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NORTH CAROLINA AGRICULTURAL EXTENSION SERVICE

ANNUAL REPORT

AGRICULTURAL PRODUCTION
MANAGEMENT AND NATURAL RESOURCE USE PROJECT (III)
Title of Project

Forestry
Section

1963
Annual Year

Name and Title of Worker	Percentage of Time Devoted to Entire Project by Each Worker
W. M. Keller In Charge, Forestry Extension Project Leader	100 %
Forest Management Extension Specialists	%
J. C. Jones, Head	100 %
E. M. Jones	100 %
F. E. Whitfield	100 %
John Gilliam	100 %
Leonard Hampton	100 %
W. M. Stanton 1/	100 %
Ross S. Douglass 2/	83 %
	%
	%
	%
	%
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	%
	%
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	%

Study Leave
1/ 1/1 - 9/1, 1963
2/ 11/1 - 12/31, 1963

Signed Walter M. Keller
Project Leader

Date Submitted 1-22-64

ANNUAL REPORT

FARM FORESTRY EXTENSION WORK

NORTH CAROLINA

January 1, 1963 - December 31, 1963, Inclusive

Walter M. Keller, In Charge, Forestry Extension
J. C. Jones, Head, Forest Management Extension Section

George Hyatt, Jr., Director

N. C. Agricultural Extension Service
N. C. State of the University of North Carolina
at Raleigh
and
U. S. Department of Agriculture, Cooperating

State College Station
Raleigh, N. C.

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Exhibits

ANNUAL REPORT

FOREST MANAGEMENT SECTION

AGRICULTURAL PRODUCTION, MANAGEMENT AND NATURAL-RESOURCE USE (III)

1963

Walter M. Keller, In Charge, Forestry Extension
J. C. Jones, Head, Forest Management Extension Section

I. Program Accomplishments

A. "The over-all problem continues to be to raise net income through better management, marketing, and utilization of the present forest resources." Thus, the opening paragraph from the "Plan of Action" section of the Plan of Work clearly indicates the areas where major program accomplishments must be realized.

This report will deal with the five major areas of interest set forth in the "Plan of Action." These include:

1. Expansion in production of large, high-quality hardwoods.
2. The development of a large-scale Christmas-tree enterprise in the Mountain area.
3. The development of a sound business approach to, and increased efficiency in, forest management and forest development.
4. Reduction of losses caused by forest diseases, insects and storms.

5. Establishment of a cooperative bottomland hardwood management study by the School of Forestry-Extension Forestry Department with several major hardwood-using companies.

1. Expansion in Production of Large, High-quality Hardwoods

During the year of 1963, there has been a marked increase in interest in the hardwood management program.

There has been a continuation of the work started with several of the industrial landowners along the Roanoke River. Information has been collected from the result demonstrations on the establishment of hardwood on non-productive lands. In some cases, as many as 300,000 to 400,000 seedlings of desirable species are established after the first growing season.

Private landowners have also used the services of the hardwood specialist. Mr. Jimmy Shields of Halifax County was given assistance in the marking and marketing of a nice stand of tupelo gum. A 10-acre demonstration plot was marked for an improvement cut. There was about 10,000 board feet of mature and defective tupelo removed per acre, leaving an excellent stand of young, thrifty tupelo.

This is the first known private stand of tupelo treated in this way.

In 1962, a proposal was submitted to the U. S. Army Corps of Engineers requesting that they ask the U. S. Forest Service to conduct two intensive studies to determine the effects of flooding below the Kerr Reservoir on the Roanoke River. The first study would determine the effect of prolonged flooding on logging and log cost. This study was conducted with the cooperation of the Corps of Engineers, United States Forest Service, North Carolina Forest Service, and the North Carolina Extension Forestry Department, and was completed during the month of November. The findings will be published in 1964.

The second study is a much longer-ranged program and is expected to continue for eight to ten years. The purpose of this program is to determine the effect prolonged flooding has on existing stands of timber and the establishment of new reproduction. This study, in cooperation with the United States Forest Service, was started in December. Nine deer

exclosures have been constructed to prevent deer-browse damage on plots set up to determine water damage from flooding.

Forestry Extension Specialist E. M. Jones provided leadership for this program, with other members of the staff assisting.

2. The Development of a Large-scale Christmas-Tree Enterprise in the Mountain Area

Steps to accomplish the objectives in this program were outlined and discussed in the 1962 annual report. These steps were again set forth in the 1964 Plan of Work as a continuation of this program. In addition to the five original steps outlined, one has been added.

a. "To promote further development of private sources of Fraser fir planting stock for Christmas-tree growers in the Mountain counties."

One commercial nursery was established in Jackson County. A detailed management plan for growing Fraser fir was prepared for the nurseryman. This plan was used in securing a loan from the Farmers Home Administration, and with this

financial assistance he has been able to establish and expand his nursery operation. Approximately one-half million Fraser fir seedlings were transplanted in the spring of 1963, and these seedlings will be available to buyers in the spring of 1965.

Assistance has been given to one other landowner in Jackson County who would like to establish a commercial nursery for the production of Christmas-tree seedling stock.

b. "To promote the planting of 700,000 Fraser fir and 1,500,000 additional seedlings for Christmas trees from among these species: white pine, Scotch pine, white spruce, Douglas fir, Norway spruce, Serbian spruce, and red cedar.

Only one-half million Fraser fir were planted in 1963, because of a shortage of acceptable planting stock for purchase by growers. Additional sources of planting stock will alleviate this situation and make it possible to reach anticipated planting goals. Two million seedlings of other species were planted for Christmas trees. Of this number, 1,500,000 were white pine.

mention anything done to alleviate this situation.

The following methods were used to promote this planting program:

(1) News articles
(2) Radio
(3) Television
(4) Group meetings
(5) News letters
(6) Personal contact
(7) Demonstrations

The forestry specialists assisting with this program were Leonard Hampton and John Gilliam.

c. "To assist landowners in the Mountain counties to increase income by at least $250,000 in 1963-64 through the sale of both cut and bagged Fraser fir and sheared white pine."

The harvest of Fraser fir and white pine in 1963-64 was 60,000 over the harvest the previous year. This harvest increased the income to growers by approximately $300,000. Shearing and improved management techniques raised the quality of trees harvested for market, making them more acceptable to the buyer. The better-quality white pines increased the sales of this species as Christmas trees and ornamentals.

To increase the harvesting and marketing of

these trees the following methods were used:

(1) Demonstrations in shearing techniques
(2) News letters to Christmas-tree growers
(3) Personal contacts with growers and buyers
(4) Group meeting with growers to discuss cultural practices necessary for the production of quality trees
(5) Sources of quality trees made known to buyers

The forestry specialists assisting with this program were Leonard Hampton and John Gilliam.

d. "To reduce the cost of weed control in Christmas-tree plantations through the use of chemicals."

The control of grasses and weeds in Christmas-tree plantations on slopes too steep and rough for mechanical equipment is a major problem. Established result demonstrations using several weed-control chemicals to determine their effectiveness in terms of control and cost are being continued. Assistance was given to several new growers who started using chemicals in their weed-control program. A new method of hand application was developed and found successful. The chemical is placed in a jar with holes punched in the lid and used as one would use a salt shaker.

some individuals, or at least specific counties.

Methods used in this program:

(1) Results of demonstrations made known to the growers through the quarterly news letter
(2) Group meetings
(3) Personal contact

Assisting with this program were Forestry Specialists L. A. Hampton and J. H. Gilliam.

e. "To keep Christmas-tree growers informed on the best cultural practices for producing a premium tree at the lowest possible cost.

Result and test demonstrations in the application of commercial fertilizers, planting methods, using different sizes and grades of Fraser fir seedlings, shearing techniques and other cultural practices discussed in the 1962 Annual Report are being continued.

Meetings were held throughout the Mountain area to teach cultural practices necessary to produce a premium-grade tree, and inform the growers of new knowledge gained through demonstrations and research.

This phase of the program was carried out by Forestry Specialists L. A. Hampton, R. S. Douglass and J. H. Gilliam.

f. "To assist Christmas-tree growers in developing a practical and economical way of controlling blackberry briars in their plantations through the use of mist-blown chemicals."

Two result demonstrations were established to determine the results of applying with a mist blower 2 pounds acid equivalent of 2,4,5-T per acre on the control of briars and the residual effect, if any, on the Christmas trees. The results of these demonstrations will be evaluated in the spring of 1964.

Assisting with this program were Extension Foresters L. A. Hampton, R. S. Douglass, and J. H. Gilliam.

Christmas-tree production budgets for Fraser fir and white pine were prepared as a guide for analyzing profit possibilities in the production of these trees in western North Carolina. These budgets were prepared by John L. Gray; John H. Gilliam; and Robert L. Johnstone, Farm Management and Public Affairs Extension. (A-1)

3. <u>The Development of a Sound Approach to, and Increased Efficiency in, Forest Management and Forest Development</u>

One North Carolina tree farmer, Voit Gilmore, said, "As a businessman I am convinced that the development of a commercial timber-growing enterprise is a sound investment capable of producing an attractive return on capital and time required." This is true when one approaches his woodlands as Mr. Gilmore did, making his decisions based on factual data and sound technical advice. Before money is invested in timber production, or idle lands, a person should determine the productive capacity of the soil and the management practices necessary to produce a timber crop that will pay off the investment. The value of harvests is directly related to the productive capacity of the soil.

To create an awareness of this among the timberland owners and businessmen of North Carolina, the following things were done:

a. Six two-day workshops for vocational agriculture workers were held in various parts of the state. The workshops included classroom lectures and

exercises and field training in soil productivity, economics of forest management, timber stand improvement, and forest insects and diseases. (A-4 and A-6).

b. Two three-day schools were held for Albemarle Paper Company foresters. Instruction was given in soil productivity and forest economics. (A-5 and A-6)

c. Field trips and classroom sessions on soil site index, timber stand improvement, and economics of forest management were held in three counties.

d. Two field trips on the determination of soil site index and productivity were conducted for the Agricultural Economics appraisal class in the School of Agriculture.

e. Assisted with forestry program planning at Area Development and Rural Area Development meetings.

f. Gave television and radio programs on forest planting and timber stand improvement.

This phase of the department program was given leadership by Ross S. Douglass, with all other staff members assisting.

For the past five years Leonard Hampton has been working with Charles Taylor, a one-time state winner in 4-H demonstration activity. A native of Transylvania County, Charles has, since his first year in 4-H work, exhibited outstanding leadership qualities. While still in high school, Charles became interested, through Extension assistance, in obtaining forest land and managing the timber for investment purposes. After purchasing his first tract of approximately 100 acres, he received assistance in laying out a complete management plan to include harvesting methods, road layout, and reforestation procedures. This was only the beginning. Besides learning basic concepts of forestry, he quickly learned the ways of a good businessman. He acquired several loans for the purchase of other mountain tracts of timber. On each purchase he received instruction on the best management techniques. One one area, several one-acre plots were laid off for other 4-H forestry boys to carry forestry.

Mr. Taylor has received instruction in all phases of acquisition, harvesting, reforestation, timber contracts, invitations to bid on sawtimber, pulpwood

and fence posts, and other phases of handling a timber sale. He learned the value of marking timber for specialty products such as veneer. Today he has several hundred acres of woodland under intensive management.

Charles is now a law student at Wake Forest College. He plans to include in his college studies courses in forest economics and forest management. When his college training is completed, he will have an excellent background to assist his clients in woodland investments.

4. Reductions of Losses Caused by Forest Insects, Diseases and Storms

The southern pine beetle outbreak that became a serious epidemic during the summer of 1962 subsided during the fall of that year. The efforts of Extension and State Forest Service personnel to inform the public of preventative and control measures, during 1963, contributed much to the reduction in number and severity of attack by bark beetles. Several action programs were initiated in cooperation with other agencies. One series of meetings was held in Davidson County (A-2). A state-wide radio and television network was used to disseminate information

to the public. A number of articles were prepared and carried by newspapers throughout the state.

A serious attack of pine bark beetles occurred in Moore County as a result of a 30,000-acre forest fire. Foresters from public agencies and industries met to discuss control methods, salvage recommendations and opportunities and to coordinate their activities in the area. At a meeting held in the area for landowners, recommendations for controlling the outbreaks and salvaging trees damaged by the fire and insects were discussed. As a result of these efforts, the insect outbreak was contained in the fire-damaged area; and an orderly salvage program was carried out.

The Dutch elm disease was confirmed in several new areas of the state during 1963. The Extension foresters, State Forest Service personnel and personnel from the Entomology and Pathology Departments of North Carolina State met to discuss the latest research and recommendations concerning the disease. At a public meeting held in Guilford County these specialists presented this information

to local governing agencies, institutions, professional foresters, county Extension personnel, and other agricultural workers. Newspapers, radio and television stations cooperated in disseminating this information to the people.

A one-day training program on forest insects and diseases was held for the Piedmont Area Development Association, consisting of fifteen counties. Instruction was given in the classroom and field to community leaders, county Extension agents, professional foresters and agricultural workers.

The North Carolina Christmas Tree Growers' Association had as their topic for their annual meeting, "Control of Insects and Diseases as a Means of Reducing Losses in Plantations." (A-3) The Extension forestry specialist was assisted in presenting this program by personnel from the Southeastern Forest Experiment Station and the Entomology Department of North Carolina State.

One Christmas-tree grower was given assistance in eliminating root rot (Phytophthora) from his nursery beds. This prevented the transplanting of

Extension's specific role. Just what is being done?

diseased seedlings that would not have survived, thus saving the grower the cost of this operation.

There has been a continuation of effort in the study of the balsam woolly aphid. Cooperation with other agencies in reporting its location and efforts to control its spread are being continued.

Instruction in forest entomology was again presented to the fifth-grade students of the Madison-Mayodan schools and city schools of Greensboro as reported in the 1962 Annual Report. These training sessions have become an annual affair.

At a meeting of the Southern Chapter of the International Shade Tree Conference, Fred E. Whitfield gave a paper on forest insects, with particular emphasis on bark beetles.

5. Establishment of a Cooperative Bottomland Hardwood Management Study by the School of Forestry-Extension Forestry Department with Several Major Hardwood-Using Companies

Partially as an outgrowth ~~As a result~~ of the Extension bottomland hardwood program a cooperative hardwood research program was initiated July 1, 1963. Ten companies located throughout

the Southeast support the program financially. Applied research studies of interest to each company are located on company lands, with technical help from the School of Forestry and the North Carolina Extension Forestry Department.

The first interim progress report on this program has been submitted to the participating companies and is herewith submitted as exhibit A-7.

Mr. E. M. Jones serves as associate director of this program.

B. In addition to the five major areas of interest report, the department was involved in many other activities. Some of these are reported very briefly in the following paragraphs:

1. At the invitation of the North Carolina Commissioner of Agriculture, the North Carolina Forestry Association sponsored the central theme, forestry, for the 1963 North Carolina State Fair. "Miracle of the Forest" was the title selected for the forestry exhibits placed both inside and outside the Dorton Arena located on the fairgrounds. J. C. Jones, forestry Extension specialist, was named chairman

of the Action Committee responsible for building the exhibits. Fourteen major exhibits were constructed over a period of five weeks with the cooperation of the Extension Service, U. S. Forest Service, North Carolina Forest Service, and industry representatives and associations. The theme title and exhibits received much recognition through the press, radio and television. Representatives of two other states visited the fair to view the exhibits. A film of the exhibits was made by the American Forest Products Industries. Fair attendance set a record of over one million persons. The forestry exhibits were viewed by large crowds throughout the week.

All members of the Extension Forestry staff gave assistance on this project.

2. The annual meeting of the North Carolina Forestry Association was held at the Dorton Arena in connection with the official opening of the 1963 North Carolina State Fair and its theme and title, "Miracle of the Forest." Mr. Walter M. Keller served as chairman of this meeting.

CHRISTMAS TREE PRODUCTION BUDGETS

FOR

WESTERN NORTH CAROLINA

Prepared by:

John H. Gilliam, Forestry Extension
John Gray, Forestry Extension
Robert L. Johnstone, Farm Management and
Public Affairs Extension

North Carolina Agricultural Extension Service
State College Station, Raleigh, N. C.

May, 1963

Background and Basic Assumptions

These budgets are prepared as a guide for analyzing profit possibilities in Christmas tree production in western North Carolina.

Two sets are included. One is for growing Fraser fir; the second is for growing white pine. Fraser fir is suited primarily for the mountain area on land at altitudes of 2000 feet or more. White pine can be grown over a wider range which includes western Piedmont counties on land at altitudes up to 3600 to 4000 feet.

Both trees have market possibilities other than as cut Christmas trees. Both are sold in balled-and-burlapped form for ornamental planting. In addition, there is a ready market for Fraser fir boughs for decorative uses at Christmas time. However, these budgets are confined to the production of cut Christmas trees sold on a wholesale basis at the farm.

In the development stage, a Christmas tree operation resembles an orchard enterprise. For the first five to six years the operator is involved in planting and cultural operations to get the trees up to "bearing" age and size. No harvests occur. Then the trees start "coming in" to the bearing stage and yields build up until the optimum "bearing" period is reached. With Christmas trees where plantings are made in sequence over the development period and where each mature acre is then replanted, this optimum "bearing" period can be maintained indefinitely.

Therefore, two budgets have been prepared for each species - "A + B" and a "C" budget. The "A + B" budget lists annual costs and returns and labor and machine inputs for the optimum "bearing" period when the first planting reaches rotation age. From this point on, a continuous harvest at a given level is assumed.

The "C" budget shows costs and returns and labor and machine inputs for each year of the development or build-up period plus the period as a whole.

These budgets assume a family-farm type of operation. No land or building costs are included. Labor has not been priced. No interest charges are budgeted against capital required except

for equipment and hand tools used. Here a 6% rate applied to average investment was included in arriving at hourly or annual ownership and operating costs.

Although plantings must be protected from fire and from grazing, no charges have been included because protection measures needed will depend on the individual situation.

Prices, labor requirements and yields are based largely on the experience of pioneer growers since research in this enterprise under western North Carolina conditions is just beginning. Prices are at 1962-63 levels.

It is assumed that plantings will be established on land already cleared which can be worked with hand tools. Other than this, steepness or the presence of surface rock is not critical. Land now in native pasture which cannot be worked with tractor or horse-drawn mowers is suitable - or better land if available.

Table 1A. FRASER FIR CHRISTMAS TREES, 8½-YEAR ROTATION*:
ESTIMATED COSTS AND RETURNS PER YEAR
9-ACRE UNIT**

Item	Description	Unit	Quantity	Price	Amount
REVENUE					
Yield	Christmas trees averaging 6 feet in height	Tree	2,160	$ 2.00	$4,320.00
TOTAL REVENUE					$4,320.00
VARIABLE EXPENSES					
Planting stock	Fraser fir 2-2 transplants	1,000 plants	2.72	$55.00	$ 149.60
Fertilizer	10-10-10	cwt.	25	$ 3.50	$ 87.50
Side dress	Ammonium nitrate	cwt.	9.5	$ 4.00	$ 38.00
Briar control	2,4,5-T	lbs. acid	2	$ 3.00	$ 6.00
Sod control	Amizine	lb.	3.5	$ 4.25	$ 14.88
Weed control	4G Simazin	lb.	12	$ 8.25	$ 99.00
Insect control	Insecticide as needed	--	--	--	$ 43.00
Machine operation	Tractor, 24-40 DBH	hr.	78	$ .60	$ 46.80
	Trailer	hr.	78	$ .10	$ 7.80
TOTAL VARIABLE COSTS					$ 492.58
FIXED EXPENSES					
Equipment	Tractor, 24-40 DBH	hr.	78	$ 1.00	$ 78.00
	Trailer	hr.	78	$ .11	$ 8.58
	2 knapsack sprayers	Annual	Annual	$11.68	$ 23.36
Hand tools	2 planting spades 2 buckets 2 bow saws and blades 2 pruning shears 2 pruning snips	Annual	Annual	$16.68	$ 16.68
TOTAL FIXED COSTS					$ 126.62
TOTAL COSTS					$ 619.20
RETURN TO LABOR, CAPITAL AND MANAGEMENT					$3,700.80

*This budget is for a 9-acre unit in the 9th calendar year and all succeeding years after the

(Over)

buildup period has been completed. During the buildup period successive 1-acre units are added annually to the operation over 8½ years. This budget assumes that an intensive level of management will be followed.

**Cleared land at altitudes of 2000 feet or higher. This budget does not include cost of fencing or special fire protection measures, if needed.

Table 1B FRASER FIR CHRISTMAS TREES

ANNUAL LABOR AND TRACTOR INPUTS PER 9-ACRE UNIT

IN THE 9TH CALENDAR YEAR AND EACH SUCCEEDING YEAR OF OPERATION

Month	Type of operation	Equipment used	Number of acres treated	Hours required	
				Labor	Tractor and trailer
April and/or May	Plant 2,720 Fraser firs	Haul trees to planting site with tractor and trailer	1	1	1
		Hand plant - spades and buckets		54	
	Spot-treat for weed control with 4G Simazin	By hand	6	30	
	Top-dress with 10-10-10	Haul fertilizer to site with tractor and trailer	5	2	2
		Apply by hand		25	
	Side-dress with ammonium nitrate	Haul fertilizer to site with tractor and trailer	3	2	2
		Apply by hand		13	
	Insect control as needed	Knapsack sprayer, hand operated	-	22	
July	Briar control with 2,4,5-T	Knapsack sprayer, hand operated	1	8	
Aug. or Sept.	Sod control with Amizine	By hand	1	5	
Sept. and/or Oct. and/or Nov.	Shear and shape trees	Pruning shears and snips By hand	6	228	
Nov. and/or early Dec.	Select, harvest and load trees on buyer's truck at farm	Bow saws. Haul trees from field with tractor and trailer.	3	357 73	73
		Hand load			
Totals				820	78

Table 1C

FRASER FIR CHRISTMAS TREES
INPUTS AND RETURNS PER YEAR DURING 7½-YEAR BUILDUP PERIOD
TO A CONTINUOUS OPERATION

		Inputs						Revenues	
Year	Month	Description of operation	Number of acres required	Labor required[5/]	Tractor and trailer: Hours	Tractor and trailer: Total cost[1/]	Cost of materials	Number of trees harvested and sold	Gross receipts
Pre-plant	July	Briar control	1	8			$ 6.00		
		Buy knapsack sprayer[2/]					$ 11.68		
	Aug. or Sept.	Sod control	Same	5			$ 15.00		
Pre-plant	Totals		1	13			$ 32.68		
First planting	April and/or May	Plant treated acre	1				$ 149.60		
		Buy planting spades and buckets[3/]		55	1	$ 1.81			
							$ 3.97		
		Fertilize planted acre	Same	5			$ 17.50		
	July	Briar control on 2nd acre	1	8			$ 11.68		
	Aug. or Sept.	Sod control on 2nd acre	Same	5			$ 15.00		
First planting	Totals		2	73	1	$ 1.81	$ 203.75		
Second planting	April and/or May	Plant treated acre	1	55	1	$ 1.81	$ 149.60		
							$ 3.97		
		Weed control on 2nd year planting	1	5			$ 16.50		
		Fertilize 2 planted acres	Same	10	1	$ 1.81	$ 35.00		
	July	Briar control on 3rd acre	1	8			$ 6.00		
							$ 11.68		
	Aug. or Sept.	Sod control on 3rd acre	Same	5			$ 15.00		
Second planting	Totals		3	83	2	$ 3.62	$ 237.75		

Table 1C (continued)

Year	Month	Description of operation	Inputs: Number of acres required	Inputs: Labor required[5/]	Inputs: Tractor and trailer: Hours	Inputs: Tractor and trailer: Total cost[1/]	Inputs: Cost of materials	Revenues: Number of trees harvested and sold	Revenues: Gross receipts
Third planting	April and/or May	Plant treated acre	1	55	1	$ 1.81	$ 149.60		
							3.97		
		Weed control on 2 planted acres	2	10			$ 33.00		
		Fertilize 3 planted acres	Same	15	1	$ 1.81	$ 52.50		
	July	Briar control on 4th acre	1	8			$ 6.00		
							11.68		
	Aug. or Sept.	Sod control on 4th acre	Same	5			$ 15.00		
	Sept. and/or Oct. and/or Nov.	Shear and shape trees in 3-year-old planting							
		Buy pruning shears and snips[4/]	Same	43			$ 3.73		
Third planting	Totals		4	136	2	$ 3.62	$ 275.48		
Fourth planting	April and/or May	Plant treated acre	1	55	1	$ 1.81	$ 149.60		
		Weed control on 3 planted acres	3	15			3.97		
							$ 49.50		
		Fertilize 4 planted acres	Same	20	2	$ 3.62	$ 70.00		
	July	Briar control on 5th acre	1	8			$ 6.00		
	Aug. or Sept.	Sod control on 5th acre	Same	5			$ 15.00		
	Sept. and/or Oct. and/or Nov.	Shear and shape trees in 3- and 4-year plantings	Same	86			$ 3.73		

Table 1C (continued)

Year	Month	Description of operation	Inputs: Number of acres required	Inputs: Labor required[5/]	Inputs: Tractor and trailer: Hours	Inputs: Tractor and trailer: Total cost[1/]	Inputs: Cost of materials	Revenues: Number of trees harvested and sold	Revenues: Gross receipts
Fourth planting cont.	Totals		5	189	3	$ 5.43	$ 309.48		
Fifth planting	April and/or May	Plant treated acre	1	55	1	$ 1.81	$ 149.60		
							3.97		
		Weed control on 4 planted acres	4	20			$ 66.00		
		Fertilize 5 planted acres	Same	25	2	$ 3.62	$ 87.50		
	July	Briar control on 6th acre	1	8			$ 6.00		
							11.68		
	Aug. or Sept.	Sod control on 6th acre	Same	5			$ 15.00		
	Sept. and/or Oct. and/or Nov.	Shear and shape trees in 3-, 4- and 5-year plantings	Same	131			$ 3.73		
Fifth planting	Totals		6	244	3	$ 5.43	$ 343.48		
Sixth planting	April and/or May	Plant treated acre	1	55	1	$ 1.81	$ 149.60		
							3.97		
		Weed control on 5 planted acres	5	25			$ 82.50		
		Fertilize 6 planted acres	Same	30	3	$ 5.43	$ 107.50		
	July	Briar control on 7th acre	1	8			$ 6.00		
							11.68		

Table 1C (continued)

Year	Month	Description of operation	Inputs: Number of acres required	Inputs: Labor required[5]	Inputs: Tractor and trailer: Hours	Inputs: Tractor and trailer: Total cost[1]	Inputs: Cost of materials	Revenues: Number of trees harvested and sold	Revenues: Gross receipts
Sixth planting cont.	Aug. or Sept.	Soc control on 7th acre	Same	5			$ 15.00		
	Sept. and/or Oct. and/or Nov.	Shear and shape trees in 3-, 4-, 5- and 6-year plantings	Same	176			$ 3.73		
	Nov. and/or early Dec.	Select and harvest in 6th year planting and load trees on buyer's truck at farm.	Same	70	15	$ 27.15	$ 8.97	440	$ 880.00
		Buy bow saws and blades[6]							
Sixth planting	Totals		7	369	19	$ 34.39	$ 388.95	440	$ 880.00
Seventh planting	April and/or May	Plant treated acre	1	55	1	$ 1.81	$ 149.60		
							3.97		
		Weed control on 6 planted acres	6	30			$ 99.00		
		Fertilize 7 planted acres	Same	35	4	$ 7.24	$ 119.50		
		Insect control as needed							
		Buy 2nd knapsack sprayer[2]		22			$ 43.00		
							11.68		
	July	Briar control on 8th acre	1	8			$ 6.00		
							11.68		
	Aug. or Sept.	Sod control on 8th acre	Same	5			$ 15.00		

Table 1C (continued)

Year	Month	Description of operation	Inputs: Number of acres required	Inputs: Labor required 5/	Inputs: Tractor and trailer: Hours	Inputs: Tractor and trailer: Total cost 1/	Inputs: Cost of materials	Revenues: Number of trees harvested and sold	Revenues: Gross receipts
Seventh planting cont.	Sept. and/or Oct. and/or Nov.	Shear and shape trees in 3-, 4-, 5-, 6- and 7-year plantings	Same	211			$ 3.73		
	Nov. and/or early Dec.	Select and harvest trees in 6- and 7-year-old plantings and load on buyer's truck at farm	Same	217	45	$ 81.45	$ 8.97	1,320	$2,640.00
Seventh planting	Totals		8	583	50	$ 90.50	$ 472.13	1,320	$2,640.00
7½ years cumulative totals over buildup period			8	1,577	80	$144.80	$2,263.70	1,760	$3,520.00

1/ Includes operating cost and fixed annual cost prorated per operating hour.
2/ Purchase price = $50.00. Carried at annual owner and operating cost of $11.68.
3/ Purchase price of 2 spades and 2 buckets = $17.00. Carried at annual owner and operating cost of $3.97.
4/ Purchase price of 2 shears and 2 snips = $16.00. Carried at annual owner and operating cost of $3.73.
5/ Does not include driving tractor. Labor time for tractor driving considered equal to tractor operating time.
6/ Purchase price of 2 bow saw frames = $17.00. Purchase price of 2 blades yearly = $5.00. Frames carried at annual owner and operating cost of $3.97.

Table 1C (concluded)

Summary at end of 8th calendar year:

Total gross receipts	=	$3,520.00
Less: Total cost of materials plus ownership and operating cost of equipment and tools	=	2,408.50
Net to labor, capital and management	=	$1,111.50
Total labor plus hours to drive tractor	=	1,657 hours

Table 2A WHITE PINE CHRISTMAS TREES, 7½-YEAR ROTATION*: ESTIMATED COSTS AND RETURNS PER YEAR 8-ACRE UNIT**

Item	Description	Unit	Quantity	Price	Amount
REVENUE					
Yield	Christmas trees averaging 6 feet in height	Tree	1,400	$ 1.50	$2,100.00
TOTAL REVENUE					$2,100.00
VARIABLE EXPENSES					
Planting stock	White pine, 2-0 seedlings	1,000 plants	1.75	$ 6.50	$ 11.38
Briar control	2,4,5-T	lbs. acid	2	$ 3.00	$ 6.00
Sod control	Amizine	lb.	3.5	$ 4.25	$ 14.88
Insect control	Insecticide as needed	--	--	--	$ 43.00
Machine operation	Tractor, 24-40 DBH	hr.	46	$ .60	$ 27.60
	Trailer	hr.	46	$ .10	$ 4.60
TOTAL VARIABLE COSTS					$ 107.46
FIXED EXPENSES					
Equipment	Tractor, 24-40 DBH	hr.	46	$ 1.00	$ 46.00
	Trailer	hr.	46	$ .11	$ 5.06
	2 knapsack sprayers	Annual	Annual	$11.68	$ 23.36
Hand tools	2 KBC planting bars 2 buckets 2 bow saws and blades 2 pruning shears 2 pruning snips	Annual	Annual	$17.14	$ 17.14
TOTAL FIXED COSTS					$ 91.56
TOTAL COSTS					$ 199.02
RETURN TO LABOR, CAPITAL AND MANAGEMENT					$1,900.98

*This budget is for an 8-acre unit in the 8th calendar year of the initial buildup period and each succeeding year of continuous operation. During the buildup period, successive 1-acre units are added annually to the operation over 7½ years. This budget assumes that an intensive level of management will be followed.

**Cleared land in the western Piedmont and mountain counties up to an altitude of about 3600 feet. Fire and livestock must be excluded from white pine plantations. This budget does not include cost of fencing or special fire protection measures, if needed.

Table 2B WHITE PINE CHRISTMAS TREES

ANNUAL LABOR AND TRACTOR INPUTS PER 8-ACRE UNIT

IN THE 8TH CALENDAR YEAR AND EACH SUCCEEDING YEAR OF OPERATION

Month	Type of operation	Equipment used	Number of acres treated	Hours required	
				Labor	Tractor and trailer
March, April or May	Plant 1,750 white pines	Haul trees to planting site with tractor and trailer		1	1
		Hand plant - KBC bars and buckets	1	26	
May or June	Insect control as needed	Knapsack sprayer, hand operated	--	22	
June or July	Shear and shape trees	Pruning shears and snips. By hand	5	117	
July	Briar control with 2,4,5-T	Knapsack sprayer, hand operated	1	8	
Aug. or Sept.	Sod control with Amizine	By hand	1	5	
Nov. and/or early Dec.	Select, harvest and load trees on buyer's truck at farm	Bow saws. Haul trees from field with tractor and trailer.	3	45	45
		Hand load		269	
Totals				493	46

Table 2C

WHITE PINE CHRISTMAS TREES
INPUTS AND RETURNS DURING 6½-YEAR BUILDUP PERIOD
TO A CONTINUOUS OPERATION

			Inputs					Revenues	
					Tractor and trailer				
Year	Month	Description of operation	Number of acres required	Labor required[1]	Hours	Total cost[2]	Cost of materials	Number of trees harvested and sold	Gross receipts
Pre-plant	July	Briar control	1	8			$ 6.00		
		Buy knapsack sprayer[3]					$ 11.68		
	Aug. or Sept.	Sod control	Same	5			$ 14.88		
Pre-plant	Totals		1	13			$ 32.56		
First planting	March, April or May	Plant treated acre					$ 11.38		
		Buy KBC planting bars and buckets[4]	1	26	1	$ 1.81	$ 4.44		
	July	Briar control on 2nd acre	1	8			$ 6.00		
							$ 11.68		
	Aug. or Sept.	Sod control on 2nd acre	Same	5			$ 14.88		
First planting	Totals		2	39	1	$ 1.81	$ 48.38		
Second planting	March, April or May	Plant treated acre	1	26	1	$ 1.81	$ 11.38		
							$ 4.44		
	July	Briar control on 3rd acre	1	8			$ 6.00		
							$ 11.68		
	Aug. or Sept.	Sod control on 3rd acre	Same	5			$ 14.88		
		No treatment on 2-year planting	1						

Table 2C (continued)

Year	Month	Description of operation	Inputs: Number of acres required	Inputs: Labor required[1]	Inputs: Tractor and trailer: Hours	Inputs: Tractor and trailer: Total cost[2]	Inputs: Cost of materials	Revenues: Number of trees harvested and sold	Revenues: Gross receipts
Second planting cont.	Totals		3	39	1	$ 1.81	$ 48.38		
Third planting	March, April or May	Plant treated acre	1	26	1	$ 1.81	$ 11.38		
							$ 4.44		
	June or July	Shear and shape trees on 3-year planting	1	28					
		Buy planting shears and snips[5]					$ 3.73		
	July	Briar control on 4th acre	1	8			$ 6.00		
							$ 11.68		
	Aug. or Sept.	Sod control on 4th acre	Same	5			$ 14.88		
		No treatment on 2-year planting	1						
Third planting	Totals		4	67	1	$ 1.81	$ 52.11		
Fourth planting	March, April or May	Plant treated acre	1	26	1	$ 1.81	$ 11.38		
							$ 4.44		
	June or July	Shear and shape trees on 3-year- and 4-year-old plantings	2	56			$ 3.73		

Table 2C (continued)

Year	Month	Description of operation	Inputs: Number of acres required	Inputs: Labor required[1]	Inputs: Tractor and trailer: Hours	Inputs: Tractor and trailer: Total cost[2]	Inputs: Cost of materials	Revenues: Number of trees harvested and sold	Revenues: Gross receipts
Fourth planting cont.	July	Briar control on 5th acre	1	8			$ 6.00 $ 11.68		
	Aug. or Sept.	Sod control on 5th acre	Same	5			$ 14.88		
		No treatment on 2-year planting	1						
Fourth planting	Totals		5	95	1	$ 1.81	$ 52.11		
Fifth planting	March, April or May	Plant treated acre	1	26	1	$ 1.81	$ 11.38 $ 4.44		
	June or July	Shear and shape trees on 3-, 4- and 5-year-old plantings	3	84			$ 3.73		
	July	Briar control on 6th acre	1	8			$ 6.00 $ 11.68		
	Aug. or Sept.	Sod control on 6th acre	Same	5			$ 14.88		
	Nov. and/or early Dec.	Select and harvest trees in 5-year-old planting and load on buyer's truck at farm.	Same	46	9	$16.29		280	$ 420.00
		Buy bow saws and blades					$ 8.97		
		No treatment on 2-year planting	1						

Table 2C (continued)

Year	Month	Description of operation	Inputs: Number of acres required	Inputs: Labor required[1]	Inputs: Tractor and trailer: Hours	Inputs: Tractor and trailer: Total cost[2]	Inputs: Cost of materials	Revenues: Number of trees harvested and sold	Revenues: Gross receipts
Fifth planting cont.	Totals		6	165	10	$18.10	$ 61.08	280	$ 420.00
Sixth planting	March, April or May	Plant treated acre	1	26	1	$ 1.81	$ 11.38		
							$ 4.44		
	May or June	Insect control where needed		22			$ 43.00		
		Buy 2nd knapsack sprayer[3]					$ 11.68		
	June or July	Shear and shape trees on 3-, 4-, 5- and 6-year-old plantings	4	106			$ 3.73		
	July	Briar control on 7th acre	1	8			$ 6.00		
							$ 11.68		
	Aug. or Sept.	Sod control on 7th acre	Same	5			$ 14.88		
	Nov. and/or early Dec.	Select and harvest trees in 5- and 6-year-old plantings and load on buyer's truck at farm	Same	139	27	$48.87	$ 8.97	840	$1,260.00
		No treatment on 2-year planting	1						
Sixth planting	Totals		7	305	28	$50.68	$115.76	840	$1,260.00
6½ years cumulative totals over buildup period			7	723	42	$76.02	$410.38	1,120	$1,680.00

Table C (concluded)

1/ Does not include driving tractor. Labor time for tractor driving considered equal to tractor operating hours requirement.
2/ Includes operating cost and ownership cost prorated per operating hour.
3/ Purchase price = $50.00. Carried at annual ownership and operating cost of $11.68.
4/ Purchase price of 2 bars and 2 buckets = $19.00. Carried at annual ownership and operating cost of $4.44.
5/ Purchase price of 2 pruning shears and 2 pruning snips = $16.00. Carried at annual ownership and operating cost of $3.73.

Summary at end of 7th calendar year:

Total gross receipts	=	$1,680.00
Less: Total cost of materials plus ownership and operating cost of materials and tools	=	$ 486.40
Net to labor, capital and management	=	$1,193.60
Total labor plus hours to drive tractor	=	765 hours

C O P Y (Mr. Whitfield's Copy)

This letter was mailed out to 1400 landowners so hope we have good turnouts at each of our six meetings. LOOK FORWARD TO SEEING YOU on JAN. 31st little BEFORE 9:00 A.M.

NOTICE - - - TREE GROWERS

As most of you know, beetles in your pines can cause thousands and thousands of dollars in losses.

We have arranged a series of meetings on January 31st. and February 1st. at the following places:

January 31, 1963

Time	Place	Address	
9:00 A.M.	S. A. & S. R. Daniels	Route #2 Clemmons	Hampton (Turn next road West of Roy Pickles).
10:45 A.M.	Marvin Craver & Stamey Craver	Route #8 Lexington	(Meet at Welcome Ready-Mix Cement sign on Welcome-Arcadia Road).
2:00 P.M.	Virgil Parker	Route #3 Lexington	Reeds (on old #64 just before get to Reeds Cross Roads - Dr. Gobble Place).

February 1, 1963

9:00 A.M.	Donald Frank	Route #6 Lexington	Hedrick's Grove (Kepley and Frank's Hardwood Co.).
10:45 A.M.	Jess Taylor	Route #1 Denton	(Turn to right on Loflin Road off #109 Highway, go ½ mile on left.).
2:00 P.M.	Ned Welborn	Route #4 Thomasville	(First house North of Ledford High School).

We will have at the meeting places representatives from the North Carolina Forestry Service, North Carolina Extension Services and others to help landowners with the following:

1. How to recognize or identify the Southern Pine Beetle, IPS Beetle and Turpentine Beetle.
2. What steps landowners should take when beetles are found in their timber and what to do to help prevent attack of beetle.
3. Explain services available from N. C. Forestry Service and other Agricultural Agencies. Explain State Law in regard to infestation of forest trees with insects and diseases.
4. Directions and Spraying with BHC. Question and Answer period.

Please invite your neighbors to attend one of these meetings with you. This notice does not go to all landowners.

Sincerely,

C. E. Bernhardt

C. E. BERNHARDT, COUNTY EXTENSION CHAIRMAN

Bryant Braswell

BRYANT BRASWELL, COUNTY FORESTRY AIDE

NORTH CAROLINA CHRISTMAS TREE GROWERS ASSOCIATION

Summer Meeting
August 23, 1963
PLACE - Burnsville, N. C., in the Community Building located on Robertson Street
TIME - 9:30 A. M., Friday, August 23

Meeting Outline

Friday

Morning

8:30	Board of Directors' meeting
9:30	Start regular meeting - Welcome to county by Mr. Dillingham, county agent
9:35	Business session - Opening remarks by Association president - Russell Beutell
9:40	Secretary and treasurer's report - Raymond Farthing
9:45	Election of three members to Board of Directors
10:00	Discussion of changes in by-laws and constitution--membership to vote on suggested changes - John Lynch, chairman of Temporary Legislative Committee
10:30	Introduction of guest speakers - Fred Whitfield, forest management extension specialist
10:35	Diseases Affecting Evergreen Trees - Dr. Charles Hodges, pathologist, Southeastern Forest Experiment Station
11:20	Morning break
11:30	Insect Problems of Evergreen Trees - Dr. M. H. Farrier, entomologist, North Carolina State College. Dr. Farrier will discuss in detail the insects with which Christmas-tree growers will be most concerned.
12:30	Lunch

Afternoon

1:45	(1) Trip to Mt. Mitchell to observe the damage to Fraser fir by the balsam woolly aphid (2) Trip to Christmas-tree plantations to observe insect and disease damage of Christmas trees
6:00	Supper - restaurant on Mt. Mitchell -- Dutch

Afternoon
cont.

7:00 Board of Directors' meeting - selection of officers for coming year

Saturday

Morning

9:00 Meet at Crossnore drugstore to tour Christmas-tree plantations in Avery County -- Purpose - See work being done in chemical weed control, fertilization, brush control, shearing, and varieties being grown for Christmas trees.

Note 1 - The Saturday tour is set up for those persons interested in seeing what is being done to improve the quality of Christmas trees through improved cultural practices.

Note 2 - For those who plan to stay over for the Saturday meeting, reservations should be made in advance at one of the local motels in Burnsville or at the Nu-Wray Inn located on the square in Burnsville.

1963 FORESTRY WORKSHOPS

Vocational Agriculture Teachers

8:30	Bark Beetles
10:00	Timber stand improvement
11:00	Diseases of forest trees
1:00 - 5:00	Field trip
8:00	Insects of wood in use
9:00	The soil horizons
10:00	Drainage and aeration
11:00	Soil-site quality
1:00	Economics in forest management
2:00 - 5:00	Classroom problem

ALBEMARLE PAPER MANUFACTURING COMPANY
Forestry Staff Soils Seminars

June 12 - 14 and 25 - 27, 1963

First Day

8:30	Soils of North Carolina
9:30	Soil Forming Factors
10:30	
12:00	The Soil Horizon
	Color
	Texture
	Structure
	Consistence
1:30	
5:00	Field trip - Piedmont Soils

Second Day

8:00	Drainage and Aeration
9:00	Soil Reaction and Cation Exchange Capacity - Dr. Davey
10:00	Humus and Microorganisms - Dr. Davey
11:00	Forest Fertilization - Dr. Maki
1:30	Soil Site Quality
2:30	Compound Interest in Forest Management
3:30	Classroom Problem
6:00	

Third Day

8:00	Field trip - Coastal Plain Soils

HIGHER CATEGORIES OF SOIL CLASSIFICATION[1/]

I. ZONAL SOILS

A. Soils of the Cold Zone

1. Tundra

B. Light-colored soils of arid regions

2. Desert soils
3. Red desert soils
4. Sierozem
5. Brown soils
6. Reddish-brown soils

C. Dark-colored soils of semi-arid, subhumid, and humid grasslands

7. Chestnut soils
8. Reddish chestnut soils
9. Chernozem soils
10. Prairie soils
11. Reddish prairie soils

D. Soils of the forest-grassland transition

12. Degraded chernozem
13. Noncalcic brown or shantung brown soils

E. Light-colored podzolized soils of the timbered regions

14. Podzol soils
15. Graywooded, or gray podzolic soils
16. Brown podzolic soils
17. Gray-brown podzolic soils
18. Red-yellow podzolic soils

F. Lateritic soils of forested warm-temperate and tropical regions

19. Reddish-brown lateritic soils
20. Yellowish-brown lateritic soils
21. Laterite soils

1/ J. Thorp & G. D. Smith. Soil Sci. 67:117-126 (1949)

II. INTRAZONAL SOILS

G. Halomorphic (saline and alkali) soils of imperfectly drained arid regions and littoral deposits

22. Solonchak or saline soils
23. Solonetz soils
24. Soloth soil

H. Hydromorphic soils of marshes, swamps, seep areas, and flats

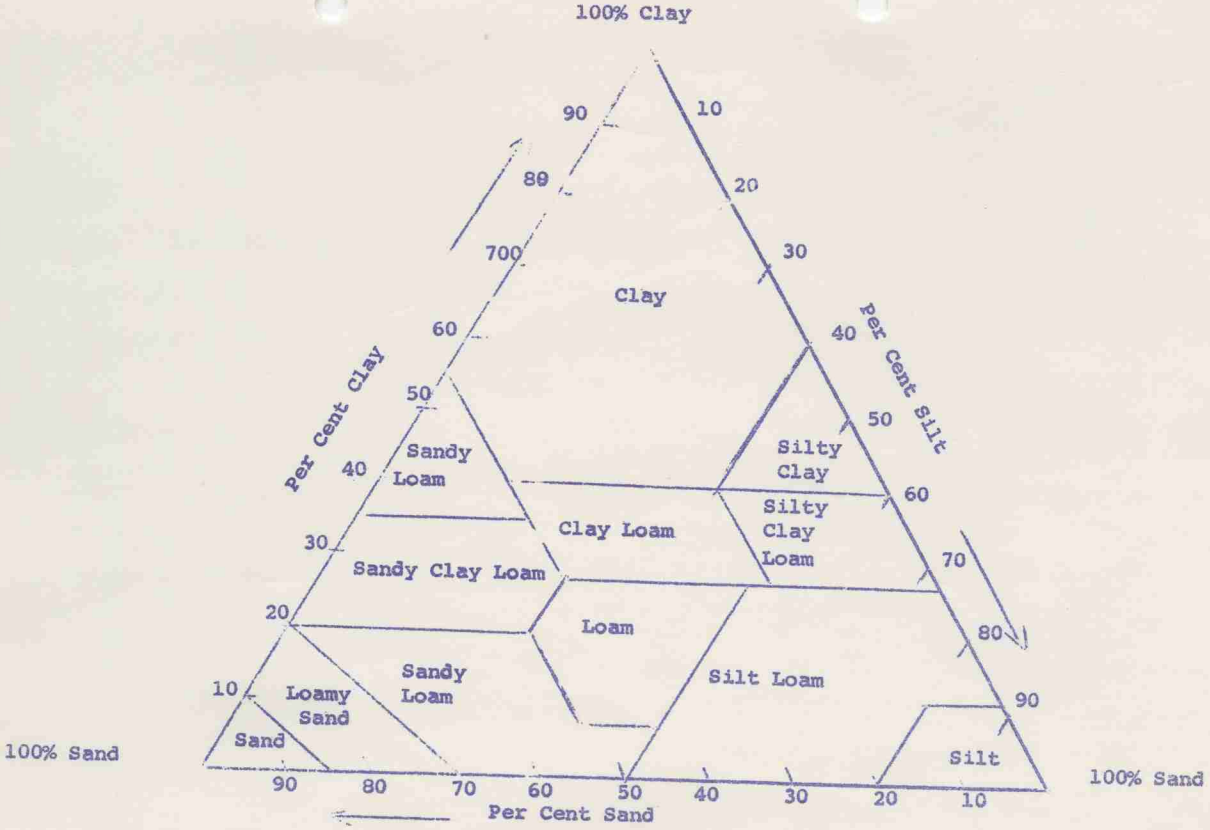
25. Humic - Glei soils (Including Wiesenboden)
26. Alpine meadow soils
27. Bog soils
28. Half-bog soils
29. Low-humic glei soils
30. Planosols
31. Ground-water podzol soils
32. Ground-water laterite soils

I. Calcimorphic soils

33. Brown forest soils (Braunerde)
34. Rendzina soils

III. AZONAL SOILS

35. Lithosols
36. Regosols (includes Dry Sands)
37. Alluvial soils



TEXTURAL CLASSIFICATION OF SOILS - U.S.D.A.

COLLOIDAL SYSTEMS

The world of living organisms has, in fact, been molded largely on a colloidal pattern. It is quite impossible, therefore, to obtain any adequate comprehension of physiological processes without a background of facts and principles regarding colloidal systems.

Some of the most important components of the material environment of plants are essentially colloidal. Most soils contain a considerable proportion of matter in the colloidal or near-colloidal condition, and owe many of their most distinctive properties to this fact.

The most important properties of colloidal systems are a consequence of the small size of their dispersed particles. As the size of the particles becomes smaller, their aggregate surface area becomes greater.

The contact surfaces between colloidal particles and the liquid in which they are dispersed are called interfaces. Interfaces are characteristically the location of the phenomenon called adsorption.

Adsorption refers to the tendency of particles (usually molecules or ions) of a substance to adhere to the surface of certain solids. This term should not be confused with absorption which refers, for example, to the taking up of water by a sponge, or to the penetration of a solid by a liquid or a gas because of the porosity of the solid. Adsorption is largely a surface phenomenon and, consequently, the power of adsorption that a solid possesses depends (1) upon the amount of surface which it exposes to the particles of another substance and (2) its chemical nature.

Since colloidal particles are extremely small particles, they possess very large amounts of surface (for a given weight) and consequently possess extremely great adsorptive powers. The adsorption of ions is responsible, at least in part, for the electrical charge of colloidal particles. Other solids whose particles are larger than colloids also adsorb certain substances, especially certain liquids and gases; but in all of these cases the adsorption increases with the surface of the solid and, therefore, as the size of the particles decreases.

Effect of Progressive Subdivision upon the Surface Exposed by a Given Mass of Material

Length of one edge	Number of cubes	Total surface
1 cm.	1 = 1	6 sq. cm.
1 mm	10^3 = 1,000	60 sq. cm.
0.1 mm	10^6 = 1,000,000	600 sq. cm.
0.01 mm	10^9 = 1,000,000,000	6,000 sq. cm.
0.001 mm (1 micron)	10^{12} = 1,000,000,000,000	6 sq. meters
Colloidal 0.1 micron	10^{15} = 1,000,000,000,000,000	60 sq. meters
range 0.01 "	10^{18} = 1,000,000,000,000,000,000	600 sq. meters
of sizes 0.001 "	10^{21} = 1,000,000,000,000,000,000,000	6,000 sq. meters

1 acre = 4,047 sq. meters

SOIL MOISTURE CHARACTERISTIC CURVES

pF - The logarithmic expression of the height in centimeters of a column of water having a weight equivalent to the force with which water is held at the surfaces of colloidal particles by adhesion.

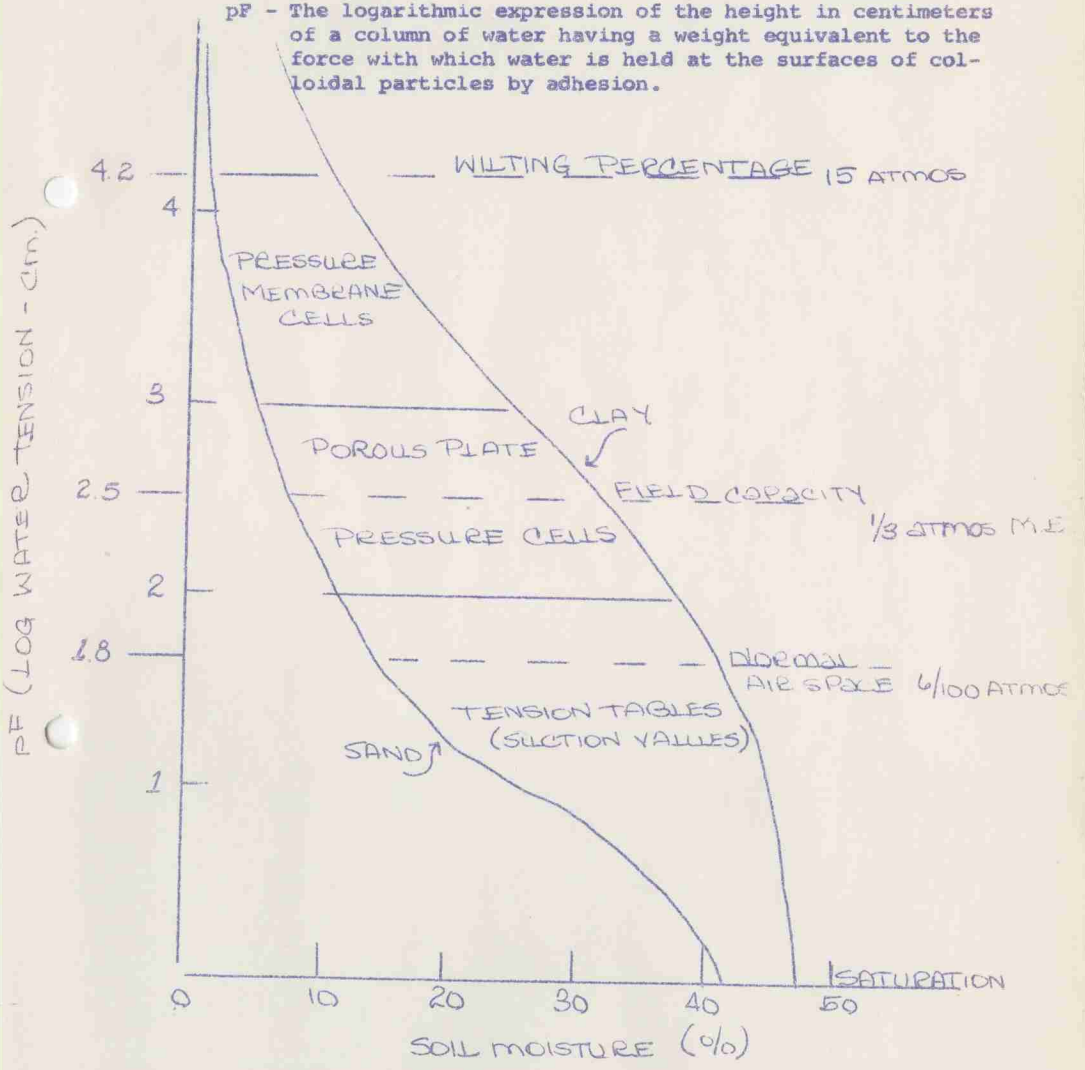


TABLE 1 - INTERRELATIONS OF CONSISTENCE, TEXTURE, AND IMBIBITIONAL WATER VALUES OF PIEDMONT SUBSOILS

Subsoil class	Consistence when moist	Texture	Class range (X_9)	Number of soil samples n	Mean X_9	Standard error of mean
1	Very friable	Loamy sands and sandy loams	0-5	31	3.82	± 0.54
2	Friable	Loams to clays	5-10	270	7.35	± 0.18
3	Semi-plastic	Sandy clay loams to clays	10-15	20	12.00	± 0.67
4	Plastic	Sandy clays to clays	15-20	33	17.00	± 0.52
5	Very plastic	Clays	20-25	34	21.80	± 0.51

TABLE 2 - SITE INDEX VALUES FOR LOBLOLLY AND SHORTLEAF PINES IN THE PIEDMONT PLATEAU AS INFLUENCED BY SOIL

Subsoil class	Subsoil consistence when moist	Species	Depth to subsoil - inches						
			2	4	6	8	10	12	18
			Site index						
1	Very friable	Loblolly	57	79	82	86	88	89	91
		Shortleaf	51	62	66	68	69	70	71
2	Friable	Loblolly	52	74	77	81	83	84	86
		Shortleaf	47	59	62	64	65	66	67
3	Semi-plastic	Loblolly	46	68	71	75	76	77	79
		Shortleaf	43	54	58	60	61	62	63
4	Plastic	Loblolly	38	60	63	68	69	70	72
		Shortleaf	38	49	53	55	56	57	58
5	Very plastic	Loblolly	32	54	57	61	62	64	66
		Shortleaf	33	44	48	50	51	52	53

EXAMPLES OF PREDICTED RETURNS
FROM GROWING FULLY STOCKED CROPS OF LOBLOLLY PINE
ON LAND OF GIVEN PRODUCTIVITY RATINGS

Age at which crop is clearcut	Returns based on yields of natural stands grown without any thinning harvests							
	Site Index 60		Site Index 70		Site Index 80		Site Index 90	
	All trees in pulpwood	Sawtimber and pulpwood	Pulpwood	Sawtimber and pulpwood	Pulpwood	Sawtimber and pulpwood	Pulpwood	Sawtimber and pulpwood
20	$ 65	$	$ 86	$	$109	$	$138	$ 185
30	107		141	224	179	312	223	467
40	135	196	177	315	224	470	278	704
50	155	247	201	406	254	576	314	850
60	169	293	218	478	275	677	338	1005

RETURNS BASED ON PLANTED STANDS
GROWN WITHOUT THINNINGS TO 20 YEARS
OR WITH THINNINGS TO 40 YEARS OR 60 YEARS

Age at which crop is clearcut	Site Index 80				Site Index 90			
	With earnings from thinnings carried to clearcut age at				With earnings from thinnings carried to clearcut age at			
	No interest	3% C.I. 1/	4% C.I.	5% C.I.	No interest	3% C.I.	4% C.I.	5% C.I.
20 yrs.	$ 130	$ 130	$ 130	$ 130	$ 220	$ 220	$ 220	$ 220
40 yrs.	$ 568	$ 599	$ 642	$ 668	$ 747	$ 824	$ 860	$ 903
60 yrs.	$1093	$1388	$1550	$1762	$1296	$1721	$1966	$2295

1/ C.I. - Compound interest.

COMPOUND INTEREST FORMULAS

Type	Formula	Meaning of Symbols
1. End value of an initial sum after a number of years (Davis #1)	$V_n = V_o(1 + r)^n$	V_n = end value n = number of years V_o = initial value r = interest rate in decimals
2. Initial value of an end sum (Davis #2)	$V = \frac{V_n}{(1 + r)^n}$	Same as above
3. Rate of interest earned on an initial sum (Davis #3)	$(1 + r)^n = \frac{V_n}{V_o}$	Same as in #1
4. Amount of interest earned	$R_n = V_o\left[(1 + r)^n - 1\right]$	R_n = amount of interest in dollars. Others as in #1
5. Initial value of perpetual annual payment or annuity. 1'st payment 1 year hence. (Davis #10)	$V_o = \frac{a}{r}$	a = annual payment or annuity. Others as in #1
6. Initial value of perpetual annual payment. 1'st payment now	$V_o = a + \frac{a}{r}$	Same as above
7. Initial value of perpetual annual payment changing in amount annually	$V_o = \frac{a}{r} + \frac{1}{r^2}$	i = annual increase or decrease in payment. Others as above.
8. Initial value at perpetual annual payment. 1'st payment in "m" years	$V_o = \frac{\frac{a}{a + r}}{(1 + r)^m}$	m = number of years preceding 1'st payment. Others as above
9. Initial value of perpetual periodic payment. 1'st payment to come at end of period (Davis #11)	$V_o = \frac{p}{(1 + r)^t - 1}$	p = periodic payment t = years between payments. Others as above

	Type	Formula	Meaning of Symbols
10.	Initial value of perpetual periodic payment. 1'st payment to come now	$V_o = p + \frac{p}{(1+r)^t - 1}$	Same as above
11.	Initial value of perpetual periodic payment to come in m years	$V_o = p + \frac{\frac{p}{(1+r)^t - 1}}{(1+r)^m}$	m = number of years preceding 1'st payment. Others as above
12.	Initial value of terminable series of annual payments (Davis #6)	$V_o = \frac{a\left[(1+r)^n - 1\right]}{r\,(1+r)^n}$	n = number of payments or years. Others as in #6
13.	End value of terminable series of annual payments (Davis #4)	$V_n = \frac{a}{r}\left[(1+r)^n - 1\right]$	Same as above
14.	End value of terminable series of periodic payments. (Davis #8)	$V_n = p\,\frac{(1+r)^{st} - 1}{(1+r)^t - 1}$	s = number of payments p = periodic payment t = interval between payments
15.	Initial value of terminable series of periodic payments (Davis #9)	$V_o = p\,\frac{\left[(1+r)^{st} - 1\right]}{\left[(1+r)^t - 1\right](1+r)^{st}}$	Same as above
16.	Annual payment or annuity required to amount to a specified end value after a number of years. (Sinking fund formula) (Davis #5)	$a = V_n\,\frac{r}{(1+r)^n - 1}$	a = annual payment or annuity required V_n = specified end value Others as above
17.	Annual payment or annuity required to pay off an initial value in a specified number of years. (Installment payment formula) (Davis #7)	$a = V_o\,\frac{r\,(1+r)^n}{(1+r)^n - 1}$	n = number of years specified Others as above

Value of $1 after N Years at Annually Compounded Interest

$(1 + i)^n$

Years	Rate of Interest						
	3%	3½%	4%	4½%	5%	5½%	6%
5	1,159	1.188	1.217	1.246	1.276	1.307	1.338
10	1.344	1.411	1.480	1.553	1.629	1.708	1.791
15	1.558	1.675	1.801	1.935	2.079	2.232	2.397
20	1.806	1.990	2.191	2.412	2.653	2.918	3.207
25	2.094	2.363	2.666	3.005	3.387	3.813	4.292
30	2.427	2.807	3.243	3.745	4.322	4.984	5.743
35	2.814	3.334	3.946	4.667	5.516	6.514	7.686
40	3.262	3.959	4.801	5.816	7.040	8.513	10.286
45	3.782	4.702	5.841	7.248	8.985	11.127	13.765
50	4.384	5.585	7.107	9.033	11.467	14.542	18.420
55	5.082	6.633	8.646	11.26	14.64	19.01	24.65
60	5.892	7.878	10.52	14.03	18.68	24.84	32.99

Present Value of $1 to be Received N Years in Future

$1/(1 + i)^n$

Years	Rate of Interest						
	3%	3½%	4%	4½%	5%	5½%	6%
5	.8626	.8420	.8219	.8026	.7835	.7651	.7473
10	.7441	.7089	.6756	.6439	.6139	.5854	.5584
15	.6419	.5969	.5553	.5167	.4810	.4479	.4173
20	.5537	.5026	.4564	.4146	.3769	.3427	.3118
25	.4776	.4231	.3751	.3327	.2953	.2622	.2330
30	.4120	.3563	.3083	.2670	.2314	.2006	.1741
35	.3554	.3000	.2534	.2143	.1813	.1535	.1301
40	.3066	.2526	.2083	.1719	.1420	.1175	.0972
45	.2644	.2127	.1712	.1380	.1113	.0899	.0727
50	.2281	.1791	.1407	.1107	.0872	.0688	.0543

Value of Initial Amount after N Years at 4% Annually Compounded Interest

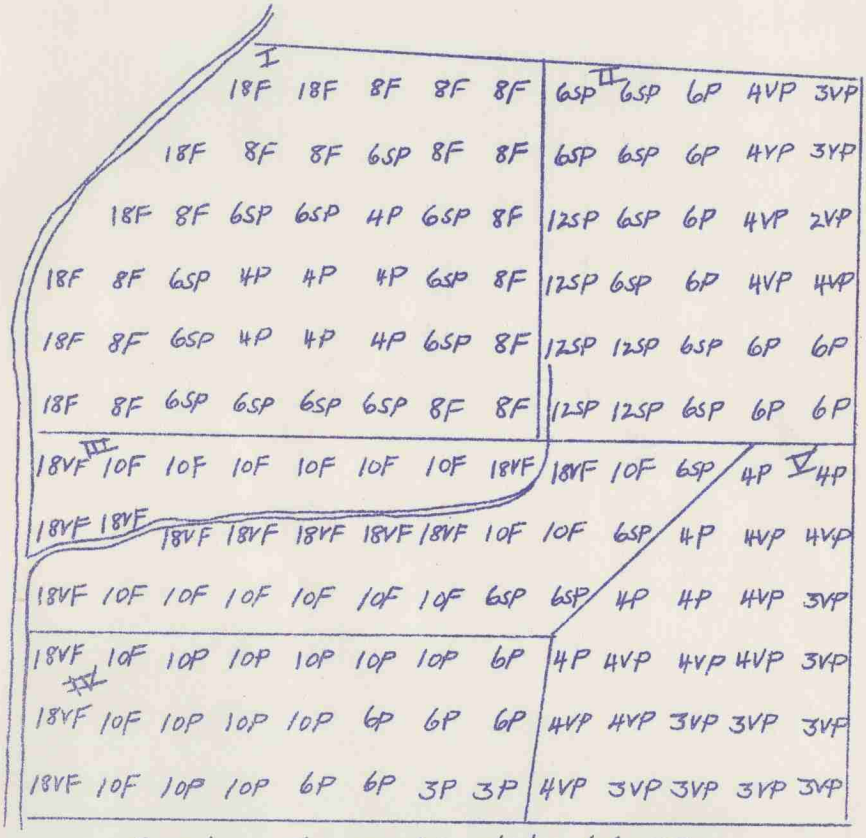
Initial Amount	20 years	30 years	40 years
5	$ 10.96	$ 16.22	$ 24.01
10	21.91	32.43	48.01
15	32.87	48.65	72.02
20	43.82	64.86	96.02
25	54.78	81.08	120.03
30	65.73	97.29	144.03
35	76.69	113.51	168.04
40	87.64	129.72	192.04
45	98.60	145.94	216.05
50	109.55	162.15	240.05
55	120.51	178.39	264.06

Annual expenses @ $1.00 per acre per year
4% annually compounded interest

20 years	$39.78
30 years	56.08
40 years	95.03

Sheet #1

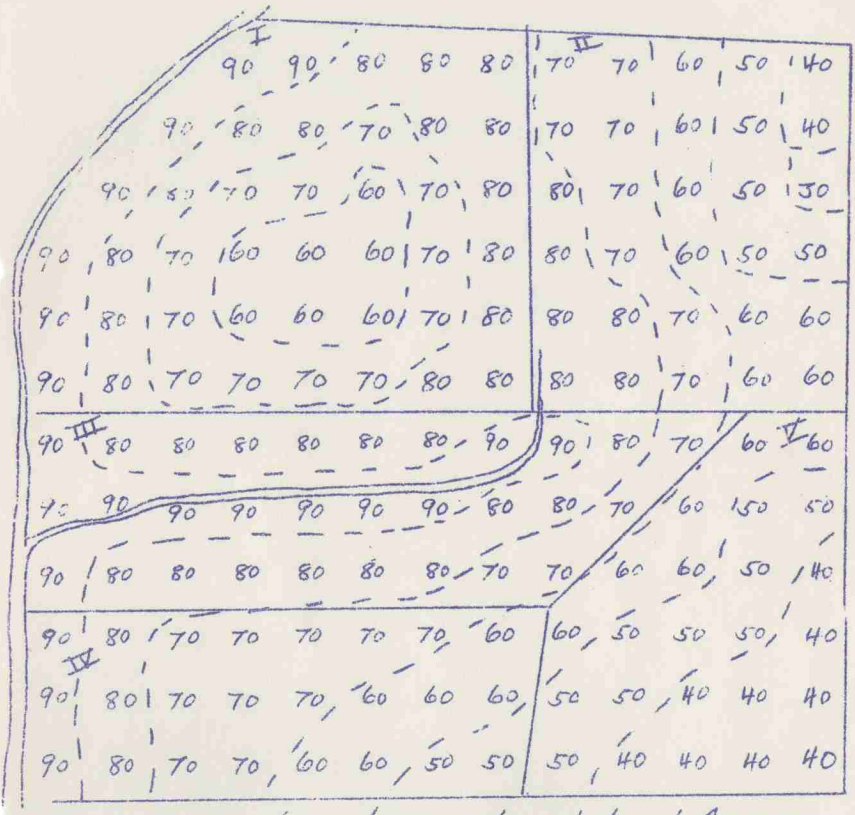
Site Index Survey
I. M. Rich
Richsoil, N.C.



Scale: 1 sample plot = 1 acre

PROBLEM #1: Using thin paper and S.I. table, trace map and convert survey data to S.I. for each sample plot.
Mark areas of similar site index similar to contour lines.

Site Index Map
I. M. Rich Property
Solution to problem #1



scale: 1 sample plot = 1 Acre

Problem #2: Calculate Average S.I. for each area.

PRESENT STAND AND MANAGEMENT NEEDS DATA
I. M. Rich Property

	Present condition	Recommendations	$ cost/ac.
Area I	Fairly good stand cull hardwoods.	Disc with heavy equipment to control brush	
	Up to 18" DBH.	and small hardwoods.	20
	No logs merchantable.	Frill 2,4,5-T hardwoods 4" DBH and	
	No market for hardwood pulpwood.	larger.	5
	Heavy brush.	Plant to loblolly pine.	15
	Needs planting.		
Area II	Similar to Area I but only	Disc all of area.	15
	15 acres need frilling.	Frill 15 acres @ $10/ac.	5
	Needs planting.	Plant all of area.	15
Area III	Old pasture, needs planting.	Disc all of area.	15
	Heavy brush needs discing.	Plant all of area.	15
Area IV	75% stocking loblolly 2 to 3 feet tall. No improvement work needed now. Removal of scattered cull hardwoods by frilling.	Frill hardwoods.	10
Area V	Old pasture. Clumps of brush need mistblower treatment. Needs planting.	Mistblow brush areas at average cost/ac. for entire area $5.	5
		Plant all of area.	15

Problem #2: Calculate average site index for each area.

Sheet #4

Work Sheet for Problem #2
I. M. Rich

	(a) No. samples	(b) S.I.	(a x b)
Area I			
Total (a) & (a x b)			
Area II			
Area III			
Area IV			
Area V			

$$\frac{\text{Total (a x b)}}{\text{Total (a)}} = \text{weighted av. S.I.}$$

Solution to Problem #2
I. M. Rich

	(a) No. Samples	(b) S.I.	(a x b)	
Area I	7	90	630	Total (a x b) = weighted av.
	16	80	1,280	Total (a) S.I.
	12	70	840	
	7	60	420	3170 = 75
Total				42
(a) & (a x b)	42		3,170	
Area II	6	80	480	
	8	70	560	
	8	60	480	1880 = 63
	5	50	250	30
	2	40	80	
	1	30	30	
	30		1,880	
Area III	11	90	990	
	15	80	1,200	2470 = 82
	4	70	280	30
	30		2,470	
Area IV	3	90	270	
	3	80	240	1670 = 70
	10	70	700	24
	6	60	360	
	2	50	100	
	24		1,670	
Area V	6	60	360	
	9	50	450	1170 = 49
	9	40	360	24
	24		1,170	

Sheet #6

COST AND RETURNS ESTIMATE
I. M. Rich

Problem #3: Using present stand data, S.I. table, yield data, and compound interest tables, calculate costs and returns for each area for 40-year rotation on per acre basis.
Annual operating costs $1/ac./yr.
Use return value of $60/ac. for Area V.

	Treatment	$ cost now	$ cost @ 40 yrs.	$ estimated returns	$ difference cost and returns + or -
Area I	Frilling	5	24.01	xx	xx
	Discing	20	96.02	xx	xx
Av. S.I.	Planting	15	72.02	xx	xx
+ 75	Annual operating costs	$1/ac./yr.	95.03	xx	xx
			287.08	392	105

Area II

Av. S.I.
= 63
Use 60

Area III

Av. S.I.
= 82
Use 80
with thinnings at
4%

Area IV

Av. S.I.
= 70

Area V

Av. S.I.
= 49
Use 50
Use given return value

Solution to Problem #3
COST AND RETURNS ESTIMATE
I. M. Rich

Problem #3: Using present stand data, S.I. table, yield data, and compound interest tables, calculate costs and returns for each area for 40-year rotation on per acre basis.
Annual operating costs $1/ac./yr.
Use return value of $60/ac. for Area V.

	Treatment	$ cost now	$ cost @ 40 yrs.	$ estimated returns	$ difference cost and returns + or -
Area I	Frilling	5	24.01	xx	xx
	Discing	20	96.02	xx	xx
Av. S.I. = 75	Planting	15	72.02	xx	xx
	Annual operating costs	$1/ac./yr.	95.03	xx	xx
			287.08	392	105
Area II	Discing	15	72.02	xx	xx
	Frilling	5	24.01	xx	xx
Av. S.I. = 63	Planting	15	72.02	xx	xx
Use 60	Annual operating costs	$1/ac./yr.	95.03	xx	xx
			263.08	196	-67
Area III	Discing	15	72.02	xx	xx
Av. S.I. = 82	Planting	15	72.02	xx	xx
Use 80 with thinnings at 4%	Annual operating costs	$1/ac./yr.	95.03	xx	xx
			239.07	642	403
Area IV	Frilling	10	48.01	xx	xx
Av. S.I. = 70	Annual operating costs	$1/ac./yr.	95.03	xx	xx
			143.04	315	172
Area V	Mistblowing	5	24.01	xx	xx
Av. S.I. = 49	Planting	15	72.02	xx	xx
Use 50 Use given return value	Annual operating costs	$1/ac./yr.	95.03	xx	xx
			191.06	60	-131

LAND VALUE ESTIMATE
I. M. Rich

Problem #4: This land is for sale at a price averaging $50/ac. Is this a sound investment?

If you figure it is not a good investment at $50/ac., how much is it worth?

Assume willingness to accept 4% annual compound interest on land cost.

Area	(a) No. acres	(b) Av. S.I. used	(a x b)	(c) + or - difference costs and returns	(a x c)
I					
II					
III					
IV					
V					
Totals				Net =	

Av. S.I. for tract = $\frac{\text{Sum of (a x b)}}{\text{Sum of (a)}}$ =
Loblolly pine

Av. net per acre = $\frac{\text{Net of (a x c)}}{\text{Sum of (a)}}$ =

Av. net per acre discounted for 40 yrs. = $

Therefore, this land is worth $_____/ac.

Solution to Problem #4
LAND VALUE ESTIMATE
I. M. Rich

Problem #4: This land is for sale at a price averaging $50/ac. Is this a sound investment?

If you figure it is not a good investment at $50/ac., how much is it worth?

Assume willingness to accept 4% annual compound interest on land cost.

Area	(a) No. acres	(b) Av. S.I. used	(a x b)	(c) + or - difference costs and returns	(a x c)
I	42	75	3,150	$ + 105	$ + 4,410
II	30	60	1,800	- 67	- 2,010
III	30	80	2,400	+ 403	+12,090
IV	24	70	1,680	+ 172	+ 4,128
V	24	50	1,200	- 131	- 3,144
Totals	150		10,230		Net = $ 15,474

Av. S.I. for tract = $\frac{\text{Sum of (a x b)}}{\text{Sum of (a)}}$ = 68'
Loblolly pine

Av. net per acre = $\frac{\text{Net of (a x c)}}{\text{Sum of (a)}}$ = approximately $103

Av. net per acre discounted for 40 yrs. = $21.45

Therefore, this land is worth $21.45/ac.

N. C. STATE-INDUSTRY COOPERATIVE HARDWOOD RESEARCH PROGRAM

First Interim Progress Report
January, 1964

INTRODUCTION

The Cooperative Hardwood Research Program at North Carolina State was initiated July 1, 1963 at the suggestion of lumber, pulp and paper, furniture, and veneer industries in the southeast interested in, and dependent upon, hardwood species for at least a portion of their timber needs. Ten companies representing all the above segments of industry support the program through direct financial contributions and indirectly through provision of land, labor and equipment for research studies. North Carolina State contributes financial support and provides both administrative and technical direction of the program.

R. L. McElwee and E. M. Jones serve as director and associate director, respectively. A technical committee whose membership represents allied subject matter fields and organizations doing similar type research provide technical guidance and advice as needed. Members of this committee are:

A. C. Barefoot	W. M. Keller
C. B. Davey	A. Kelman
H. J. Doyle	T. E. Maki
J. W. Duffield	G. Namkoong
E. L. Ellwood	T. O. Perry
M. H. Farrier	R. J. Preston
H. M. Fields	J. A. Putnam
P. C. Guilkey	B. J. Zobel

A second committee, composed of a representative of each cooperator provides overall guidance of the program. It reviews the activities, helps in allocating priority of work, approves the budget, and is the voice of the cooperators in administrative matters.

This first general report of the Cooperative Hardwood Research Program is submitted to participating industries to apprise them of the current status of the work and to suggest areas of investigation which might be of most benefit to participants. Future reports will be submitted as Annual Reports, Interim Progress Reports as they are warranted, and Research Reports or technical papers when useful information in the areas of hardwood management, silviculture, growth and yield, and wood variation become available.

The first task confronting us after inception of the program in July, 1963, was to define those areas where a joint effort in hardwood research could be of value to those taking part. Accordingly, each of the cooperating industries was polled, and their lands visited, to determine what problem areas of hardwood management and utilization were most pressing,what infor- was most needed by each organization, and the scope and intensity of effort which would contribute needed information more efficiently by a joint effort rather than several individual efforts. The subject of this Interim Report is to outline the ideas and information gained from these contacts, along with our suggestions as to how we think the cooperative program can operate to render the most probable solutions to the problems encountered within its scope.

SCOPE

The following premises circumscribing the scope of the program reflect the desires or consensus of the cooperators:

1. Province boundaries- It was decided from the outset to limit work to the Coastal Plain and Piedmont of the southeast. No effort will be made to work on sites or species wholly indigenous to the Appalachian Hardwood or Delta Hardwood regions. Each of the ten cooperators operates lands in the Coastal Plain, Piedmont, or both, and it is problems of these areas which will receive attention. Those organizations which own lands in both areas are

interested for the most part in working on problems of their Coastal Plain sites initially, since they consider these sites to have more growth potential for species of principal interest. Others, operating lands only in the upper Coastal Plain and Piedmont, are keenly aware of the difficulties in trying to grow hardwoods at economic rates from these less productive Piedmont sites. They face perhaps even more baffling puzzles in seeking sound principles of handling hardwood tracts than those operating forest properties in the Coastal Plain.

2. Species- With the varied site conditions represented by the combined holdings of program cooperators, and with the diversified wood requirements dictated by the many product areas represented, there is surprising agreement on species considered to be of greatest economic interest. Prior to our visits, it was thought that a major obstacle to a hardwood program would be lack of agreement on species of major interest; this, however,did not prove to be the case.

In the Coastal Plain the following species appear to be of greatest interest, and will, therefore, receive most emphasis in future studies: sweetgum (Liquidambar styraciflua); tupelo gum (Nyssa aquatica); swamp black gum (Nyssa biflora); cherrybark oak (Quercus falcata var pagodafolia); sycamore (Platanus occidentalis); green ash (Fraxinus pennsylvanica); willow oak (Quercus phellos); and water oak (Quercus nigra).

In the Piedmont, the following species seem to excite the greatest interest: sweetgum (Liquidambar styraciflua); southern red oak (Quercus falcata); willow oak (Quercus phellos); and sycamore (Platanus occidentalis).

Sweetgum, by far, is of most interest to industry in the southeast. The species has the variability which is believed to make it adaptable to a wide variety of sites, has, obviously, a very satisfactory growth rate

on the proper sites, and produces wood having desirable characteristics for veneer, lumber, and pulp. Because of the high regard in which this species is held, its desirability for many products, and the economic importance which it has, this species is one on which much of the current effort will be directed.

The other species listed have economic importance of one degree or another to all the industries represented, but none to the extent of sweetgum. Tupelo gum is a high value tree in the Coastal Plain, being in great demand for veneer and pulpwood. This species produces one of the highest yields per acre of any of our southern hardwoods. It is only the high natural site-selectivity of tupelo which currently makes it of less total economic importance than sweetgum. Similarly, cherrybark oak has a high value for both lumber and furniture stock. This species has perhaps the greatest individual tree growth rate of any of the southern hardwoods, yet its present natural site selectivity has also limited its total economic value to a fraction of that of sweetgum. The other red oaks have their greatest immediate potential for pulpwood. There is currently a high demand for the red oaks in the pulp mills, with indications that this demand will increase in the future.

To summarize species demands of the Coastal Plain and Piedmont hardwoods, sweetgum is the most important species to all segments of the hardwood industry. Following behind and of varying relative importance, depending mainly on product and location, are species of the other soft hardwoods and red oaks.

3. Needs- In the southeast major effort has been expended on seeking and improving methods and means of growing and harvesting crops of coniferous (mainly pine) species and of converting land to pine growth. Until fairly

recently, however, few realized or cared to predict how rapidly hardwoods would become a significant part of the timber economy of the region. But that day has already arrived, and it has become abundantly clear that methods and means of tending hardwood crops also must be developed and formulated. However, before intelligent production of hardwoods can be accomplished many questions need more solid answers than are available now. Some typical examples of questions we face are:

a. Which sites are best suited to production of hardwoods and which should be managed principally for pines? The effort and expense that have gone into conversion of pine-hardwood, and in some instances of pure hardwood sites, to management for pine have frequently been highly successful; but, doubtless, instances have occurred where conversion has been more costly than the pine yields have justified. Now that hardwood management is beginning to appear respectable, it is necessary to define hardwood sites. To make such definition, information is first needed on the relative volume and quality potentials for hardwoods and pine on pine-hardwood sites. What are the major elements in acceptable hardwood production, and what does acceptable hardwood growth mean? What factors determine when hardwood production becomes marginal?

b. What are the relative growth potentials of various desirable hardwoods? Once lands have been classified into pine or hardwood sites, the hardwood sites must be further classified as best for management of certain species or species combinations. For many species, the ecologic amplitudes in a practical sense are not known. How far can these amplitudes be stretched by strong-armed, artificial means? What antagonisms exist among species limiting the flexibility of species mixtures?

c. Will the economics of hardwood timber management allow the degree of intensive management now being practiced in pine? Is all-aged (or all-size) management even in most hardwood types a myth perpetuated only in text-books? Stumpage values for the lower grade hardwoods do not yet approach those of the lower grade pine. If relative values change in favor of the hardwoods, what levels of expenditures for hardwood management are justified, knowing that at least on uplands, physical productivity is sure to be materially lower for hardwoods?

d. With the low-value junk now occupying many hardwood sites, how much physical effort is required for conversion to higher quality stands to insure suitable material for future needs? It is very evident that much potential hardwood land is now unproductive. Costs to convert these areas to thrifty stands of young trees with a high potential value are as high for hardwoods as for pine. If stumpage does not increase for hardwoods, how far can we gamble on conversion now or in the future?

e. What are the wood properties of the various hardwood species which might be put under management? What variations in quality and yield of fiber can be expected among individual trees and stands? Is the internal variation within any one individual of any importance? What are the probable consequences of variation on product quality or fabrication problems?

The above are representative of the types of questions we have encountered in our preliminary contacts with men confronting hardwood management. As you might expect, the pursuit of an answer to any one raises many more questions. The job becomes one not of finding suitable problems on which to work, but of limiting our initial efforts to those on which we are best equipped to help and concentrating our efforts on a few major problems. Some helpful suggestions,

ideas, and answers can be found in existing literature, and more publications are becoming available. We can, and will, attempt interpreting and adapting the findings in current literature to specific problems, but we cannot totally escape the arduous and time-consuming task of conducting tests on specific sites to make sure that prescriptions are effective, or that definitive answers can be secured.

ACCOMPLISHMENTS

A review of activities to date in establishment of the program will set the stage for proposals to be made later in the report. These activities will not be enumerated in detail, but are included to stress the kinds of information which are desired and to indicate the types of projects which currently comprise our major field and laboratory efforts.

1. The land holdings of all cooperators have been visited and hardwood management and utilization problems have been discussed in the field with company personel. This activity will continue and will enable us to become familiar with the lands and problems. Only through such familiarity will we be able to keep the program abreast of needs,to build an adequate frame of reference, and to recommend the best courses of action in hardwood management and utilization based on what is now known or can be quickly indicated by exploratory investigations.

2. Wood samples of four species- tupelo gum, black gum, water oak, and willow oak have been collected from the lands of five companies. Specific gravity determinations are now being made to determine within tree, between tree, between stand, and geographic variation. The same wood specimens will be used to determine variation in fiber length. This work will continue in the future as one of the major efforts. The first information on specific gravity variation will be available within a few months.

3. A study has been installed, in cooperation with the U. S. Forest Service and industry personnel on the lands of Riverside Manufacturing Company and Georgia Pacific Corporation, to determine the effects of changing schedules and levels in the water regime on establishment and growth of hardwood regeneration on overflow lands in the Roanoke River bottoms below Kerr Reservoir. Initial efforts are being made on separating damage attributable to water from that due to extreme browsing pressure from deer, but it is anticipated that this study will throw light on other factors affecting stand establishment and growth of hardwoods.

4. Individual tree and bulk collections have been made of tupelo, sycamore, sweetgum, black gum, willow oak, and water oak seed. These have been processed and stored for use in both direct seeding and nursery studies. Germination tests are being run on the bulk of the collections at the present time.

5. Release studies in stands of tupelo gum, black gum, and mixed hardwoods have been established, initial measurements taken and cuts made, on lands of Williams Furniture Corporation. Similar studies in mixed hardwood and sweetgum stands have been established on Georgia Pacific Corporation lands. Response to release, both in terms of growth and amount of epicormic branching as influenced by degree of release will be assessed and analyzed.

6. A graduate student, Richard Usanis, working under Dr. Duffield and interested in genetics of hardwoods is doing his research on the extent of hybridization between willow oak and water oak. This will be a study of variation within the two species and the hybrid in an effort to determine the extent of crossing between these species. It will also help to clarify the muddy existing picture of bottomland oak taxonomy. Mr. Usanis will be making collections from the lands of several companies.

7. Several hundred publications on all aspects of hardwood management and utilization have been acquired. It is planned to classify this literature by major topics, to annotate or abstract the more significant portions of them, and to make them available to all cooperators so that interested ones may know about, and take advantage of the material available.

8. Study plans have been written for and approved by Williams Furniture Corporation for the following projects to be initiated in 1964:

a. Survey of tupelo and black gum reproduction and growth established after clearcutting: Williams has had annual cutting operations on adjacent areas of the same tupelo and black gum stands for the last several years. Planned surveys of these cut areas will provide information on establishment and growth of reproduction for several successive years after logging, and the success of desired species in competition with unwanted ones.

b. Establishment of Hardwood Arboretum: A small arboretum is planned where commercially important hardwood species, both indigenous and exotic, will be established. Only four plants of each species will be established, so the area is regarded more as a survival trial for the various species than a Research Arboretum.

c. Response of sweetgum to release: this study will resemble those which have been established in mixed hardwoods and tupelo gum. Response of sweetgum growth and epicormic branching will be observed under varying degrees of release.

d. Species-site study: A species-site study incorporating six hardwood and two pine species to be planted in row plots from the wet bottom to the dry ridge is to be established in the Coastal Plain next fall. Objectives are to determine relative growth rates of the various species by site, to

delimit those sites where hardwood production is feasible from those which should be managed for pine, and to gain insight on the feasibility of establishing these species by planting. A similar study is planned in the Piedmont with Riegel Paper Corporation.

9. Only one company, Weyerhaeuser, is planning and developing hardwood seed orchards right now. Grading of select trees of red gum, red maple, yellow poplar, and tupelo is being continued. Grafting of cuttings from selected trees of these species for orchard establishment will be made this spring.

10. Plans are being developed with Riegel for comparing performance and growth of oak and gum species with pine in both drained and undrained portions of the Green Swamp. Additionally, trials will be made to compare the performance and economics of seeding versus planting of the hardwood species on these sites.

A study is also planned to determine response of Piedmont hardwood species and stands to management through release, sanitation cuts, and salvage operations.

11. Plans are nearing completion with Planters Manufacturing Company for studies of response of hardwoods to drainage and response of near-stagnated stands to release.

The drainage studies are to be established in an area which has been subjected to artificial drainage for several years. Information sought includes effects of the water reduction on growth, mortality and the influence of the changed water regime on understory vegetation. Part of the same area which has not been drained will serve as the check area.

The release studies are planned in young stagnated stands of tupelo, black gum, and red maple in and around the Dismal Swamp. After the areas were originally cut, pure stands came back so thick in some areas that they

have virtually stagnated at age 20-25. Attempts will be made to attain satisfactory growth and expression of dominance in the stands through release.

12. Other activities which have been initiated and which will be expanded soon are:

a. dendrometer studies to compare amount and phenology of growth of individual trees of several species in both thinned and unthinned stands, and also in relation to degree and time of flooding.

b. development of nursery and direct seeding techniques.

PROPOSED PROGRAM

You will recall a major objective during the first year of the program was the formulation of a project analysis and proposal of a plan for future efforts of a Hardwood Research Program. We feel that after our discussions with all cooperators in the program, we are in a position to propose this base for future effort.

Projects appear to fall into two categories. First, are those which are of over-all or general concern; they are basic to all cooperators in their management and utilization of hardwoods. Separate facets of each may be tackled on lands of several different cooperators, but ultimately the results can be pooled to provide the necessary answers of wider applicability. At this stage, we propose three studies in this first category:

a. Empirical yield tables and site quality guides for sweetgum. Since sweetgum is the one species in which there is unanimous interest, it appears to warrant concentration of much initial effort. Many organizations want yield information for this species, and also a gauge of its productive potential in relation to pine on a variety of sites. This study would attempt to develop empirical yield tables and site index curves for sweetgum in the

Coastal Plain and in the Piedmont. Sampling for necessary field data would be from sweetgum stands throughout the region in an effort to include all sites and conditions for which stands of suitable extent and density can be found. A working plan for this project is being initiated.

It is anticipated that similar information for other species will be in demand, and work on them will be undertaken when the sweetgum work is completed.

b. Hardwood Regeneration:

This area of inquiry has many ramifications, and quickly leads to difficult ground. As a starter, we propose to concentrate on elementary problems of regeneration.

What are the essential conditions for securing satisfactory natural regeneration of the desired species: What are the initial growth rates in comparison to rates of competing unwanted vegetation? Under what circumstances is seeding or planting justified? What are the principal biologic and climatic hazards to the key species? For several species, additional information is needed on such elementary facets as the phenology of flowering, seed collection techniques, nursery practices, planting methods, direct seeding, etc., before we can prescribe action programs with any degree of confidence. It is axiomatic that seedling or suitable sprouts must first be established before there can be subsequent silviculture applied for improving yields. That is why we are placing much emphasis on regeneration methods as one of our first overall studies, to secure as quickly as possible the information now in great demand in existing operations.

c. Wood Variation Studies.

Most cooperators in the program have a strong interest in the wood properties of their hardwoods, particularly in those characteristics which

influence either yield or quality. One or two cooperators consider wood variation information to be their most pressing hardwood need at this time. For our wood variation studies, we propose to analyze the within tree, between tree, and between geographic area variation in specific gravity and fiber length for sweetgum, tupelo gum, and willow oak. Some work has been started on these and other species, but initially we feel these three species should be concentrated upon because of their importance to cooperators. Rather intensive information will soon be available for sweetgum from work done by Charles Webb in his doctoral program. It is not our intention to duplicate Webb's study, but rather to fill in any gaps or to develop related information of most interest to program participants.

In the second category of projects would be smaller studies of special interest to individual cooperators, several of these were discussed earlier. These would in no sense be pursued less vigorously than those in the first category. We anticipate demands for individual studies of one type or another with all cooperators, in addition to the overall projects already proposed or others on which there is also a consensus.

The general philosophy of the Hardwood Research Program is to remain sufficiently flexible to tackle other important problems as needs arise.

Several related aspects of hardwood culture have not been mentioned, including problems of insect and disease resistance and control, soils and water interrelationships, and the like. Problems in these areas will arise and are expected to prove troublesome, at least under some circumstances; they will be dealt with as they occur. It seems unnecessary at this juncture, however, to expend effort in trying to anticipate what these problems might be, or to cope with probable solutions until their extent and magnitude are better defined.

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