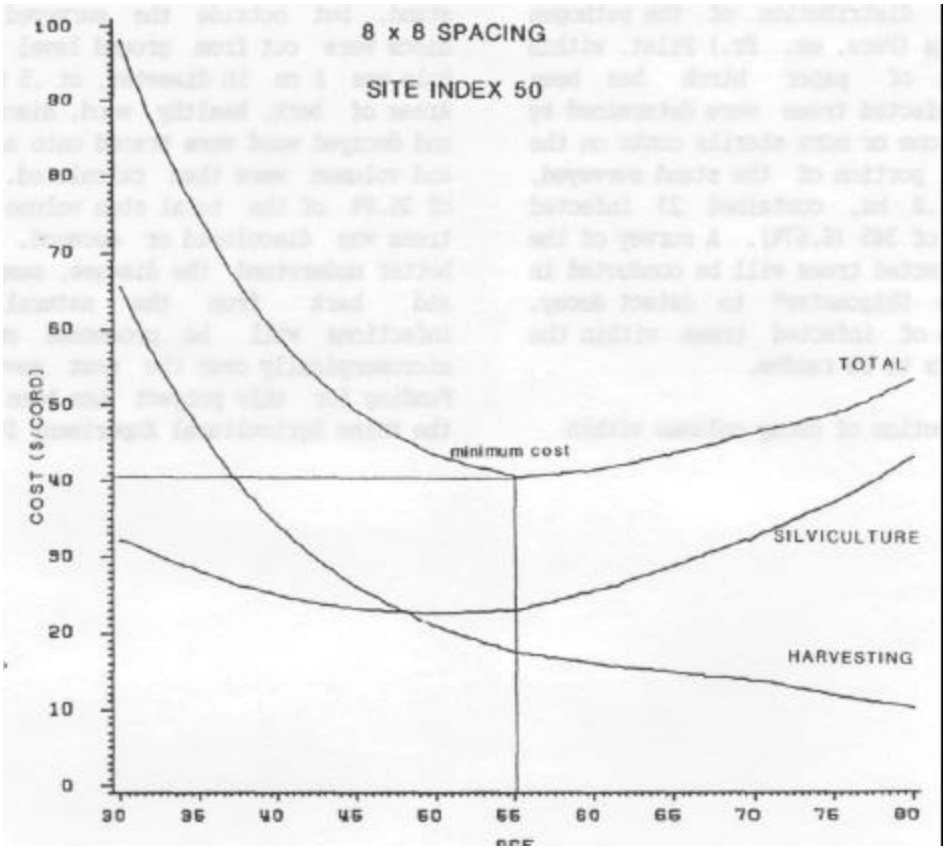

Figure 2. Total costs ($/cord, roadside) of spruce-fir wood grown on an 8 x 8 foot spacing, site index 50, showing silvicultural and logging cost components.

Several preliminary analyses were conducted and presented to several groups. Typical results are illustrated in Figure 3 which shows costs per cord for differe nt planting densities on site 60. In general, the following conclusions are warranted:

1. There is little difference in cost per cord among a wide range of densities for spacing, although yields are greater at high densities (narrow spacings) especially before age 50.

2. Planting at densities of 700 trees/acre or less produces wood at about the same cost as precommerically thinning natural stands.

On site 50, either planting or spacing results in cheaper future wood costs before age 50 than a custodial strategy (unthinned natural regeneration) due to high logging costs of the small trees which develop without thinning. On longer rotations, the compounded silvi - cultural costs begin to exceed lower logging costs, and the inte nsive manage- ment strategies become more costly.

Perhaps most importantly, planting high - quality sites results in much lower future wood costs than any strategy on moderate or low quality sites, especially on rotations under 40 years.

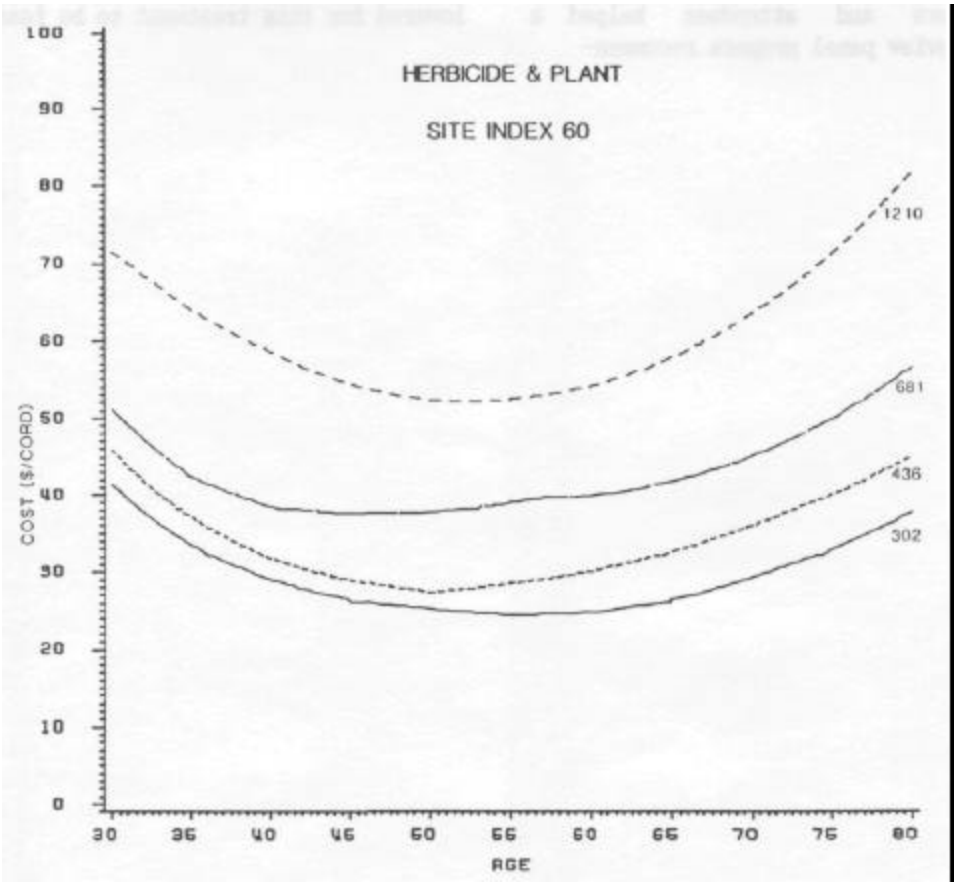

Figure 3. Comparison of total wood cost among four initial plantation densities (trees per acre), site 60.

Forest Development Modeling

Research and development work began on a major effort to develop yield equations for all major timber types in Maine, and apply them in a forest-level model to predict future timber supplies in Maine using data from the mid -cycle resurvey of the spruce -fir resource and other sources. This work was accelerated when the Dept. of Conservation Forests for the Future Program joined CFRU as a cooperator late in 1986. Work on this FFF project will extend well into 1987; developing stand -level growth and yield models will be an ongoing effort.

To begin work on growth modeling, I chaired the program committee to sponsor a workshop on growth and yield which was held in early 1987. Invited speakers and attendees helped a distinguished review panel prepare recommendations for future regional cooperative research in this field. Proceedings will be published in 1987.

Density Control in Young Spruce-fir

In September, a brief trial of a brush -saw mounted herbicide applicator was tested on Scott timberlands in Thorndike Twp. The purpose of this device is to treat surfaces of cut hardwoods with herbicide to prevent subsequent sprouting. Eight 1/40 -acre paired plots were spaced; half were treated. Tim e-study results showed that use of the applicator required no additional time in cutting, but that in these stands with dense hardwood stocking (over 9000 stems/ac), nearly 4 gallons of product per acre were used. Clearly, rates must be greatly lowered for this treatment to be feasible.

FERTILIZATION PROJECT Dr.
Robert K. Shepard, Jr.

The major effort in 1986 was directed toward remeasurements in established plots in both red spruce and white pine stands and analysis of these measurements. Additional plots in white pine stands in southern, western, and eastern Maine were treated with different rates of nitrogen (N); these we re the last plots to be treated. Presented here are the major results from red spruce and white pine stands.

Efforts were begun to select areas and establish plots to study the effects of applying papermill sludge and wood ash to forest lands.

Red Spruce

Work consisted of sampling plots on somewhat poorly and poorly drained soils. Analyses of measurements on increment cores taken in 1985 from plots on moderately well and well drained, somewhat poorly drained and poorly drained soils were completed. These cores include two years of growth since treatment. Results of these analyses are presented in three categories: (1) response on soils of different drainage classes (2) response to multiple application rates and (3) respo nse to fertilization plus thinning.

Response on Different Drainage Classes

Growth on all drainage classes was significantly increased by 200 Ib of N/ac. The average increase after two years was approximately 30 percent. Only application rates of 0 and 200 Ib/ac were used in this portion of the study.

Response to Multiple Application Rates

All rates, 100, 200, and 300 Ib of N/ac, significantly increased growth. Increases over the control were 27, 40 and 56 percent on the somewhat poorly drained soil and 24, 23, and 39 percent on the poorly drained soil. This portion of the study did not include plots on the moderately well and well drained soils due to the small sizes of spruce stands on these soils.

Response to Fertilization Plus Thinning

The effect of fertilization (200 Ib of N/ac) was significant on both the poorly and somewhat poorly drained soils, but the effect of thinning was significant only on the somewhat poorly drained soil. However, even though the effect of thinning on the poorl y drained soil was not significant, growth in thinned plots on that soil was 13 percent greater than growth in the control plots. For reasons stated above, this portion of the study includes no plots on the moderately well and well drained soils.

White Pine

Analyses of four -year measurements from eight stands and two -year measurements from 11 stands were completed. Results of these analyses are presented below.

Four-Year Measurements

Treatment Effects: Growth was significantly increased by 100 and 200 Ib of N/ac but not by 50 Ib/ac; there was no difference between the effects of 100 and 200 Ib/ac. Basal area, and volume growth by treatment are presented in Table 4.

Table 4. Four-year growth of eastern white pine stands treated with different rates of nitrogen

ılication Rate (Ib/ac)	Basal Area (ft'/ac)	Growth	
		Volume	Volume (bd
0	17.0	769	3772
50	20.0	855	4020
100	22.1	948	4802
200	22.6	957	4868

Differences in growth between the first two years and the second two years were not significant. There is, however, an indication that 200 Ib/ac may ultimately produce the best growth. During the first two years basal area

growth at 100 Ib/ac was 33 percent greater than the control and during the second two years 28 percent greater. In contrast, for 200 Ib/ac the differences were 30 percent and 36 percent.

Soil Effects: Response was not significantly affected by soil (till vs. outwash), but there was a significant difference in growth between soils. For plots in stands on soils that originated in basal till, four -year growth per acre in basal area, cubic volume, and board foot volume was 25.0 ft ^{2}, 1003 ft ^{3}, and 4784 bd ft. For stands on outwash soils growth was 15.8 ft ^{2}, 761 ft ^{3} and 3977 bd ft. It is reasonable to expect better growth on till soils due to more favorable moisture conditions.

Two-Year Measurements

Sawlog Stands: All treatments signif - icantly increased mean basal area growth per tree (Figure 4). The largest increase, 0.025 ft ^{2} per tree (39 percent), occurred at 175 Ib of N/ac. That trea tment was significantly greater than 75 Ib/ac but not greater than 125 Ib/ac.

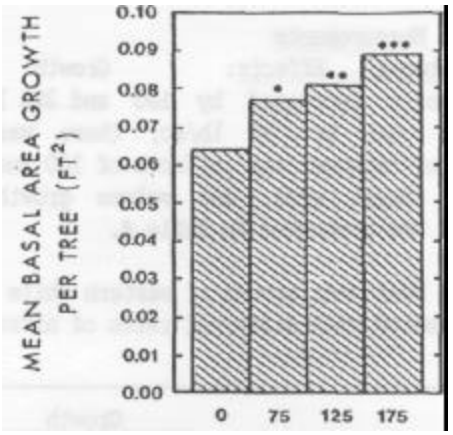

Figure 4. Basal area growth per tree of white pine sawlog stands treated with different rates of nitrogen (*,**,*** = signifi- cantly different from 0 Ib/ac at P<0.05, 0.01, and 0.001, respectively).

Pole Stands: Mean basal area growth was significantly increased by all treatments (Figure 5) and there were no significant differences among treatments. The average increase was 0.010 ft ^{2}/tree (34 percent). Absolute increases were much less than in the sawlog stands due to the smaller tree size.

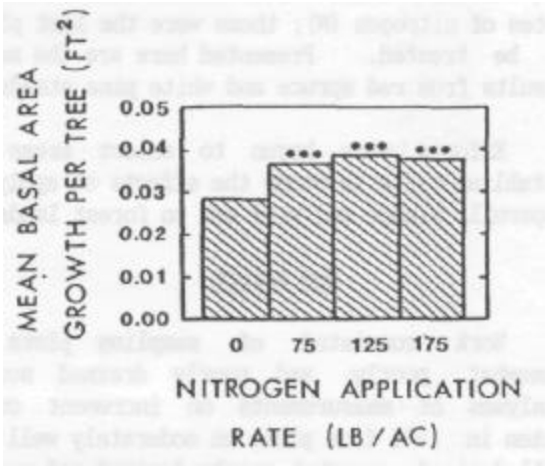

Figure 5. Basal area growth per tree of white pine pole stands treated with different rates of nitrogen (*** = significantly different from 0 Ib/ac at P<0.001).

Additional Work

One-hundred thirty six plots in white pine stands were treated with N at rates of 0, 75, 125, and 175 Ib/ac. These plots are distributed among stands in southern, western, and eastern Maine. Plots were also established in two red pine plantations. These plots will be used in the sludge-ash study.

TREE IMPROVEMENT Dr.
Katherine K. Carter

Black Spruce

Progeny Test/Seedling Seed Orchard

The establishment of a series of black spruce progeny tests and seedling seed orchards has been completed. This series of plantations includes 100 open-pollinated families collected from individual parent trees located throughout the State of Maine. Two progeny tests were planted in 1986, to accompany the three seedling seed orchards established in 1985. Additional seedlings were also added to the 1985 plantations to replace those which had died during the first year. Locations of the five plantations in this series are shown in Table 5.

Table 5. Year of establishment and location for Maine black spruce seedling seed orchards and progeny tests.

Year	Location
1985	Rowland (International Paper)
1985	Unity (Scott Paper)
1985	Rice Farm (Great Northern)
1986	Black Brook, NB (Irving)
1986	Beddington (Champion)

Evaluation of Baseline Selection

A trial of the baseline method of superior tree selection in black spruce was evaluated at age seven, after five growing seasons in the field. Seedlings in this trial are open-pollinated progeny of parents that were identified as "average" or "select" on the basis of baseline selection carried out in stands of pure black spruce located throughout Maine.

Seedlings from each average or select parent were raised in the nursery for two years and then outplanted at three test locations in northern Maine (Rowland, Loon Lake, and Demo Pond). At age seven, overall survival in each plantation is excellent, ranging from 88% to 94%. Overall mean height varies from 3.8 feet to 4.5 feet among the plantations; within each plantation, family mean heights range from approximately 80% to 120%of the plantation mean.

Analysis of variance for height at age 7 indicates that there are significant differences in height among the planta tions, and among the half-sib families (Table 6).

Table 6. ANOVA for age 7 height of black spruce in families three plantations, based on plot means.

SOURCE	DF	MEAN SQUARE	
Plantation	2	21.8158	34.3**
Family	61	1.2223	1.9**
Family x Pit.	122	0.4738	0.7ns
Error	54	0.6359	

However, there is no significant difference in overall height between offspring of the "average[1.1]" and "select" parents, nor is there a significant correlation between parental height or DBH and progeny height. Heritability values are also relatively low ($h^2 = 0.14$). Based on these 7-year results, selection of superior black spruce in native stands is not effective in identifying fast-growing progeny. The low heritability values characteristic of black spruce, and the lack of effect ive results from baseline selection, indicate that selection for improved growth rates should utilize a seedling seed orchard/progeny test approach rather than intensive parental selection in natural stands. The seedling seed orchard/progeny tests described in the preceding section have been initiated in response to these results.

Larch

Clonal.plantations

A trial planting of 490 tamarack clones from Maine and New Brunswick was established in Shirley, Maine, to accompany other tests of the same material which were established in 1985 in Westmoreland, Me. and Fredericton, NB. Clonal material propagated by rooting cuttings was planted adjacent to th e original seedling of the same clone. Future measurements of these trees will reveal whether variation in growth and form exists between seedlings and rooted cuttings, and will indicate the degree of phenotypic variability which exists within a single clone.

Select Japanese Larch Seedlots

Open-pollinated half -sib seedlots from Japanese larch select trees in the Oji Paper Company's (Japan) seed orchard have been received by International Paper Company and are being made available to the Cooperative Forestry Research Unit for testing. Seedlings from these Japanese larch seedlots are being grown this winter for outplanting at a single site. Additional seeds from the same seedlots are available, and current plans call for supplementing this material with additional Japanese seedlots that have been previously tested in Maine, as well as with seedlots of other native and exotic larch species. This expanded seedlot collection will be grown in the greenhouse next winter, for outplanting in the spring of 1988. Any cooperators who have seed of native or exotic larches which could be included in the filed test should contact Katherine Carter prior to November 1987 so that appropriate plans can be made for growing the seedlings.

1986 PUBLICATIONS RESULTING FROM RESEARCH SUPPORTED BY THE CFRU

D'Anieri, P., H. L. McCormack, Jr., and D. M. Leslie, Jr. 1986. The small mammal community in a glyphosate conifer release treatment in Maine. Proc. Northeast. Weed Sci. Soc. 40:205-209.

Jennings, D. T., M.W. Houseweart, and A. Franoeur. 1986. Ants (Hymenoptera: For - micidae) associated with strip clearcut and dense spruce -fir forests of Maine. Can. Entomol. 118:43-50.

Jennings. D., and M.W. Houseweart. 1986. Helicopter propwash dislodges few spruce budworms. USDA For. Serv. Res. Note NE - 333. 7p.

Ostrofsky, W.D. 1986. An evaluation of red spruce vigor using the Shigometer in Proc. Eastern Spruce Budworm Research Conference, Orono, ME. Jan. 7-8, 1986. (Abstract).

_____ . 1986. An evaluation of red spruce vigor using the Shigometer. Prog. Rept. 28. Coop. For. Res. Unit, Coll. of For. Resour., Univ. Maine, Orono. (Maine Agr. Exp. Stn. Misc. Rept. 315). 7 pp.

Ostrofsky, W.D., and M. L. McCormack, Jr. 1986. Silvicultural management of beech and the beech bark disease. Nor. J. Appl. For. 3:89-91.

Ostrofsky, W.D., R.S. Seymour, and R.C. Lemin 1986. Damage to northern hardwoods from thinning using whole -tree harvesting technology. Can. J. For. Res. 16:1238 - 1244.

Reynolds, P.E., T.S. MacKay and M.L. McCormack, Jr. 1986. One -year results for a hexazi - none conifer release trial. Proc. North - east. Weed Sci. Soc. 40:218. (Abstract).

_____ . 1986. Results of a hexazinone - mechanical site preparation trial. Proc. Northeast. Weed Sci. Soc. 40:222. (Abstract).

Seymour, R.S., P.R. Hannah, J.R. Grace, and D.A. Marquis. 1986. Silviculture: the next 30 years, the past 30 years. Part IV. The Northeast. J. For. 84:31-38.

Seymour, R.S. 1986. Stand dynamics and productivity of Northeastern forests – biomass harvesting considerations. p 63 - 68. in C.T. Smith, W.C. Martin, and L.M. Tritton, eds., Proc. Sympos. Productivity of Northern Forests Following Biomass Harvesting. Durham, NH, May 1 -2, 1986. USDA For. Serv. Gen. Tech. Report NE -115. 104 p.

1986. Efficacy of targeted harvesting and protection against spruce budworm: a five -year remeasurement of two Green Woods Project demonstration areas, in Proc. 1986 Eastern Spruce Budworm Research Conference Orono, ME. Jan. 7 -8, 1986. (Abstract)

. 1986. Trends in forest management - potential effects of "good forestry" on future habitat, p. 239 -250 in "Is good forestry good wildlife management?" Proc. joint meeting, New England SAF, Wildl. Soc. and Amer. Fish . Soc., Portland, ME, March 6-8, 1985. Maine Agr. Expt. Stn. Misc. Pub. 689, 377 p.

_____ . 1986. Can we ijnprove Maine's timber supply? in A forest -based economy: carrying a tradition into the future, p. 13-21, Proc. 2nd. Blaine House Conference on Forestry, Augusta, ME, Dec. 6 -7, 1984. 182 p.

Smith, C.T. Jr., M.L. McCormack, Jr., J. W. Hornbeck and C. W. Martin. 1986. Nutrient and biotnass removals from a red spruce-balsam fir whole-tree harvest. Can. J. For. Res. 16:381-388.

Smith, D.M., and R.S. Seymour. 1986. Relationship between pruning and thinning, p.62-66. in Eastern white pine: today and tomorrow. Proc. SAF Reg. VI Tech. Conf., Durham, NH, June 12-14, 1985. USDA For. Serv. Gen. Tech. Rep. WD-51, 124 p.

ADDITIONAL TECHNOLOGY TRANSFER ACTIVITIES BY CFRU PERSONNEL

Houseweart, M.W. Invited speaker at Canadian/United States Meeting on seedling debarking weevil, Hylobius congener: Problems, Progress and Prospects; February 5-6, Truro, Nova Scotia. (Pres: H. congener research results in Maine, and Pest Status report).

_____ . Invited speaker at New Brunswick Forestry Research Advisory Committee Conference on Larch, October 14, Fredericton, New Brunswick, Canada (Pres. with A. Lee Eavy, Larch Seed and Cone Insects.)

McCormack, M.L., Jr. One -year results of a hexazinone conifer release trial, (presentation of joint -authored paper). 40th Annual Meeting, Northeastern Weed Science Society, Boston, MA. 7 Jan. 1986.

_____ . Dealing with environmental confrontation. (panel presentation & discussion). Sylvicon. Annual Meeting, New Brunswick CIF, Fredericton, NB. 19 February 1986.

_____ . Forest vegetation management with herbicides. (invited seminar) Unity College, Unity, ME. 28 February 1986.

_____ . Videogramrnetry: an innovation for tiaie/volume tree harvesting production measurements (College of Presentation Forest Resources for T.J. Cameron). Corcoran & M.L. Annual Pulpwood Assn. Meeting, American St. 1986. Louis, MO. 5 March

. The forest imrortal. (presentation for the College of Forest Resources with R. B. Owen). Maine Scholars' Day, Univ. of Maine, Orono. 19 May 1986.

_____ . Aerial precotanercial thinning with chemicals. Spring Meeting, Northeastern Technical Committee, American Pulpwood Assn., Bangor, ME. 22 May 1986.

_. Results of herbicide treatments at the Austin Pond Study Site. (field tour). Maine Chapter, The Wildlife Society. 14-15 July 1986.

_____ . Herbicide use for plantations and tree improvement (presentation) Northeastern Forest Tree Improvement Conference, Biennial Meeting.

_____ . Forestry industry and forestry practices in Maine. Kiwanis Club, Orono, ME. 18 September 1986.

Ostrofsky, W.D. Hardwood Headlines, Newsletter Series, Vol 3. No. 1. 1986.

_____ . Canker Diseases of Hardwoods. Seminar presentation, BOT. 456, Orono, ME. Feb. 13, 1986.

_____ . Impact of harvesting for biomass on residual tree quality. Seminar presentation, Threshold to Maine RC&D Forestry Committee, Westbrook, ME. Feb. 20, 1986.

_____ . How forest pathogens change forest development. Seminar presentation, Forest History Seminar, Orono, ME. Feb. 25, 1986.

_____ . Assessing vigor of red spruce with the Shigometer. Seminar presentation, Great Northern Paper, Millinocket, ME. March 27, 1986.

_. Forest pathology in forest practice. Seminar presentation and field tour, College of Forest Resources Summer Camp, Bridgton, ME. June 3, 1986.

___ . Intermediate silvicultural practices. Seminar presentation, Georgia-Pacific Corp., Woodland, ME. and St. Croix, New Brunswick. June 4 -5, 1986.

_____ . Silvicultural management of beech and the beech bark disease, and Damage to northern hardwoods from thinning using whole-tree harvesting technology. Poster presentations, Managing Northern Hardwoods: A Silvicultural Symposium. Syracuse, NY. June 23-25, 1986.

_____ . Introduction to forest diseases. Seminar presentation, FTY 349, Orono, ME. Oct. 22, 1986.

_____ . Whole-tree harvesting for biomass in northern hardwoods. Seminar presentation, National Indian Forestry Institute of Canada, Orono, ME. Oct. 23, 1986.

_____ . Response of phloem to infection by Inonotus obliguus. Seminar presentation, NE-99 Technical Coranittee, Biology and Management of Vascular Diseases of Trees. Stowe, Vermont. Nov. 3, 1986.

_____ . The beech bark disease and its impact on forest management in Maine. Seminar presentation, College of Forest Resources Seminar Series. Orono, ME. Nov. 21, 1986.

Seymour, R.S. Invited speaker at Forests for the Future Citizens Advisory Council on Future of Maine's Timber Resources. Jackman, ME. Jan. 10, 1986.

and W.D. Ostrofsky. Impacts of whole -tree harvesting on stand quality. Threshold to Maine RC&D Coranittee, Westbrook, ME. October 16, 1986. and: Maine ACF Meeting, Augusta, ME. October 15, 1986.

_. Review of mechanized Precom. Thinning in Maine, CFS Precom. Thinning Working Group, Moncton, NB. April 3, 1986.

_____. Silviculture in the NE US, Northern Forest Forum. Caribou, ME. April 21, 1986.

_____ . Specific precommercial thinning–man or machine?, APA NE Tech. Div. Meeting. Bangor, ME. May 22, 1986.

_____ . Economic analysis of intensive managa-nent; silvic. impacts of different logging systems, Georgia -Pacific Woodlands Staff, Woodland, ME and St. Croix, NB. June 4-5, 1986.

____. Effect of spruce budworm on natural stand development, Baxter Park, Maine Chapter of Wildlife Sec. T4 RIO, ME. July 15, 1986.

Agric. Economics of Coranercial Forestry, Econ. Class, Waterville, Colby College, ME October 14, 1986.

___. Biological realities and silvicultural opportunities for Maine's Spruce-fir resource, Maine Audubon Forum, Tenants Harbor, ME. Nov. 19, 1986.

COOPERATIVE FORESTRY RESEARCH UNIT ADVISORY COMMTITEE

1986 Membership

The CFRU Advisory Committee sets priorities and reviews proposals for the Cooperative Forestry Research Unit. Members active during all, or part, of 1986 were:

Robert V. Withrow, Jr., General Manager, Wood Department, Boise-Cascade Corporation (Chairman)
Clifford L. Swenson, President, Seven Islands Land Company (Vice Chairman)
E. Bart Harvey, Jr., Director, Forest Management, Great Northern Paper (Financial Officer)
Robert Gardiner, Director, Maine Bureau of Public Lands (Member at Large)
Gregory N. Brown, Acting Vice President-Academic Affairs (CFRU Director)
Fred B. Knight, Acting Dean, College of Forest Resources (CFRU Director)
Barton M. Blum, Project Leader, USDA Forest Service
Robert P. Chadbourne, Land Division Manager, P. H. Chadbourne & Company
Edward Chase, Chase Tree Farm
Thomas Colgan, Scott Paper Company
Michael Coffman, Champion International Corporation
Ronald Lovaglio, Manager, Forest Management, International Paper Company
Michael Partridge, Galley and Currier Company, Inc.
L. Oscar Selin, Director of Forestry, Georgia-Pacific Corporation

Liaison to Forest Resources Research Advisory Committee

Richard B. Anderson, Commissioner, Maine Department of Conservation

CFRU STAFF
(December 31, 1986)

Program Leaders

Mark W. Houseweart, Research Professor of Forest Resources Maxwell L. McCormack, Jr., Research Professor of Forest Resources Katherine K. Carter, Associate Professor of Forest Resources Robert S. Seymour, Associate Research Professor of Forest Resources Robert K. Shepard, Jr., Associate Professor of Forest Resources William D. Ostrofsky, Assistant Research Professor of Forest Resources

Professional Staff

Peter Caron, Research Technician (Tree Improvement)
Ronald C. Lemin, Jr., Research Associate (Timber Management and Harvesting)
Eleanor G. Heinz, Executive Secretary

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Houlton International Corporation
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Sprowl Brothers
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USG Industries, Inc.
Western Maine Nursery
R. Leon Williams Lumber Company

OTHER ORGANIZATIONS PROVIDING SUPPORT FOR CFRU PROJECTS

E.I. duPont de Nemours & Co.
Helicopter Systems
Maine Agricultural Experiment Station
Maine Forest Service
Mclntire-Stennis
Sandoz Chemical Company
USDA Northeastern Forest Experiment Station
USDA State & Private Forestry

APPENDIX - TERMS

COMMON NAME	SCIENTIFIC NAME
TREES	
American beech	Fagus grandifolia Ehrh.
Paper birch	Betula papyrifera Marsh.
Yellow birch	Betula alleghaniensis Britt.
Balsam fir	Abies balsamea (L.) Mill.
Eastern larch	Larix laricina (DuRoi) K. Koch
Japanese larch	Larix leptolepsis (Sieb. & Zucc.) Gord.
Red maple Red	Acer rubrum L.
oak White pine	Quercus rubra L.
Black spruce	Pinus strobus L.
Red spruce	Picea mariana (Mill.) B.S.P. Picea rubens Sarg.
OTHER PLANTS	
Common red raspberry	Rubus spp.
INSECTS	
Eastern spruce budworm	Choristoneura **fumiferana** Clemens
FUNGI	
White trunk rot of birch	Inonotus obliquus (Pers. ex Fr.) Pilat.