

CFRU Information Report 16

1987 Annual
Report
of the Cooperative Forestry
Research Unit

Miscellaneous Report 324

December 1987

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ADVISORY COMMITTEE CHAIRMAN'S REPORT

The Cooperative Forestry Research Unit is the preeminent forest research organization in Maine. This position is by virtue of the scientific strength of the staff and the active participation of the cooperators through the CFRU Advisory Committee.

The Cooperative finished 1987 in an improved financial position and with research priorities reaffirmed or redirected. This is a direct result of assessment and restructuring begun in 1986 under Chairman Withrow.

Director Fred Knight, serving as interim Dean of the College of Forest Resources, has provided vigorous, constructive leadership to the Cooperative and has been a significant contributor to the administrative improvements. Most noteworthy is the improved statement that reflects our financial position. Jan Gifford, Assistant to the Dean - Finance, has been a major help in providing timely financial information to the Advisory Committee. A financial report is part of this Annual Report.

The improved financial position has allowed the Cooperative to postpone until October, 1988, a planned one-half cent per acre dues increase saving cooperators about \$35,000. This increase was to take place in October, 1987. The Advisory Committee also plans to make more operating funds available to the scientists in 1988.

The Advisory Committee has asked a Funding Mechanism Subcommittee, composed of Bart Harvey, Cliff Swenson and Oscar Selin, to review the methods of assessment for cooperative funding and report to the Advisory Committee in January, 1988. Presently, most funding is by landowners on a per-acre basis. It is hoped the committee can find a funding method that allows equitable participation by other cooperators. Both the

cooperators as well as other organizations within the state show the need for topics of forest research that would be supported by non-landowning cooperators.

On the personnel side, Dr. Robert Seymour has left the Cooperative to accept the Curtis Hutchins Chair of Quantitative Silviculture at the University of Maine. Dr. Seymour has been a particularly strong contributor to silvicultural research. We are pleased that Dr. Seymour will remain in Maine; however, we will miss his expertise and enthusiasm on the staff. Dr. Seymour is recognized throughout New England for his work.

Dr. Seymour's leaving has enabled us to develop a new staff position in site productivity. A search committee is in the process of hiring a scientist for site productivity research. The emphasis will be on site classification and resultant productivity predictors for the best sites. This new staff position is a result of the 1986 Research Priority Task Team recommendations.

As we look to the future we note with sorrow the passing of Morris R. Wing of International Paper Company. Morris was one of the visionary founding fathers of the CFRU.

All of the above management activity would be fruitless without the scientific research results shown on the following pages. The scientific staff of the CFRU has region-wide, and in some cases national, recognition for the quality of their research.

One of the staff's particularly strong suits is the transfer of results into management action by cooperators. The statewide improvement in forest productivity would not be at the present level without the effort and

dedication of CFRU scientists.

past, improved financial position, renewed

dedication by cooperators and opportunities to

I wish to thank the other members of the grow. We look forward to the new year.

Executive Committee, Mike Coffman and Bob Withrow, for their enthusiasm and effort to help keep the CFRU vibrant.

The CFRU has a strong and productive

Ronald Lovaglio, Chairman
CFRU Advisory Committee

KAN'S REPORT

It has been a pleasure for me to serve as Director of the Cooperative Forestry Research Unit during 1987. I have enjoyed working with our scientists and staff and have appreciated opportunities for interaction with colleagues on the Advisory Committee. Our chairman has been a tremendous help to me during the year and I thank him for his dedicated service to the Unit. The Executive Committee, Ron Lovaglio, Mike Coffman and Bob Withrow, has dedicated many extra hours to operations of the Cooperative. Their help during personnel changes and priority setting has made a difficult year manageable.

Early in 1987, Dr. Robert Seymour was selected as the Curtis Hutchins Professor of Quantitative Silviculture. This required a long process of careful review of priorities which resulted in a research direction for his replacement. Site productivity/site classification was agreed by the Advisory Committee as the top priority for future research. A search committee was set up with Dr. Fred Knight as Chair and Mike Coffman, Tom Colgan, Dr. Michael Greenwood, Dr. Maxwell McCorraack and Dr. William Ostrofsky as members. The search was commenced with hopes for an appointment early in 1988.

Two scientists are on the staff at this time as well as other college faculty members who receive operating funds for projects approved by the Advisory Committee. Research productivity has been outstanding during 1987; this will become readily apparent as you read the remainder of the report.

The Advisory Committee asked us to provide an accounting of the financial situation of the Unit in this report. I am including this here so you will know specifically how we stand as of the end of the year (Sept. 30, 1987). Some explanation is needed to refresh memories about

general policies for the Unit. The unit policy since the time of establishment has been to retain at all times the equivalent of a full year's operating funds as a reserve. This serves two purposes: (1) it assures that the Cooperative may be phased out over a one year period if the program is not renewed and (2) income is derived from the funds on reserve. The main objective is to protect our scientists from any unusual circumstance.

Our balance ended nearly \$100,000 larger than the reserve but obligations for additional operating funds and purchase of vehicles have cut that more than half. We were fortunate that our expenditures in 1987 were less than projected because of personnel changes already discussed. Budgets in 1988 are larger though some savings will accrue while we wait for the arrival of our replacement for Dr. Seymour. We will need the full amount available when we commence the 1989 fiscal year on October 1, 1988.

I hope this accounting will be helpful to you. Please call me or any member of the CFRU Executive Committee if further explanation is needed. The Advisory Committee is well informed on the funding situation. They all have details on all project expenditures which are provided to them at each quarterly committee meeting.

This has been a successful year for CFRU. Productivity has been high and the cooperators have been well served. We continue to meet the long term mission to complete useful research results on intensive management and greater productivity of Maine's forest resources.

Fred B. Knight, Acting Dean
College of Forest Resources

MAINE AGRICULTURAL EXPERIMENT STATION MISCELLANEOUS REPORT 324

BALANCE SHEET
1986-87 Period
10/01/86-9/30/87

Balance Forward September 30, 1986		\$ 406,556.66
Contributions 1985-86 Received after 9/30/86		26,493.00
Contributions 1986-87 10/01/86-9/30/87		384,114.00
Special Contributions 1986-87 10/01/86-9/30/87		22,850.00
Contributions Received for 1987-88 before 9/30/87		10,000.00
Investments 10/01/86-8/31/87		27,178.06
Total Assets:		\$ 877,191.72
Expenses: 10/01/86-9/30/87		
Silviculture	M. McCormack	98,753.61
Timber Management	R. Seymour	80,909.45
Protection	M. Houseweart	22,958.03
Hardwood	W. Ostrofsky	39,375.20
Tree Improvement	K. Carter	4,000.00
Fertilization	R. Shepard	10,000.00
Special Expenses:		
	Maine Helicopters, Inc.	15,750
	M. Cyr - Consulting	1
	Special Equipment Purchases	17,494.37
	Special Funds from Chemical Co.	5,000.00
Technical Support		45,918.37
Administration		16,718.16
Total Expenses: 10/01/86-9/30/87		-358,778.69
Balance on Hand 9/30/87		\$ 518,413.03

SILVICULTURE Dr. Maxwell L.
McCormack, Jr.

During 1987, R. A. Lautenschlager, a Ph.D. candidate conducting research on forest vegetation dynamics and life history of cannon red raspberry, was employed as Research Associate in the silviculture research program. Patrick Strauch, M.S. student, completed data collection on development of red spruce and balsam fir reproduction. Thesis completion is anticipated by the end of the year. The Ph.D. program of G. R. Schaertl has progressed while he maintains his full-time position as Field Representative for Monsanto Agricultural Company. He will be evaluating vegetation dynamics following a variety of aerially-applied herbicide treatments. David Santillo completed his M.S. in wildlife. His thesis is in the publication listing later in this report.

Dr. McCormack began the year presiding over the General Session of the 41st Annual Meeting, Northeastern Weed Science Society. Later in the meeting he advanced to President of that Society, an office he filled through 1987. In February, he presided over a workshop on aerial application of herbicides for CFRU cooperators and other industrial landowners across Maine and the Maritimes. Also, he participated in a number of herbicide workshops across the Northeast as well as the annual meetings of the Ontario Vegetation Management Association in Thunder Bay and Guelph. McCormack contributed summary comments for a workshop in Fredericton, N.B. on precommercial thinning and made two invited contributions to the program of the First International Christmas Tree Convention in Halifax, N.S. The textbook "Forest Vegetation Management for Conifer Production" edited by J. D. Walstad and P. J. Kuch was published with contributions from CFRU included in the chapter on the Northeast.

The silviculture project continues to provide maintenance and supervision for the CFRU trailer located at the Telos Operation of Great Northern Paper. This facility provided housing and support for a wide variety of researchers conducting work in the Telos Area. Maintenance

and coordination of use for the CFRU Building located on the University Forest was also provided. This building houses CFRU equipment and supplies. It also provides space for vehicles and processing large volume field samples. After many years of measuring and preparing herbicides in dry laboratory space in the CFRU Building, wet laboratory facilities in Nutting Hall became available for that purpose during 1987. This has facilitated greatly the preparatory phases of the herbicide research work.

Intensive Forest Harvesting

The paired watershed study at Weymouth Point, T4R12 WELS, has continued. The eighth year of soil solution and stream water sampling (Fig. 1) will be completed in the autumn of 1987. Peter Caron, CFRU Research Technician, has provided significant assistance in maintaining the continuity of sampling, especially through the winters. These samples are forming the basis for intensive evaluations of nutrient dynamics on the treatment watershed as well as interactions of the 1985 aerial triclopyr treatment with the nutrient cycle. Close cooperation continued with C. W. Martin and J. W. Hornbeck of the U.S.D.A. Forest Service, Durham, N.H. and C. T. Smith, Jr. of the Univ. of New Hampshire. Several graduate students have been actively pursuing projects in the Telos Area and on the watershed. The landowner, Great Northern Paper, has provided close cooperation and continuous support with such needs as access road maintenance. Bear damage to instrumentation and precipitation collectors is a persistent problem.

Information from the long-term studies on the watershed continues to be published (Smith, et al. 1987). At the 42nd Annual Meeting of the Northeastern Weed Science Society in January, 1988, two papers will report on watershed losses of triclopyr and changes in nutrient cycling following the aerial application. The regeneration and vegetation



Figure 1. Stream water sampling on the treatment watershed eighth year of sampling will be completed in 1987.

dynamics continue to be monitored; the permanent sample plot system across the treated watershed was remeasured during the 1987 field season. These efforts are all planned for continuation.

Development of Spruce-Fir Reproduction

Patrick Strauch, M. S. graduate student, has been investigating the early stand development of red spruce and balsam fir. After a thorough review of the literature he has formulated four hypotheses:

1. Advance regeneration is the precursor to successful seedling establishment once the overstory is removed.

of the Weymouth Point study area; the

There is a correlation between seedling crown position at the time of release and the future sapling crown position.

3. Seedling response to release is a function of seedling age and height at the time of release.
4. Red spruce and balsam fir have identical patterns of growth during the seedling and sapling stages.

During initial investigations of seedling development, minute growth rings were discovered within seedling root collars. These rings were not visible without the use of a microscope

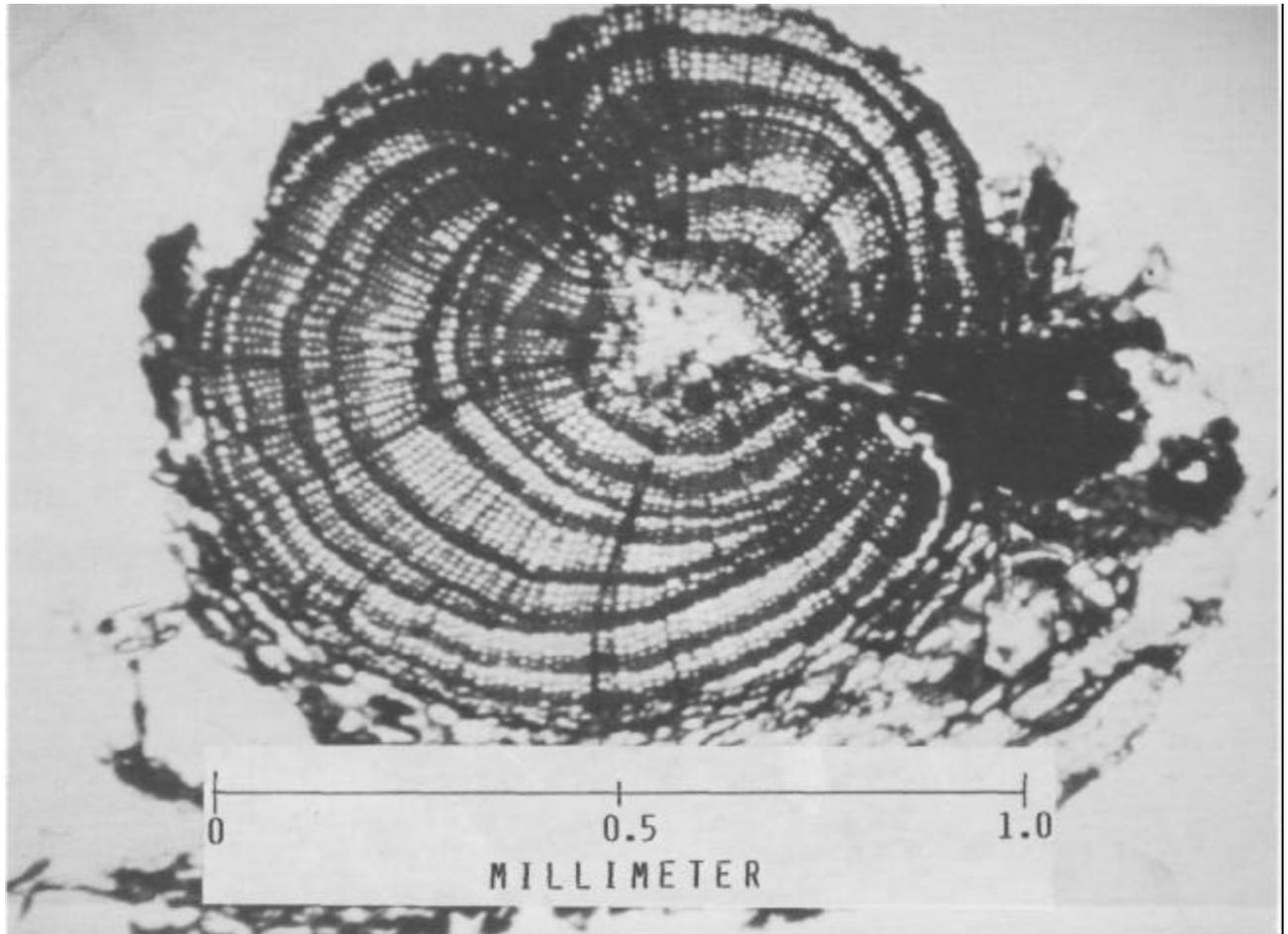


Figure 2. Micro-cross section of a spruce seedling showing the rings which are typical of saplings studied in evaluation of advanced regeneration. At least eight rings are visible within the 1.0 mm diameter of the root collar.

(Fig. 2). Because accurate aging of seedlings is essential in investigations of the timing of seedling establishment, a micro-measuring technique for microscopic examination of seedling root collars was developed. The procedure involves removing sample blocks of stem tissue from sapling trees so the original seedling growth patterns which preceded sapling development can be evaluated from microscope slides. A microtome is used to remove 20 micron thick sections from the sample blocks.

Using the micro-measuring procedures, two field plots were established to investigate the

hypotheses. Each plot was 2m X 2m within dense spruce-fir saplings. One plot located near Misery Stream, Sandwich Academy Grant on land owned by Scott Paper Co., provided a sample of four red spruce and 15 balsam fir saplings. The second plot on Great Northern Paper ownership in T4R12 WELS had seven red spruce and 30 balsam fir saplings. Sample trees were uprooted and stem analysis measurements were made at every 0.25 m section along each bole. The entire one meter base section of each tree bole was taken to the lab for further dissection. Once the tree root collar was located, discs at every 0.25 m were cut and measured for radial growth

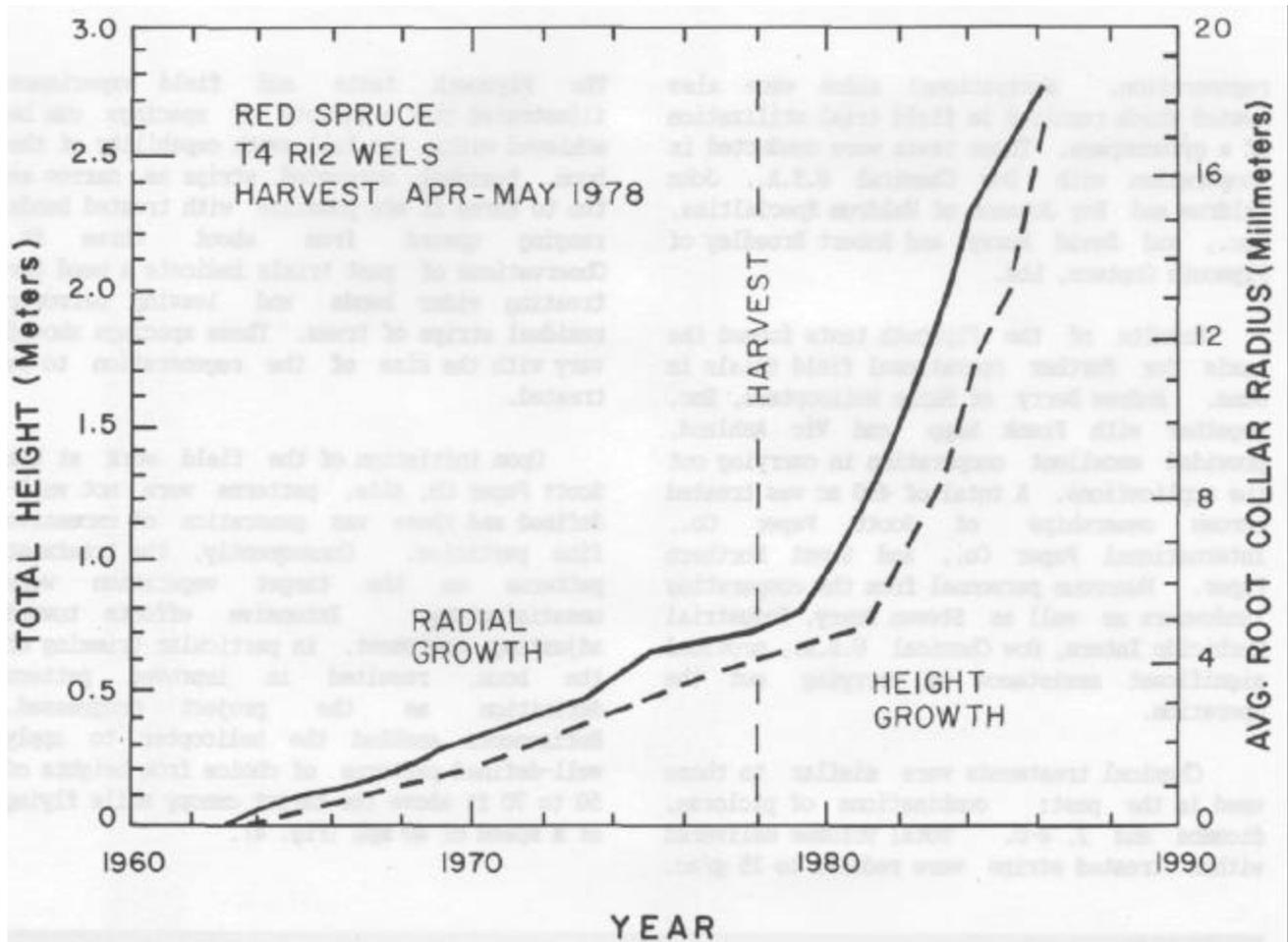


Figure 3. Growth curves for a red spruce seedling with an age of 15 yrs. at harvest, Spruce budworm defoliation probably helped the seedling reach its 12-yr height of 0.5 m. Radial growth response to harvest preceded that of height growth, a typical pattern.

using a Measu-Chron® digital micrometer. For every tree root collar disc a micro-measurement slide of the central area was made to measure early seedling growth.

Graphs of radial and height growth plotted over time have been prepared for each sample tree (Fig. 3). Direct comparisons of these case histories of tree growth are being made among samples and the resultant patterns of growth are being compared to the research hypotheses.

Statistical analyses of these observations are in progress for each plot. Tree age, root collar diameter, and interpolated height at the time of release are being statistically evaluated as in-the-field indicators of seedling

response to release. Although investigations of early stand development presently generate more questions than answers, the ultimate goal of this research is to help foresters evaluate natural spruce-fir regeneration. Once a forester understands how regeneration originates and will respond when released, silvicultural treatments can be properly timed and improved harvesting prescriptions can be made.

Precoercial Thinning

In late March 1987, field tests were conducted in Plymouth, MA to perfect use of the THRU VALVE BOOM™ (TVB™) for application of selected strip spacings as a mechanical, aerial method of reducing the stocking of natural

regeneration. Navigational aides were also tested which resulted in field trial utilization of a gyrocompass. These tests were conducted in cooperation with Dow Chemical U.S.A., John Waldrum and Roy Johnson of Waldrum Specialties, Inc., and David Morey and Robert Broadley of Plymouth Copters, Ltd.

Results of the Plymouth tests formed the basis for further operational field trials in June. Andrew Berry of Maine Helicopters, Inc. together with Frank Kopp and Vic Ashland, provided excellent cooperation in carrying out the applications. A total of 450 a c was treated across ownerships of Scott Paper Co., International Paper Co., and Great Northern Paper. Numerous personnel from the cooperating landowners as well as Steven Peary, Industrial Herbicide Intern, Dow Chemical U.S.A., provided significant assistance in carrying out the operation.

Chemical treatments were similar to those used in the past: combinations of picloram, dicamba and 2, 4 -D. Total volumes delivered within treated strips were reduced to 15 g/ac.

The Plymouth tests and field experience illustrated that a variety of spacings can be achieved within the full -swath capability of the boom. Residual, untreated, strips as narrow as two to three ft are possible with treated bands ranging upward from about three ft. Observations of past trials indicate a need for treating wider bands and leaving narrower residual strips of trees. These spacings should vary with the size of the regeneration to be treated.

Upon initiation of the field work at the Scott Paper Co. site, patterns were not well defined and there was generation of excessive fine particles. Consequently, the treatment patterns on the target vegetation were unsatisfactory. Intensive efforts toward adjusting equipment, in particular trimming of the boom, resulted in improved pattern definition as the project progressed. Refinements enabled the helicopter to apply well-defined patterns of choice from heights of 50 to 70 ft above the target canopy while flying at a speed of 40 mph (Fig. 4).



Figure 4. Application of strip thinning treatments. The helicopter is flying 40 mph at a height of 60 ft above the target vegetation.

Preliminary observations show that, in the early stages, when fines were being generated, the ground patterns are not well defined. However, after adjusting the delivery apparatus, the patterns of treated vegetation look very good. The TVB™ equipment appears to be capable of applying a variety of silviculture treatments, but this experience emphasizes the need for thorough calibration and pattern development prior to operational applications. This preparation should include allowances for pilot style and aerodynamic peculiarities of specific aircraft.

While in the field, additional trials were conducted with the TVB™ equipment. These included a broadcast site preparation treatment on one of the International Paper Co. sites. It was possible to achieve a 5 g/ac total volume applied. This illustrates further capability of the TVB™ for broadcast application of herbicide treatments where special security of spray patterns is required around environmentally sensitive areas such as rivers and lakes. Evaluations of treatments are planned through 1989.

Thinning Spruce and Spruce-fir Stands

The long-term thinning study has been maintained in readiness for evaluation of responses after ten growing seasons. This study is based on individual study tree measurements, rather than stand data, in an effort to characterize individual crop tree conditions and environment. The remeasurements are planned for the 1988 field season.

Unfortunately, a thorough examination of the study sites during 1987 revealed

discouraging conditions at Lakeville Plantation and Rowell Brook (Table 1). These two sites represent the oldest, and most variable stands, in the study. For example, total ages across the stands ranged from 160 yrs to 42 yrs with an average of 69 yrs at Rowell Brook and from 79 yrs to 55 yrs with an average of 67 yrs at Lakeville. During the establishment of the study these two sites were considered too far into their development for a timely entry. However, data from these two sites contributes information and, to some extent, represented areas being considered for operational thinnings at the time the study was initiated.

These sites illustrate risks of late entry thinnings, but there were also extenuating circumstances. Neither site was protected from spruce budworm and both sites were subjected to harvesting of adjacent stands. The former resulted in severe defoliation of thinned study trees which undoubtedly contributed to mortality, especially in the fir. Harvesting in the adjacent stands has resulted in damaging fronts of blowdown and wind breakage advancing across the study plots. Consequently, the study trees in the control plots appear to be in better condition than the study trees in the thinned plots. At the Rowell Brook site, during 1983, measures were taken to suppress the encroaching understory brush with a backpack mistblower application of Roundup®. An untreated block was maintained for comparison. There are dramatic differences in brush development and quantity of conifer regeneration which would be free to grow upon removal of the overstory. In spite of the severe study tree losses, these case histories and the forthcoming individual tree responses related to their respective conditions will help to provide

Table 1. Summary of individual study tree conditions in 1987 on spruce-fir thinning sites. tvo

Study Site	Fir Study Trees			Spruce Study Trees		
	Total	Dead	Alive	Total	Dead	Alive
Lakeville Pit.	16	12	4	118	33	85
Rowell Brook	13	13	0	181	35	146

guidelines for management decisions regarding intermediate practice silviculture.

**Management of Undesirable Vegetation with
Herbicides**

The 1987 season was one primarily devoted to establishment of operationally treated blocks to provide a new series of data over the next three to five years. Observations have been continued at Austin Pond and data collected by Dr. Michael Newton of Oregon State University has been compiled into two manuscripts currently under review. In addition, we are presenting a joint paper at the Annual Meeting of the Weed Science Society of America in February, 1988. Growth response and vegetation data from the draft manuscripts have been provided to several CFRU cooperators to assist them in planning their operational spray programs. The precommercial thinning treatments which were superimposed across the herbicide treatment blocks in late 1985 now provide interesting visual comparisons between thinned and unthinned vegetation with and without prior herbicide treatments. Visually, there is a strong difference developing with best vigor and robustness exhibited across the thinned trees which were previously treated with Roundup® or Gar Ion*.

Through close cooperation with G. R. Schaertl, Monsanto Agricultural Company, a series of studies evaluating spray volumes, droplet sizes, and rates of glyphosate application are being established. In response to anticipated glyphosate product formulation changes by Monsanto (i.e. Roundup® with formulated surfactant to Accord® without the originally formulated surfactant), considerable attention is being devoted to glyphosate surfactant combinations. These changes will simplify labelling for forestry users and provide an opportunity for operational foresters to be more specific with their silvicultural prescriptions.

Pursuing responsibilities for development of new products and operational testing of promising materials, on the morning of 30 August

1987 in cooperation with Great Northern Paper and Jerry Hill of Ranger Helicopter Services, Inc., a series of operational -scale treatments were applied. These were all applied at 10 g/ac total volumes and included:

1. Dow EF-689 (fluroxypyr) at 1.0 and 2.0 Ibs ai/ac,
2. Dow EF-689 (fluroxypyr) + Garlon 4® (triclopyr) at 1.0 + 2.0 Ibs. ai/ac,
3. Garlon 4® (triclopyr) at 2.5 Ibs ai/ac,
4. Arsenal® (imazapyr) at 0.25, 0.375 and 0.5 Ib ai/ac and
5. Arsenal® (imazapyr) + Roundup* (glyphosate) at 0.25 + 1.0 Ib ai/ac.

As planned during 1986, a large comprehensive study for evaluation of treatments representing current herbicide technology was established in early September, 1987. This will provide information on new treatments in the early stages of development characteristic of the Austin Pond Study from 1978 to 1980. A total of two replications of each of 26 treatments was applied in a single morning five-hour spray session. The treatments are listed in Table 2.

Though it was essential to predetermine the spray sequence, treatments were applied at random at a total volume of 5 g/ac. Preliminary work involved an intensive effort in treatment block layout which included bulldozer roads between rows of blocks. Execution of the complex series of treatments was possible through coordinated cooperation of over 20 people on the morning of application. The landowner, Champion International Corp., provided numerous personnel, the helicopter application, a nurse truck for water supply and traffic control. In addition to volunteer graduate students from the College of Forest Resources and CFRU personnel, field assistance was provided by Jim O'Malley, Seven Islands Land Co.; Michael Melichar, Dow Chemical U.S.A.; and Dick Schaertl of Monsanto Agricultural Company.

Table 2. Aerial herbicide treatments applied in the morning of 11 September 1987 on T34 land of Champion International. Two 1.5 ac replications of each treatment were completed.

Treatment No.	Product	Active Ingredient (common name)	Rate of Application (lbs ai/ac)	Supplemental Surfactant
1				
2	Roundup	glyphosate	2.0	none-product formulation
3	Accord	glyphosate	2.0	none
4	Accord	glyphosate	2.0	NGN 8150 MCN 8166
5	Accord	glyphosate	2.0	MON 8161 KN 8166
6	Accord	glyphosate	2.0	X-77
7	Accord	glyphosate	2.0	CideKick
8	Accord	glyphosate	3.0	none
9	Accord	glyphosate	3.0	MON 8161 WON 8166
10	Accord + Garlon 4	glyphosate + triclopyr	1.0 + 0.5	none
11	Accord + Garlon 4	glyphosate + triclopyr	0.5 + 1.0	none
12	Accord + Garlon 4	glyphosate + triclopyr	1.0 + 1.0	none
13	Garlon 4	triclopyr	2.5	none
14	Garlon 4	triclopyr	2.5	X-77
15	Garlon 3A	triclopyr	2.5	none
16	Garlon 3A	triclopyr	2.5	X-77
17	Garlon 4 + Escort	triclopyr + metsulfuron methyl	2.5 + 0.019	X-77
18	Garlon 4 + Oust	triclopyr + sulfometuron methyl	2.5 + 0.188	X-77
19	Escort	metsulfuron methyl	0.028	X-77
20	Accord + Oust	glyphosate + sulfometuron methyl	2.0 0.188	X-77
21	Accord + Oust	glyphosate + sulfometuron methyl	2.0 0.094	X-77
22	Accord + Escort	glyphosate + metsulfuron methyl	2.0 + 0.019	X-77
23	Accord + Escort	glyphosate + metsulfuron methyl	2.0 + 0.028	X-77
24	Arsenal	imazapyr	0.5	X-77
25	Accord + Arsenal	glyphosate + imazapyr	2.0 + 0.3	X-77
26	Accord + Arsenal	glyphosate + imazapyr	2.0 + 0.15	X-77
27	Accord	glyphosate	2.0	MON 8166 MCN 8166

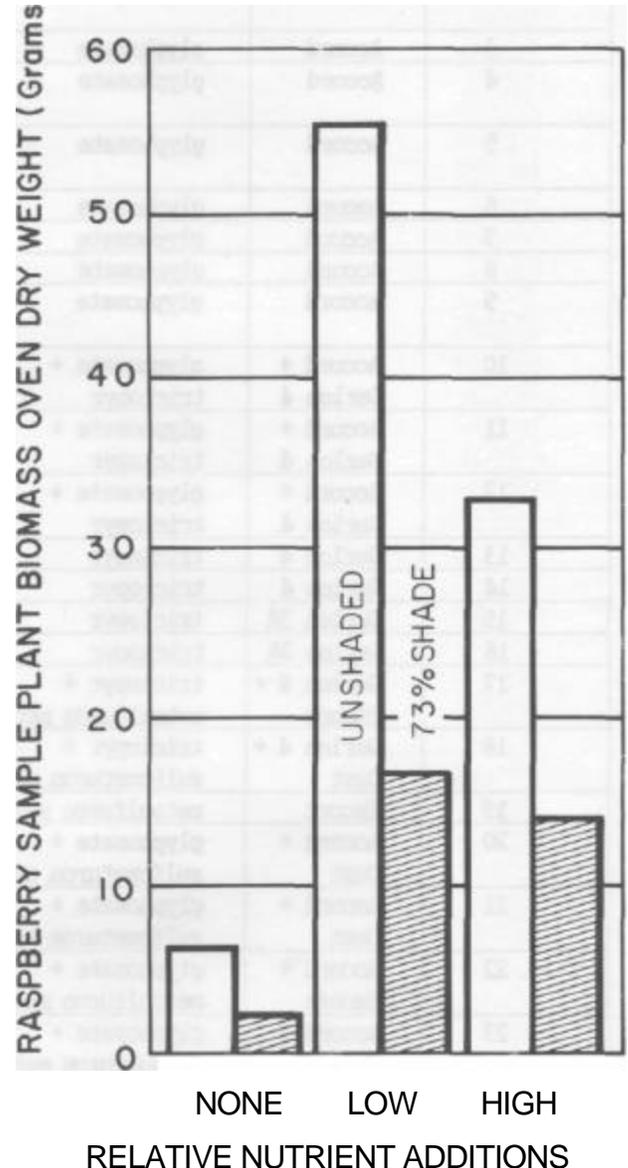
Special patience and technical support was provided by Gene Herrin and Andrew Berry of Maine Helicopters, Inc.

A review of Table 2 will show that the treatments applied are designed to anticipate needs for information regarding surfactant supplements for improved results in future operational treatments. Also, developing interest in various tank mix treatments is also included for evaluation. Dick Schaertl, as part of his dissertation research, is coordinating establishment and evaluation of a permanent plot system across all the treatment blocks. Observations indicate early expressions of efficacy from many of the treatments. Detailed data collection from the permanent plots is planned for late summer 1988.

Another component of the vegetation management studies is an intensive effort, by Richard A. Lautenschlager, on germination, establishment, and competitive potential of common red raspberry in northcentral Maine. One series of field plots in the Telos Area which received herbicide treatments in 1985 and 1986 was evaluated. These plots have been established for the study of planted spruce, soil drainage conditions, and the competitive effects of a variety of vegetation including raspberry. During the summer of 1987, the above-ground biomass from 32 of 224 quadrats on two sites was harvested and dried to provide data on vegetation dynamics and base lines for estimating biomass on the remaining quadrats. Plots, established in 1986, for evaluation of shade, nitrogen and competition effects of planted raspberry and spruce have now been maintained through two growing seasons. They will be harvested in 1988. Germination studies of raspberry seeds will be continued through 1988.

A greenhouse experiment to determine effects of shade, moisture and nutrients on the dry matter production of raspberry has been completed. Data analysis is underway. Preliminary evaluations indicate that total dry weight for roots + shoots was associated with nutrient additions, levels of shading and

moisture. Figure 5 illustrates data from this experiment from two growing seasons of production under two levels of light across three levels of nutrient additions. This information will increase our understanding, and provide for more effective management, of a major competitor on cutover sites.



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Figure 5. Raspberry biomass production over two growing seasons in the greenhouse across three levels of nutrient additions grown under two levels of light.

SILVICAL TECHNIQUES FOR THE IMPROVEMENT OF TIMBER QUALITY
 William D. Ostrofsky

Assessment of Partially Cut Stands

A new project titled "The long-term impact of harvesting techniques on productivity of partially cut stands" was initiated in 1987. The objective of this project is to evaluate the biological performance and development of stands partially cut 10 to 25 years ago using various harvesting techniques. Information obtained can provide the basis for making harvesting modifications which can result in improved timber quality and quantity over the next rotation.

Seven stands were intensively sampled and characterized for growth, composition, and quality of the growing stock, and for composition and quantity of the advance regeneration. Three hardwood stands and two softwood stands are located on lands owned by

Georgia-Pacific Corp., and two additional hardwood stands are located on lands owned by Boise-Cascade Corp. (Table 3). Three 1-chain by 2-chain plots were established in each of the seven stands, and locations of all trees 1 inch in diameter (dbh) or larger were mapped. Tree vigor measurements were taken with the Shigometer on all trees 4.0 inches dbh and larger. All remaining stumps which were found were also mapped and measured. To estimate the quantity and composition of the smaller regeneration, eight 1/4-acre plots were established and measured in each 0.2 ac plot. Peter Caron, CFWJ Research Technician, and Todd Massey, a Forest Management senior, assisted in data collection throughout the summer.

Results are currently being summarized. The stands represent a wide range of forest conditions, as shown by the initial stand data

Table 3. Characteristics of the forest stands used in 1987 to assess partial cutting techniques.

Location	Last Cut	Type	Harvest Method	Total BA/AC ¹	BA/AC ²	No. Trees/AC ³
T 43 M> BPP	1965	Softwood	Chainsaw/Skid.	124	102	302
Pit. 21	1971	Softwood	Mechanical	113	105	284
Codyville	1960	Hardwood	Horse	123	81	279
Codyville	1972	Hardwood	Chainsaw/Skid.	112	83	273
Waite	1975	Hardwood	Mechanical	85	36	165
Roxbury	1963	Hardwood	Chainsaw/Skid.	120	98	213
Canton	1970	Hardwood	Chainsaw/Skid.	130	109	265

¹ Basal area per acre in all stems 1-inch dbh and larger.
² Basal area per acre in all stems 5.0 inches dbh and larger.
³ Number of trees per acre in stems 5.0 inches dbh and larger.

in Table 3.

Graduate Student Research: A new graduate student, Mary Hennessey, started work in July and will be using the data obtained from the hardwood case histories as the basis for her thesis development. Although the specific project objectives have not yet been set, she will be focusing on the early stand development stage (sapling-sized trees) and the impact which various harvesting systems may have on tree survival and stand development.

Shigoeter Remeasurements

Shigoeter remeasurements were made of all trees at the Grafton and South Bridgton whole - tree harvested study sites, as well as all the red spruce in the tree vigor study initiated in 1985. This represents three years of data on red spruce vigor, and four years of data (three years post-harvest) on hardwood tree vigor

following a whole -tree (biomass) thinning operation. Data collection is planned through the 1989 growing season, after which final reports on both of these studies will be prepared.

White Pine Blister Rust Survey

The Maine Forest Service has completed a statewide survey of the incidence of White Pine Blister Rust. The purpose of the survey was to assess the effectiveness of the Ribes eradication program in controlling the rust disease. Dr. Ostrofsky assisted with the survey design, and Ron Lemin assisted in data analysis. Averaged over all stands surveyed, blister rust incidence is 3.8% in the areas with Ribes control, and 9.1% in areas with no control. These results will be used to make an economic evaluation of disease impact. An abstract reporting the initial results has been prepared and will be published in late 1987.

TUBER CROWH AN) YIELD
 Dr. Robert S. Seymour

In response to the Research Priorities Task Force recommendations, research was begun in several areas related to growth and yield prediction of Maine forest types. Beginning September 1, I ended my full-time association with CFRU to assume the Curtis Hutchins Chair of Quantitative Silviculture in the Department of Forest Management and Utilization, but will continue to carry out research sponsored by CFRU. My former full-time position has been redefined to focus on soil-site assessment studies.

S u l

During 1987, we extensively revised FORMAN, an age-class-based forest management simulation model developed by the New Brunswick Dept. of Natural Resources, to carry out new timber supply projections in Maine. Data from the 1980-82 USDA Forest Service inventory of Maine (over 2400 plots), supplemented by the midcycle remeasurement of 464 plots in 1986 by the Maine Forest Service, were used to derive age structures by forest type and site class (Fig. 6) and to formulate over 200 empirical yield curves.

The model revisions were described in a paper (Seymour and Lenin, in press) presented at the IUFRO Conference on forest growth modelling and prediction held in August. Results of the

new predictions will be described in a detailed technical bulletin currently in preparation. Some important highlights are:

1. Without increases in intensive management, both current and projected harvest levels will be slightly greater than forest growth for all heavily utilized species groups. The result would be gradually declining inventory levels, eventually resulting in shortfalls several decades hence (Figs. 7, 8).
2. The timing of any spruce-fir shortfall appears to be delayed in comparison to earlier predictions. Reasons include: actual losses from the spruce budworm appear to have been less extensive than previously predicted; more area has been put under "high-yield" management; and growth rates appear to be higher than those used previously.
3. At the current level of management, long-term sustainable harvest levels (i.e., that harvest level that results in a long-term balance between growth and cut, and thus, a stable inventory) are slightly below the current levels for most species, and significantly less than the projected (year) 2000 levels for hardwoods (Table 4).

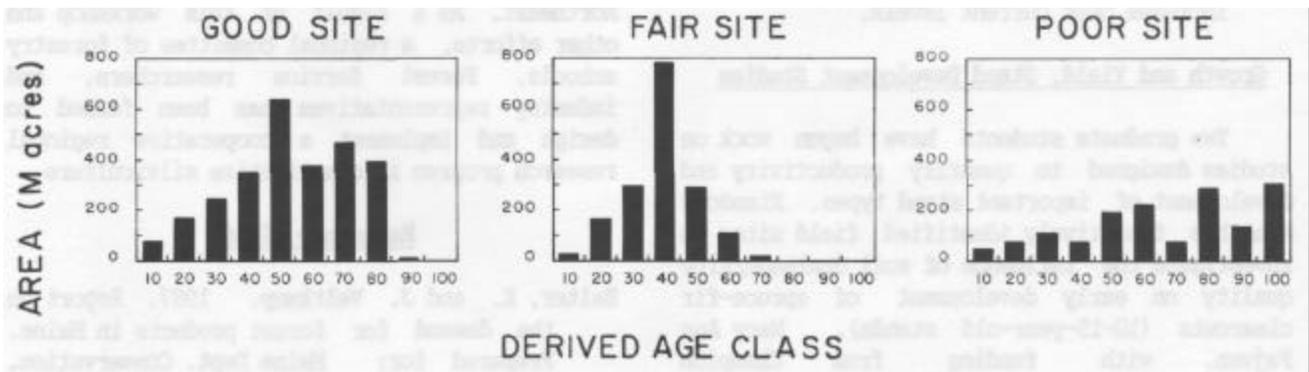


Figure 6. Derived age-class distributions by site class for the spruce-fir type in Maine.

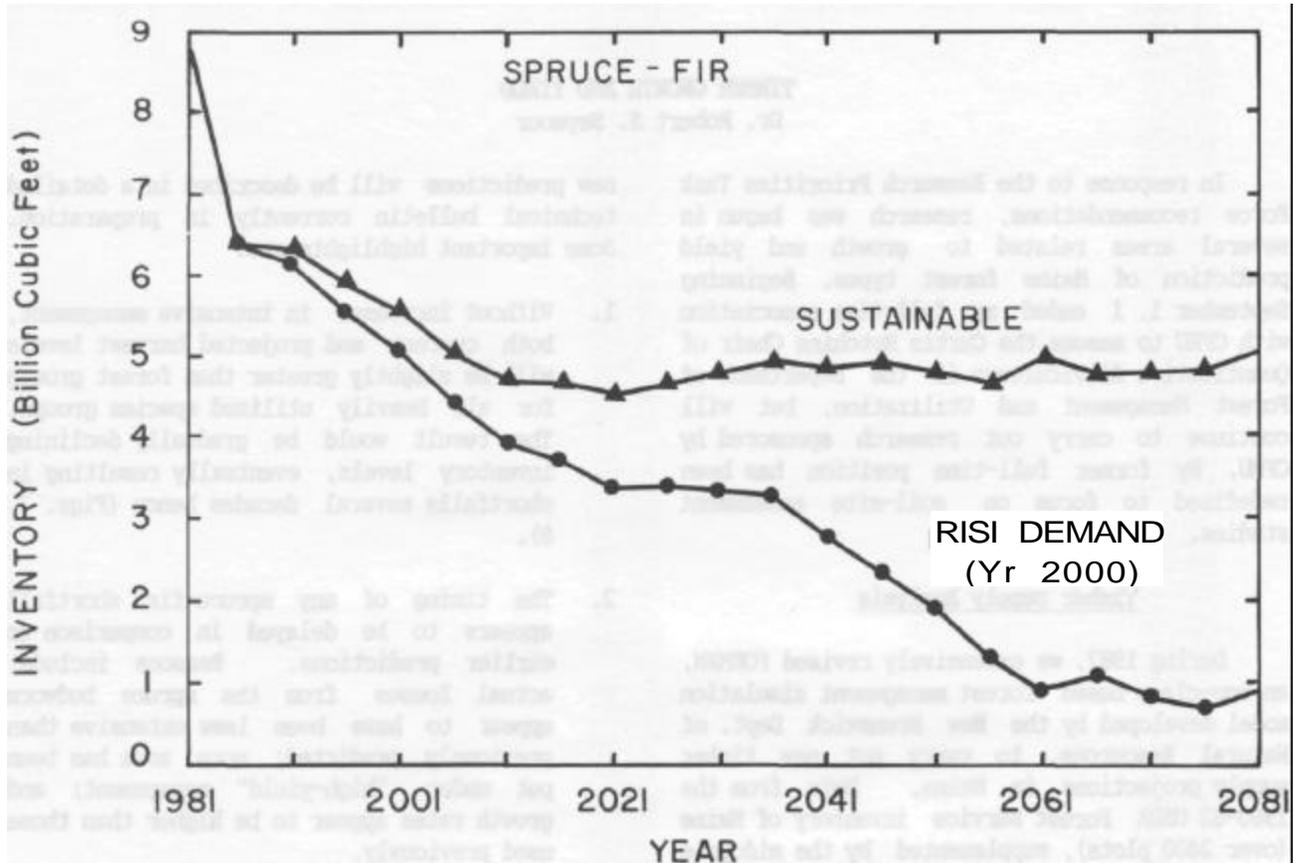


Figure 7. Projected 100 -year development of the spruce -fir inventory in Maine under two demand scenarios after the year 2000; the long -term sustainable level, and the predicted year -2000 level from the RISI demand study (Baiter and Veltkamp 1987).

- Increasing the sustainable harvest of spruce-fir and tolerant northern hardwoods to match future demands will require about 100,000 acres per year to be managed in high-yield stands (plantations or spaced natural stands) - roughly a 3 -4-fold increase over current levels.

Growth and Yield, Stand Development Studies

Two graduate students have begun work on studies designed to quantify productivity and development of important stand types. Xiandong Meng has tentatively identified field sites to investigate the influence of soil drainage/site quality on early development of spruce -fir clearcuts (10 -15-year-old stands). Mary Ann Fajvan, with funding from Champion International, has completed one field season in

a study to investigate site index and development of red spruce in a variety of irregular stand types.

I served as program chair for a regional workshop on growth and yield needs in the Northeast. As a result of this workshop and other efforts, a regional committee of forestry schools, Forest Service researchers, and industry representatives has been formed to design and implement a cooperative regional research program in quantitative silviculture.

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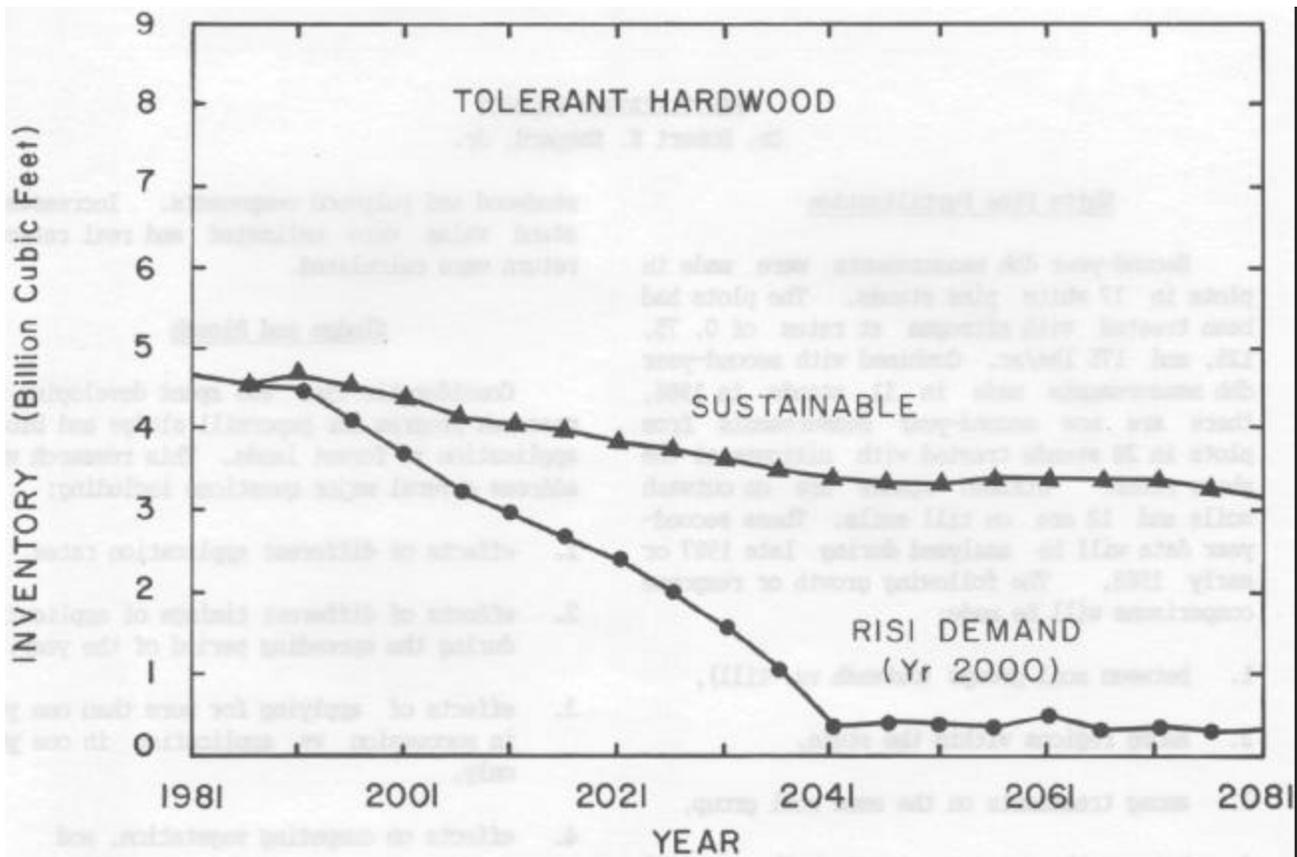


Figure 8. Projected 100 -year development of the tolerant hardwood inventory in Maine under two demand scenarios after the year 2000; the long -term sustainable level and the predicted year - 2000 level from the RISI demand study.

Table 4. Long-run sustainable harvest levels projected by the FORMAIME model compared to current harvest levels and year-2000 demand levels predicted by Baiter and Veltkamp (1987).

SPECIES	HARVEST LEVELS (Million Cubic Feet)		
	SUSTAINABLE	1980-85	YEAR 2000
Spruce-Fir	2,844	3,335	3,161
Tolerant HW	1,688	1,814	2,252
Aspen-P. Birch	1,163	662 735	1,661
White Pine	537 392	341	598 327
Hemlock			
TOTAL	6,624	6,887	8,000
SHORTFALL:		263	1,376

FISTILIZATICN PROJECT Dr.
Robert K. Shepard, Jr.

White Pine Fertilization

Second-year dbh measurements were made in plots in 17 white pine stands. The plots had been treated with nitrogen at rates of 0, 75, 125, and 175 lbs/ac. Combined with second -year dbh measurements made in 11 stands in 1986, there are now second -year measurements from plots in 28 stands treated with nitrogen at the above rates. Sixteen stands are on outwash soils and 12 are on till soils. These second - year data will be analyzed during late 1987 or early 1988. The following growth or response comparisons will be made:

1. between soil groups (outwash vs. till),
2. among regions within the state,
3. among treatments on the same soil group,
4. between the same treatment on the two soil groups,
5. between sawlog stands and pole stands, and
6. between natural stands and plantations.

Analyses of fourth -year measurements from plots in eight stands treated with 0, 50, 100, and 200 pounds of nitrogen per acre were completed. Two models to predict dbh growth were developed, one for outwash soils and one for till soils. The models were developed for the two soil groups separately, because of the highly significant effect of soil on growth. These models were used to "grow" trees in all plots on each soil as though they had received either 0 or 100 pounds of nitrogen per acre. Stand volume was subdivided into sawlog,

studwood and pulpwood components. Increases in stand value were estimated and real rates of return were calculated.

Sludge and Bioash

Considerable time was spent developing the research program for papennill sludge and bioash application to forest lands. This research will address several major questions including:

1. effects of different application rates,
2. effects of different timings of application during the spreading period of the year,
3. effects of applying for more than one year in succession vs. application in one year only,
4. effects on competing vegetation, and
5. effects of applying immediately before budbreak vs. effects of applying shortly after budbreak.

Establishment of plots to address all these questions was begun in October.

As part of a related study, water samples were taken from four streams to provide background data prior to operational spreading of ash to a small watershed drained by one of the streams. The remaining three streams will serve as controls. Analyses of these water samples were completed.

Numerous meetings which dealt with the general subject of sludge and ash application to forest lands were attended during the year.

TREE IMPROVEMENT

Dr. Katharine K. Carter
 Dr. Michael S. Greenwood

Introduction

Research activity in 1987 was devoted primarily to an evaluation of the potential for early family selection in jack pine and black spruce. Reliable early selection methods would be quite valuable in tree improvement programs for these species, as they would reduce the number of years needed to identify genetically superior families. Thus, the gains from using superior families in operational planting programs could be achieved sooner. Moreover, if superior families can be identified by early testing in a greenhouse environment, the expense of large field testing programs may be

Briefing-H-

Methods

As a preliminary test of the feasibility of early family selection, 22 families of jack pine and 40 families of black spruce were used which are represented in older field tests of the New Brunswick Tree Improvement Council. Seedlings of these families were grown in Leach tubes in the greenhouse during the winter of 1985-86, and were transplanted into large plastic pots in the spring of 1986. These seedlings were then maintained in an unheated greenhouse under normal photoperiods until October, 1987. Although no extra heat or lighting was supplied, conditions in the greenhouse promoted rapid growth, and at the end of two growing seasons under these conditions both species showed excellent survival and growth.

Results

As of October, 1987, (2 1/2 years from seed), the average height of these seedlings was 67 cm (27 inches) for the jack pine and 80 cm (32 inches) for the black spruce. When the average height of each family of greenhouse-grown seedlings was compared to the family's performance in 5- and 7-year old field tests, the Pearson correlation coefficients for both black spruce and jack pine families were quite high ($r = 0.6$ to 0.7). The high correlations indicate that some family selections might be possible after only two years, if using progeny tests in a greenhouse environment.

Greenhouse heights for black spruce are plotted vs. 7-year heights in Fig. 9. If selection after 2 years in the greenhouse environment were used to eliminate the slowest growing third of all the families, this would not result in the loss of any families which were in the upper third in height in the 7-year field test. If half of the families were eliminated through greenhouse selection, only 2 of the top third 7-year field test families are lost (eleven out of 13 top families are retained). Results for jack pine were similar; no family in the bottom third during greenhouse tests appeared in the top third in later field rankings. Although further analysis is needed before this type of selection can be applied to operational tree breeding programs, it appears that greenhouse selection may be an effective means of reducing field testing time when screening families of black spruce or jack pine.

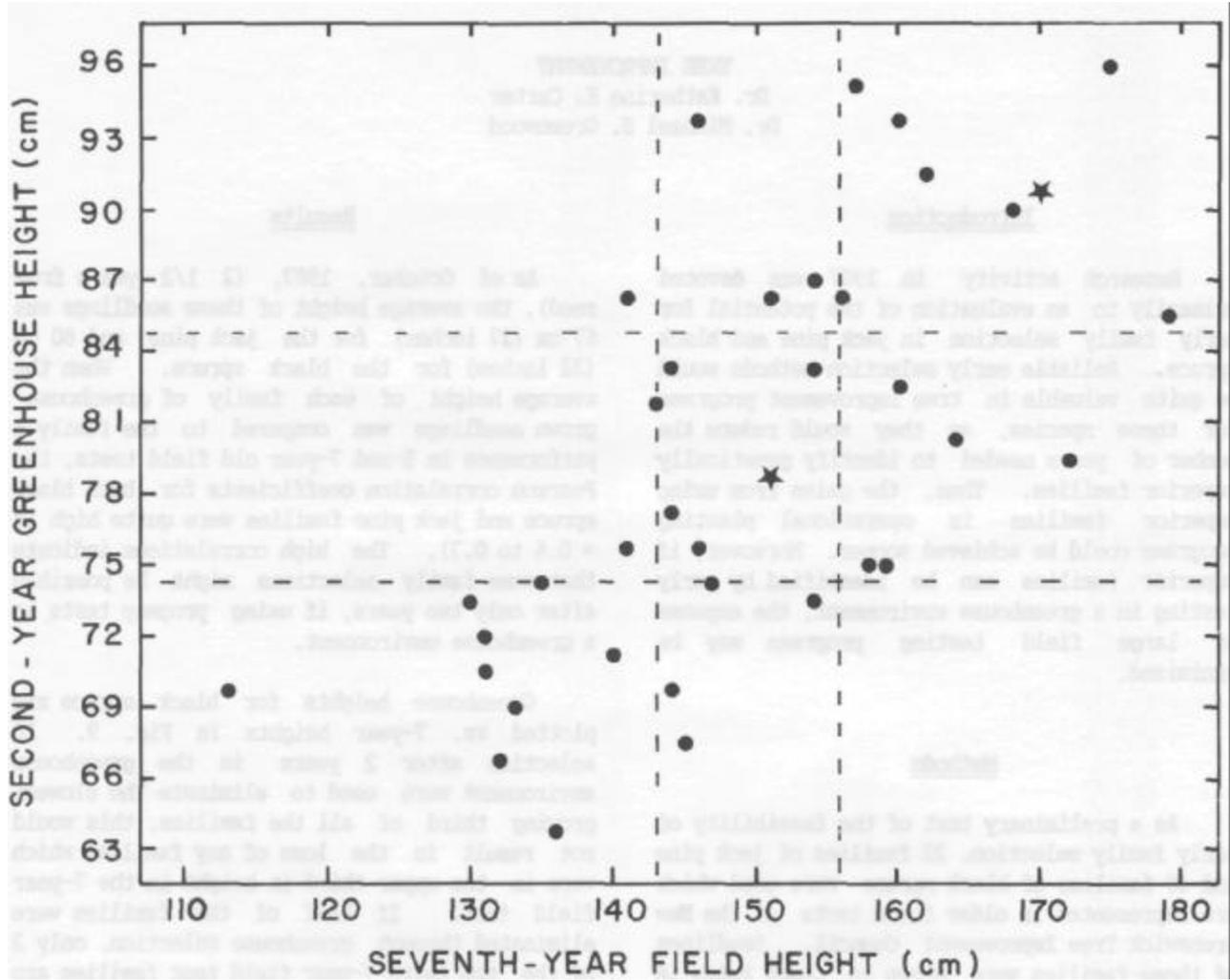


Figure 9. Second -year greenhouse height vs. seventh -year field height for black spruce half -sib families. Lower and upper thirds of families ranked by height at each age are indicated by dashed lines. (Stars represent two observations at those points.)

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- HcCormack, M. L., Jr. Strategy Coanittee, Heed Science Society of America, Annual Meeting, St. Louis, MO. February 5, 1987.
- _____. Herbicide technology in forest management. Lecture, Forest Management Technology. Orono, ME. February 24, 1987.
- Moderator. Herbicide Roundtable Workshop. Fredericton, NB. February 25-26, 1987.
- _____. Dealing with pesticide controversy. Ontario Vegetation Management Association, Thunder Bay. March 4, 1987.
- _____. Dealing with pesticide controversy. Ontario Vegetation Management Association, Guelph. March 5, 1987.
- _____. Herbicide technology in forest management. Guest Lecture. Univer sity of Guelph, Ontario. March 6, 1987.
- _____. Precommercial thinning with aerially applied herbicides. Monsanto Forest Management Workshop. Bangor, ME. March 10, 1987.
- _____. Herbicide uses for Christinas tree production. Seminar. Lunenburg County Christinas Tree Producers Association. Bridgewater, NS. March 17, 1987.
- _____. Summary cooments. Workshop on Preccmmercial Thinning. Fredericton, NB. March 19, 1987.
- _____. Research programs of the CFRU. Coop. Extension Service Workshop. Orono, ME. April 1, 1987.
- _____. Forestry uses of glyphosate for vegetation management. Monsanto Canada Workshop. Fredericton, I@. April 9, 1987.
- _____. Biological implications of long-term investments in forest resources. John Hancock Investment Seminar. Boston, MA. April 21, 1987.
- _____. Silviculture on industrial forest land in Maine. Silviculture Class. Orono, ME. April 28-29, 1987.
- _____. Silviculture on industrial forest land in Maine. Field Tour, Forestry Sunner Camp. Orono, ME. May 14, 1987.
- _____. The Forest Innortal (with Ray Owen). Maine Scholars' Day. Orono, ME. May 18, 1987.
- _____. Herbicide assessment workshop. Great Northern Paper, Millinocket, ME. June 25, 1987.
- _____. Herbicide program review. International Paper Co. Northern Maine. July 17, 1987.
- _____. Field tour of herbicide study plots. Monsanto Summer Workshop. Jackman, ME. July 22-23, 1987.
- _____. Genetic improvement of balsam fir Christmas trees. First International Christmas Tree Convention. Halifax, NS. August 12 & 14, 1987.
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- _____. The influence of forest pathogens on forest development. Seminar presentation, Forest History Seminar, Orono, ME. Feb. 24, 1987.

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_____. The epidemiology of white pine blister rust. Invited lecture, Maine Forest Service, Augusta, ME. April 29, 1987.

_____. Forest pathology in forest practice. Seminar presentation and field tour, College of Forest Resources Summer Camp, Bridgton, ME. May 20, 1987.

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Member, Maine
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 advisory committee.

Member, Baxter Park Scientific

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_____. Is Multiple Use Forestry Sustainable? Panel member, Bowdoin College, environmental awareness forum, Brunswick, ME. April 1, 1987.

_____. Timber supply projections for Maine. Presentations to: Forests for the Future Citizens' Council and Maine Dept. Conservation discussion group June 23 -24, Greenville, ME; July 31, Aug. 5, Sept. 4, 8, Augusta, ME.

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COOPERATIVE FORESTRY RESEARCH UNIT ADVISORY COMMITTEE

1987 Membership

The CFRU Advisory Committee sets priorities and reviews proposals for the Cooperative Forestry Research Unit. Members active during all, or part, of 1987 were:

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Michael Coffman, Champion International Corporation (Vice Chairman)
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Edwin Meadows, Director, Maine Bureau of Public Lands (Member at Large)
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Keith Bowser, Fraser, Inc.
Robert Chadbourne, P. H. Chadbourne Co.
Edward Chase, Chase Tree Farm
Thomas Colgan, Forestry Manager, Scott Paper Company
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(September 30, 1987)

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Robert S. Seymour, Associate Research Professor of Forest Resources
William D. Ostrofsky, Assistant Research Professor of Forest Resources
Michael S. Greenwood, Professor of Forest Resources
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Peter Caron, Research Technician (Tree Improvement)
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Sandoz Chemical Company
USDA Northeastern Forest Experiment Station
USDA State & Private Forestry
Walden Specialties, Inc.

APPENDIX
TERMINOLOGY

COMMON NAME	SCIENTIFIC NAME
Aspen	Populus spp.
Paper birch	<u>Betula papyrifera</u> Marsh.
Balsam fir	<u>Abies balsamea</u> (L.) Mill.
Hemlock	<u>Tsuga canadensis</u> (L.) Carr.
Jack pine	<u>Pinus banksiana</u> Lamb.
White pine	<u>Pinus strobus</u> L.
Common red raspberry	<u>Rubus idaeus</u> L.
Black spruce	<u>Picea mariana</u> (Mill.) B.S.P.
Red spruce	<u>Picea rubens</u> Sarg.