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A 30-Year History of Research on Auburn University's Experiment Forests

ACKNOWLEDGMENT

A major portion of this manuscript reports the research effort that preceded and results obtained following approval January 25, 1954 of Hatch Project 411. The project was revised a number of times and finally terminated June 30, 1974. Project leader 1948 to 1974 was Dr. George I. Garin, professor. Assistant project leader was Knox W. Livingston, assistant professor.

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A 30-YEAR HISTORY OF RESEARCH ON AUBURN UNIVERSITY'S EXPERIMENT FORESTS

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INTRODUCTION

A HISTORICAL and documented statistical report concerning forests of the South was prepared and published by the Southern Forest Resource Analysis Committee in 1969 (1). This report entitled "The South's Third Forest" describes three generations of southern forests as follows: [1] a "First Forest" that existed from 1608 through 1944; [2] a "Second Forest" that occurred from 1945 through 1968; and [3] a "Third Forest" projected from 1969 to 2000.

Depletion of old-growth timber in the mid-1940's marks both the demise of the first forest and the beginning of the second. The first forest provided wood for home construction, fuel, and a host of additional products for several hundred years. At the beginning of the twentieth century, the South's first forest was supplying wood for much of the Nation. Almost half of the country's wood was produced in the South in 1909. When many lumber companies departed the South in search of more timber in the west, a few remained because of strong owner belief in the potential of a new southern forest. As years passed, the number of believers increased. Through perseverance and hard work, and with a combination of favorable conditions, a second forest was created. Southern forest industries began their resurgence with this second forest.

Conditions in Alabama that preceded a serious research effort concerning forest problems reflect why new knowledge was needed. The Twelfth Census Report in 1900 recorded Alabama's forest area as 24,512,000 acres, which has dwindled over three-quarters

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of a century to approximately 21 million acres (72.5% in 1905 and 66% of the total surface area today). Alabama's First Forest contained primarily virgin timber left by Indian culture on land not required for production of life-support crops. An early related use of pine forests by white settlers was for naval stores. While naval stores production was limited to southern and south-central portions of Alabama, it was an important beginning to forest utilization for products other than lumber. Naval stores production as early as 1883 yielded 2,193,000 gallons of turpentine and 56,007,000 pounds of rosin. Alabama's production in 1956 was only 401,346 gallons of turpentine and 11,237,688 pounds of rosin (37). Evidence of a naval stores operation in Autauga County existed on lands acquired by the Alabama Agricultural Experiment Station (AES) and later referred to as the Autauga Experiment Forest.

Timber trade in Alabama had developed by 1860, and by 1869 Alabama ranked 25th in lumber production in the United States. Peak production was 2.2 billion board feet in 1925, when Alabama ranked fifth in the Nation.

The State Legislature approved the first Forestry Act in 1923, marking the beginning of a state forestry program. An action program begun in 1924 included assistance to private landowners and forest fire prevention. The State Land Act passed in 1927 provided for state parks and management of state lands. The number of parks increased from one to 11 during the period 1930–1933. Although the State had provided for a Forestry Commission charged with certain responsibilities, considerable time passed before the legislature appropriated money from the General Fund in 1939 to help finance forestry activities.

The early interest of forest landowners in doing something about their forests surfaced during the period between 1924 and 1939. They wanted their lands protected from wild fires so that the few remaining pine seedlings could grow into merchantable trees. They also made known their desire to have the State make seedlings available that might be used to put idle lands back into forest cover. It was during this period that the Alabama Agricultural Experiment Station, located at Alabama's Land Grant College in Auburn, addressed these same problems and began tests, trials, and experiments with trees. In 1927, the AES produced pine seedlings that were planted on eroded farm land acquired by the Station after abandonment for crop production by private interests. These plantings were successful and the resulting plantations stand today as evidence of very early tests using pine trees for reclamation of abandoned and eroded land, figure 1. In 1926, test plots were established on Station lands to demonstrate the effects of fire on regeneration and growth of pine stands. One-acre plots were established to test effects of no burning, annual burning, and burning at 3- and 5-year intervals. Thousands of people have observed these plots.

Following employment of the first graduate forester (D. J. Weddell) by the AES in 1935, attention was directed to several forestry problems that could be researched by professional personnel. Approved on February 14, 1936 was a project titled "The Effect of a Single Preparatory Burning, Controlled Annual Burning, and Complete Fire Protection on Certain Constituents and Properties of the Soil, and on the Establishment, Survival, and Growth of Slash and Longleaf Pines." This is the first recorded evidence of an active program of forestry research at the University (34). While the first research emphasis concerned fire, only a short time passed until a responsibility also was recognized for research concerning conditions affecting tree growth. On August 18, 1939 another study was approved titled "Affect of Certain Contrasting Forest Situations and Practices in the South on Stands, Growth, Quality, and Value of Forest Products Produced."

The research emphasis placed on fire and conditions affecting tree growth suggested that not all research should be done at one location or on one soil type. This decision led to a search for experimental land areas in soil provinces not represented in the Auburn area.

The first of the Forestry Units, later designated Experiment Forests, was acquired in January 1940. This was the Barbour Experiment Forest near the town of Clayton in Barbour County. It consisted of 180 acres which had been part of the Barbour County "Poor Farm" and was donated to the AES by the County Board of Revenue. This area had previously been cut heavily in 1938 and 1939. The Coosa Experiment Forest, located 10 miles southwest of Alexander City, in Coosa County, was a gift of 160 acres by John Newman in January 1940. Riley Newman, his son, had worked on forestry experiments for the AES as a field assistant. The last Forestry Unit, the Autauga Experiment Forest in Autauga County, was begun in March 1941 when 160 acres were given to

Fig. 1. Gulley on abandoned farm land, Auburn University campus 1926 (AES 1926)

Fig. 2. Same area (as shown in Figure 1) 17 years later after planting to loblolly pine in 1927 (AES 1943)

the AES by Autauga County and the Birmingham Trust and Savings Company; the latter held a mortgage against the Marbury Lumber Company which had logged the tract. The forest is about nine miles north of Prattville. An addition of 140 acres to the Forest in 1943 enlarged the unit to 300 acres.

Approximate location of the three forests, in relation to the main Agricultural Experiment Station at Auburn, is shown in figure 3. By the end of 1943, the AES had acquired three properties,

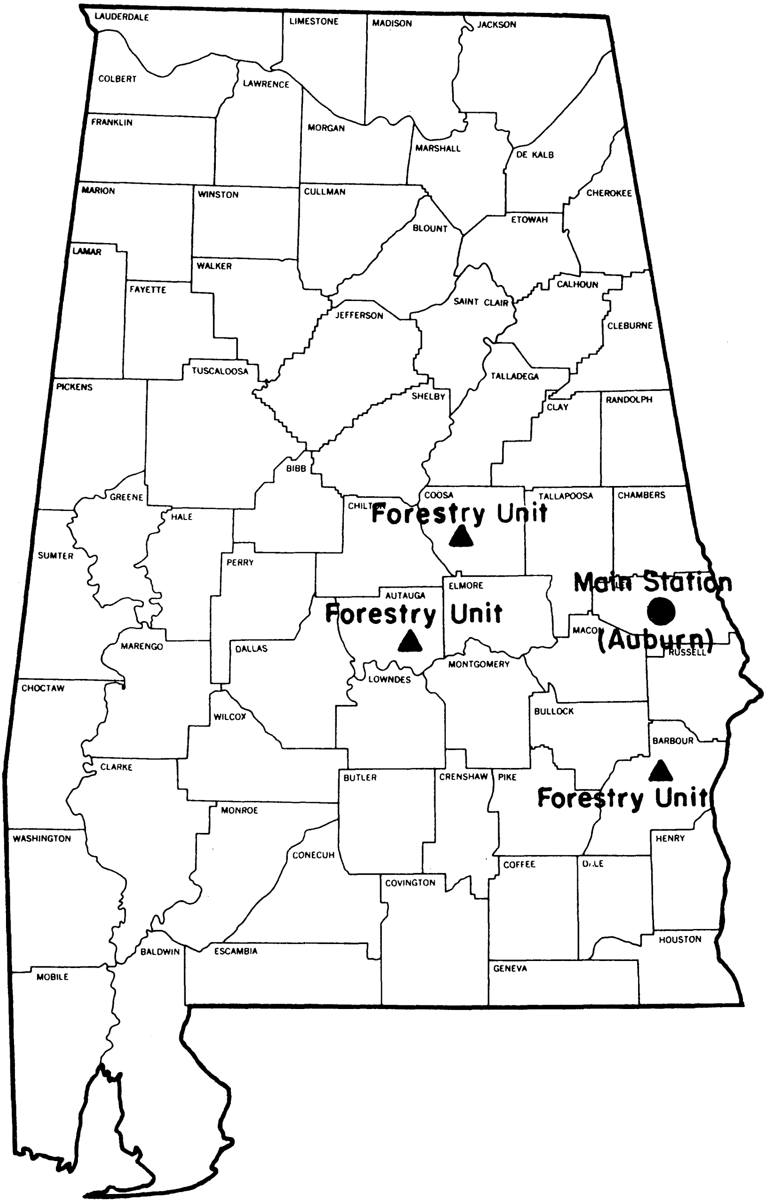

Fig. 3. Relative locations of Forestry Units (Experiment Forests) in relation to main Agricultural Experiment Station, Auburn, Alabama

one each in three counties representing three different soil conditions and totaling 640 acres, the equivalent of one section of land.

Act 294 of the 1945 Alabama Legislature appropriated $25,000 for forestry research by the AES and the same amount to support a new 4-year degree program in forestry at Auburn. This action was the first significant step forward in forestry research in Alabama by a State agency. Although the amount was small, it constituted a real beginning. Three professional foresters were added to the faculty between July 1, and August 30, 1946, which brought to five the number of graduate foresters employed. While these men were hired primarily as teachers in the new academic program, each devoted part time to research. On April 14, 1947, the Office of Experiment Stations, United States Department of Agriculture, approved a new research project titled "Effect of Various Forest Situations and Practices on Soils and on the Growth, Quality, and Value of Forest Products Produced in Alabama." This reconstituted project was a combination of the two projects previously approved in 1936 and 1939, cited in a preceding paragraph. The new research was funded for the first time with Federal research funds under the Bankhead-Jones Act. Appropriated State funds also were budgeted in support of the work. For 1 year, 1947-48, the initial work was supervised by W. R. Boggess and F. F. Smith, both graduate foresters. From 1948–1950 the project leader was the Department Head, T. D. Stevens. Following Stevens' resignation, G. I. Garin became project leader and continued in this capacity until the project was terminated in 1974 after a series of periodic revisions. During the formative years, field experiments were conducted on each of the three Experiment Forests. This work will be documented for each unit in the pages that follow.

AUTAUGA EXPERIMENT FOREST

Autauga County, in which this forest is located, has been described by Carlston (10). Surface drainage is generally southward toward the Alabama River, which bounds the county. Alluvial bottomlands up to 5 miles in width extend northward from the river. The land then grades from mature hills of moderate relief into wide, flat uplands. The Autauga Forest, figure 4, is located on land of low relief characterized by deep Norfolk loamy-sand soils of relatively low fertility. The land originally supported excellent stands of old growth longleaf pine (*Pinus palustris* Mill.). Three successive cuttings by a lumber company removed the best timber.

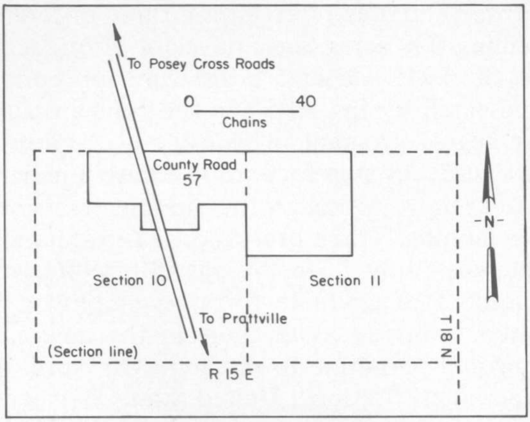

Fig. 4. Survey plat of Autauga Experiment Forest, Autauga County, Alabama

Subsequent cuttings by small sawmill operators eliminated most of the residual trees. Sites not cleared for crops supported rather heavy stands of scrub oaks. A few islands of regeneration occurred adjacent to seed trees, figure 5. The number of sawmills of all sizes in 1939 was reported as 22 for the County (32).

Fuelwood cutting and charcoal burning were both fairly well developed at the time of establishment of the Forest. Charcoal was being produced by individuals and delivered to Montgomery and Prattville. These markets were considered best for wood derived from forest lands, since no other markets existed for small-sized pine trees or low-grade hardwoods.

Fig. 5. Longleaf pine reproduction at time experiment forest was acquired (AES 1942)

Forests in the County burned annually, prior to an unsuccessful attempt to organize a cooperative fire fighting organization by the Autauga County Extension Agent. Cutover lands were also burned and lands abandoned for farming were idle. These conditions suggested that research should attempt to get the land back in production through planting, provided wild fires could be kept out.

Fuelwood Tests

The urgent need for income from forest lands indicated that initial experiments should be designed to utilize low-grade trees left after logging and to develop markets for these materials at the local level. To protect the remains of forest resources, fire lanes were established on property boundaries and along interior land lines. Wood for fuel was the main cash product. Early attempts to sell split stovewood proved unsuccessful. During 1944 round hardwood sold as fuelwood for $6 per cord at the saw. A second source of income from hardwoods removed in preparation for planting was charcoal to fill a local demand. Wood stacked at the site where cut was sold for $3 per cord and converted to charcoal by a local resident. Wood was cut by felling with a crosscut saw and cutting with a cordwood saw powered by a gasoline motor. Returns were compared for wood sold as follows:

1. Stumpage;
2. Trees felled, cut into 4 foot lengths and sold where cut;
3. Trees felled, cut into 4 foot lengths and hauled to a concentration point;
4. Trees felled, cut into stovewood lengths, f.o.b. site;
5. Trees felled, cut into stovewood lengths and delivered to a local market (approximately 9 miles)–Prattville; and
6. Trees felled, cut into stovewood lengths and delivered to customers (approximately 20 miles)–Montgomery.

The rate of return to the producer was highest when wood was delivered to the customer and decreased fairly uniformly from 27 cents per hour to 10 cents per hour when produced in the above forms numbered 2 through 5. Based on an average of 6 cords of fuelwood per acre in the local area, computed gross income to the owner ranged from $1.50 per acre stumpage to $75 per acre when cut to stovewood length and delivered.

Fence Posts

A local need for treated fence posts suggested that this outlet be considered for scrub oak. Four hundred scrub oak posts were treated by the hot and cold bath method using a mixture of 60 percent creosote and 40 percent refined coal tar. The average cost per post for material was 6 cents. Good penetration was obtained only in the sapwood area of each post. Since only a small portion of the cross section of each post was sapwood, service life was unsatisfactory when the posts were put in service in a fence line. Further work on treating oak was discontinued in favor of using the same method for treatment of pine to meet local needs.

Spot Seeding

Second only to the need to produce income from cutover forest lands in Autauga County was the need to get the land back into satisfactory production. Two methods were considered. First, longleaf pine and slash pine (*Pinus elliottii* Englem.) were spot-seeded both in clearings and under residual stands of scrub oaks. Although the seed spots were mulched and fertilized, the experiment was a complete failure due to rodent and bird destruction of the untreated seed. Any further attempt to direct seed these species was discontinued.

Plantation Trials

Planting appeared to be a better method of re-establishing pine stands on the cutover land and on abandoned crop land. Plantations were established each year from 1941 through 1948. Research objectives were: (1) to determine the best species for the site; (2) to compare plantings on land formerly cultivated with land that had supported forest; (3) to determine site capacity for successful plantations. Species planted initially were longleaf pine, slash pine, and loblolly pine (*Pinus taeda* L.). Early plantings were only partially successful because of drought conditions (summer deficit of approximately 12 inches in 1941), the deep sandy soil, and late planting. All plantings were interplanted in successive years. They were unsuccessful and expensive. Longleaf pine was favored over the other species since it was the primary component of the original virgin stand. Most plantings were disappointing because nursery techniques for producing good stock had not been developed and excessive taproot growth made establishment difficult. Survival was low, seldom reaching 45 percent.

The more successful pine plantations yielded thinnings within 20 years from planting. Slash pine, figure 6, planted approximately 100 miles north of its natural range grew rapidly in height and diameter, exceeding longleaf pine during the early years. Loblolly pine, a native species, was the best species for planting. Where survival was good, figure 7, longleaf pine was preferred since its root system could penetrate the deep sandy soil to permanent moisture.

Additional species selected for planting for experimental purposes included Arizona cypress (*Cupressus arizonica* Greene), eastern redcedar (*Juniperus virginiana* L.), and a few honeylocusts (*Gleditsia triacanthos* L.) and cork oaks (*Quercus suber* L.). Final plantings in 1945 included seven species in the numbers indicated occupying 26.9 acres.

Species	*No. Planted*
Slash pine	18,760
Loblolly pine	8,110
Longleaf pine	5,830
Shortleaf pine	1,014
Arizona cypress	600
Eastern redcedar	150
Honeylocust	81
Total	34,545

Fig. 6. Slash pine plantation, 14 years old, after first thinning that removed trees with boles infected with fusiform rust (AES 1959)

Fig. 7. Longleaf pine plantation, 11 years old, demonstrating good survival and early growth on deep sandy soil (AES 1959)

Shortleaf pine (*Pinus echinata* Mill.) was considered an offsite species. Arizona cypress and eastern redcedar were being considered as a cash crop for Christmas trees, while honeylocust was considered as a producer of seed pods high in sugar content that might have value as cattle feed. Based on studies of honeylocust conducted by the Department of Horticulture in cooperation with the Dairy Department at Auburn, pod yields from the Calhoun and Millwood varieties of honeylocust in plantings 5 years old averaged 3,150 pounds per acre. Two-year tests with dairy cows fed ground honeylocust pods as part of the concentrate mixture indicated that pods could be substituted for oats pound for pound. The per acre yield of pods, after grinding was the equivalent of 105 bushels of oats or 56 bushels of corn when reduced to a common feed-value basis (2).

Fertilization Tests

Growing agronomic crops between rows of trees was considered a possible way to increase cash income per acre. Since row crops must be fertilized and cultivated, this cultural practice was used in combination with selected tree species. Corn was interplanted with pine and honeylocust. Three acres planted in 1942 were cultivated three times during the growing season of 1945. With the first cultivation, each tree received one-fourth pound of a 6-8-4 fertilizer. The second cultivation included one-tenth pound of nitrate of soda, while no fertilizer was applied at the time of the third cultivation. Severe tip moth damage was noted but not believed to be associated with treatments. Fertilizer treatments were not considered practical or economical and cultivation between rows disturbed the root systems, damaging trees and causing reduced growth the following season.

The fertilized and cultivated plantations of slash and loblolly pine, figure 8, were included in an experiment to study the incidence of fusiform rust (*Cronartium fusiforme* (A. & K.) Hedge & Hunt ex Cumm.). Results were reported by Westberg (36). Early cankers were not detected in the 1942 plantations until June 1946, but percentages of trees with trunk or branch cankers increased sharply from June 1947 to March 1950. On the check plots, cankered loblolly pines increased from 2 to 30 percent and cankered slash pine increased from 6 to 43 percent. In the cultivated and fertilized plots, cankered loblolly increased from 2 to 32

Fig. 8. Slash pine untreated (left) and loblolly pine cultivated (right) and fertilized, 9 years old (AES 1950)

percent and cankered slash from 11 to 67 percent. Percentages of cankered loblolly were about the same on both the check and treated plots but were considerably greater for slash on the treated plots. Fertilizer increased both volume growth and incidence of fusiform rust, as was later confirmed by Gilmore and Livingston in a later study (22) on slash pine.

Success with planted pines on cutover land and on abandoned agricultural land was reported by Garin (16). The 1942 plantings of longleaf, slash, and loblolly pines on a recently cultivated field, an old abandoned field, and a cleared woodlot indicated that, after 20 years, slash and loblolly pines produced the greatest yield of wood. Survival was a factor with less than 150 longleaf per acre surviving 20 years after planting. All species were planted at a spacing of approximately 6 feet by 6 feet. Loblolly pine survived well under all field conditions. Growth on the cleared woodlot area was 37 percent less than on the recently cultivated field. Slash pine survived well and made good growth. Slash pine growth on the cleared woodlot site was 45 percent of that on the recently cultivated field and 64 percent of loblolly pine volume growth on the cleared woodlot site. Survival of the three species on the three test sites is summarized in table 1. The pulpwood yields in cords per acre over a 20-year period on the three test sites can be compared by information presented in table 2.

TABLE 1. NUMBER OF SURVIVING TREES PER ACRE OF DIFFERENT PINE SPECIES 10 YEARS AND 20 YEARS AFTER PLANTING

Planting Site	Longleaf Age 10	Longleaf Age 20	Loblolly Age 10	Loblolly Age 20	Slash Age 10	Slash Age 20
			Number per Acre			
Recently cultivated field....	141	141	491	376	531	289
Old abandoned field	103	93	575	295	263	206
Cleared woodlot.........	60	60	502	274	238	173

TABLE 2. PULPWOOD YIELD IN CORDS PER ACRE FROM PINE THINNINGS 15 YEARS AFTER PLANTING AND INVENTORY IN CORDS PER ACRE 20 YEARS AFTER PLANTING

Planting Site	Longleaf 15-year thinning	Longleaf 20-year inventory	Loblolly 15-year thinning	Loblolly 20-year inventory	Slash 15-year thinning	Slash 20-year inventory
			Cords per acre			
Recently cultivated field...........	0	16.2	10.6	32.8	7.5	31.6
Old abandoned field ..	0	9.4	6.2	26.9	2.5	22.4
Cleared woodlot.....	0	5.9	3.8	23.8	2.0	15.7

Christmas Tree Comparisons

Early tests by Moore (27), comparing species best adapted for Christmas trees in Alabama, led to the selection of Arizona cypress and eastern redcedar for planting on the Autauga Forest. The Department of Horticulture at Auburn University produced the 1-0 planting stock of both species. Plantings of the two species were established at a 4 feet by 4 feet spacing in 1945. Survival counts in December 1948 showed that 83 percent of the redcedar were living. Arizona cypress survival was 71 percent. The study terminated with final harvest of trees in 1962 as reported by Garin (12). The harvest rates were 79 percent for redcedar and 65 percent for Arizona cypress. The final harvest of Arizona cypress and redcedar at age 17 and 18 provided an opportunity to compare the yield by tree-height classes and age. These figures are summarized in table 3 for Arizona cypress and in table 4 for eastern redcedar.

Tables 3 and 4 reveal that 65 percent of the trees harvested were in the 5- and 6-foot sizes. The 4- and 7-foot trees accounted for 28 percent of the total. Only 6.3 percent of the trees was taller than 7 feet. On the average, eastern redcedar trees, figure 9, were slightly shorter, 5.38 feet, than the Arizona cypress average of 5.58 feet. Because of the more rapid growth of Arizona cypress when compared with the redcedar, 42.3 percent of the Arizona cypress trees were already harvested by the time the first redcedar trees reached crop size. At the peak of production of Arizona cy-

TABLE 3. ARIZONA CYPRESS CHRISTMAS TREES HARVESTED FROM 400 PLANTED SEEDLINGS CLASSIFIED BY HEIGHT

Age at harvest	Classification of trees by height in feet								Total harvested
	4	5	6	7	8	9	10	11	
Year	Number								
4	10	4	6	2					22
5									0
6	2	8	17	4	2				33
7	1	10	10	4	2	1			28
8	2	9	10	4	2	1			28
9	1	8	10	5	2				26
10	1	6	6	3	2	1			19
11	2	13	14	7	4	2			42
12	2	8	10	4	2	1			27
13	1	4	11	2	1	1			20
14			2			1			3
15			2	1			1	2	6
16		3	2					1	6
17		1				1			2
Totals	22	74	100	36	17	9	1	3	262

TABLE 4. EASTERN REDCEDAR CHRISTMAS TREES HARVESTED FROM 250 PLANTED SEEDLINGS CLASSIFIED BY HEIGHTS

Age at harvest	Classification of trees by height in feet								Total harvested
	4	5	6	7	8	9	10	11	
Year					Number				
8	2	7	2	1	1				13
9	1	2	1						4
10		1							1
11	6	16	5	3	1				31
12	6	17	4	3	1				31
13	5	16	4	3	1				29
14	6	5	2	4					17
15	4	13	4	2					23
16	14	10	1					1	26
17	1	3	8	4			1		17
18	1	3	2						6
Totals	46	93	33	20	4	0	1	1	198

press, when 75.4 percent of the trees had been harvested, only 24.7 percent of eastern redcedar trees had been cut. At the age of 13 years, 93.3 percent of the Arizona cypress had been harvested, while only 55.1 percent of the eastern redcedars had grown large enough to be cut.

The Arizona cypress and eastern redcedar trees were shaped by pruning and shearing. The cultural treatments increased the percentage of trees with marketable form at harvest time.

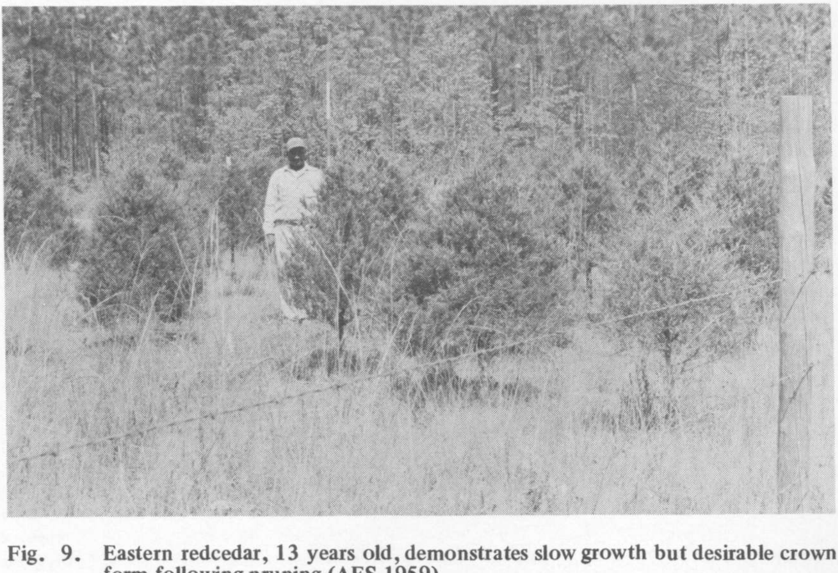

Fig. 9. Eastern redcedar, 13 years old, demonstrates slow growth but desirable crown form following pruning (AES 1959)

TVA Fence Post Study

Representatives of several agricultural experiment stations, land grant colleges, and government agencies expressed an interest in fence post preservation in 1947. The Alabama Station became a cooperator in June 1947 in a study known as the Cooperative Fence Post Preservation Investigation in the Southeast, initiated by the Tennessee Valley Authority. Although the name of the cooperative group was changed in October 1953 to the Cooperative Wood Preservation Council and membership was extended to other agencies and colleges, objectives and standards of the study remained the same. The initial research objective was to treat the posts by established methods, utilizing preservatives at fixed concentrations among all cooperators. Auburn selected three species groups for evaluation–pine, sweetgum, and oak. Reports were made annually by each cooperator to TVA. In later years these reports consisted entirely of service life results. All posts were prepared and treated according to the same standards by all cooperators, although species groups varied from state to state.

Posts were prepared from sound, live trees and were sawed square at both ends. Lengths were limited to either 6 or 7 feet. No split posts were included. Posts were peeled soon after cutting by machine or hand. Following peeling, posts were stacked for air seasoning by species in two diameter classes as measured at the mid-point of the post. The classes were 2.6-4.5 and 4.6-6.0 inches. Posts were dried to a moisture content of 20 percent or less before treatment.

Pentachlorophenol was the first preservative selected. The second preservative used was copper napthenate. Treating solutions were prepared according to a standard plan. The "penta" concentrate of 1:10 was used and was mixed with No. 2 fuel oil at the rate of one gallon of concentrate to ten gallons of oil. The copper napthenate concentrate contained 6 percent or 8 percent metallic copper. The treating solution used contained approximately 0.5 percent metallic copper by weight after mixing 1 gallon of the concentrate with 12 or 16 gallons of fuel oil.

A treating charge consisted of 28 posts of the same species and size class. After treatment, 25 posts were set in the ground for service testing, and three were destructively tested in the laboratory to determine penetration and distribution of the preservative. All treating was accomplished by the cold-soak method with posts immersed for their full length in horizontal tanks of a standard size (2.5 feet deep, 3.0 feet wide, 9.0 feet long). Posts were soaked until 6 pounds of preservative solution per cubic foot of wood was absorbed, or until the rate of absorption indicated that further soaking was impractical.

Service testing of posts began in the spring of 1949 on the Autauga Forest. Species in this phase were all southern yellow pine. Posts were cut from these species and separated into two diameter classes (2.5-4.5 inches and 4.6-6.0 inches). Posts consisting of both diameter classes were divided into three treatment groups. Group I was treated according to plan with "penta" and Group II with 5 percent copper napthenate in fuel oil. Group III remained untreated and served as controls.

All treated posts were found to be sound and serviceable after 1 year. Twelve percent of untreated posts had failed and an additional 52 percent showed evidence of decay. No evidence of insect damage to posts at this location was found.

A 25-year summary of the service life testing of the pine posts installed on the Autauga Unit appears in figure 10. Description of the experiment and the service life of posts was published by Auburn University in 1976 (3).

Administrative Changes

Dr. G. I. Garin was employed by the Department of Forestry on June 15, 1948, and assigned primary responsibility for all experimental work on the Autauga Experiment Forest. The project approved by the Office of Experiment Stations, USDA, on April 14, 1947 included work on this forest unit. Following a period of reconnaissance the 1947 project was revised and in 1954 approved under the revised title "Effect of Various Forest Situations and Practices on the Growth and Value of Forest Products and Returns from Forest Lands in Alabama." It was designated Alabama-411 and supported with Bankhead-Jones and State research funds. This support was continued until 1956 when the Bankhead-Jones fund was replaced with Hatch money.

Forest Management

Early attempts to rehabilitate pine stands that had deteriorated over the years due to heavy cutting, wild fire, and lack of natural regeneration were based on the initial inventory of growing stock made in 1951. Basal area (BA) was less than half that desired in managed stands. Merchantable volumes in cubic feet (Cu. Ft.) and board feet (Bd. Ft.) indicated a need for drastic treatment. The

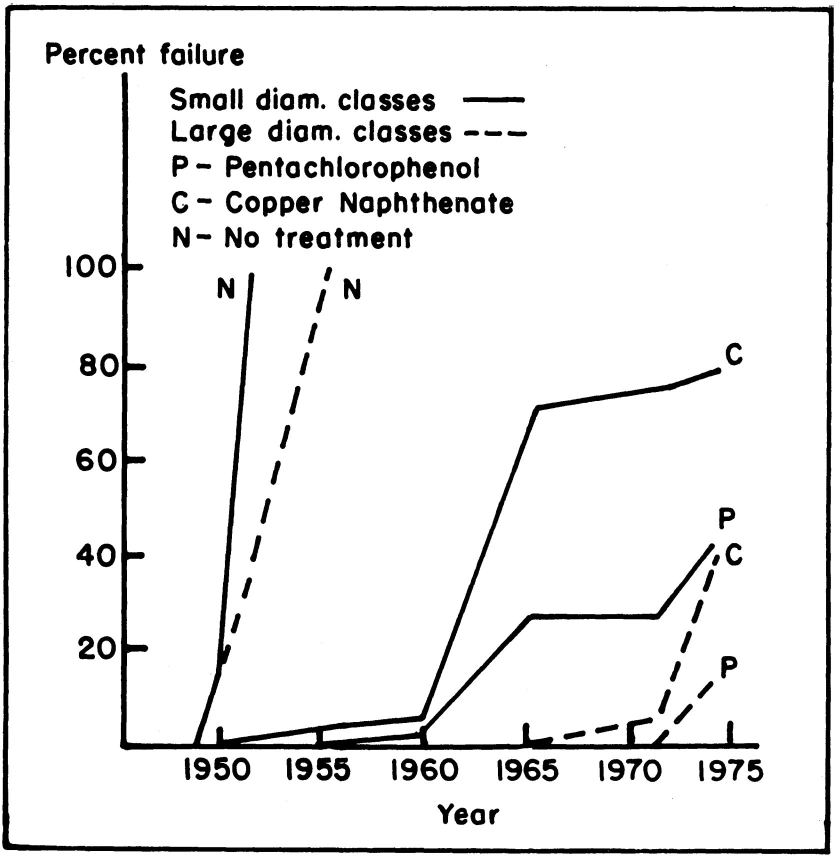

Fig. 10. Twenty-five-year summary of southern pine fence post failure at Autauga Forest (1949–1975)

LEGEND: Small Diameter Classes–Solid Line
Large Diameter Classes–Broken Line
P–Pentachlorophenol
C–Cooper Naphthenate
N–No treatment

Large diameter posts treated with pentachlorophenol and copper napthenate exhibited low failure rates for 22 years. Small posts treated with copper naphthenate showed a high failure rate after 12 years of service.

response of the natural stands without cultural treatments was evaluated at the end of a 5-year period. Comparative figures appear in table 5. Lowest densities and volumes occurred in mixed scrub hardwood - pine stands and the higher values in pine stands interspersed with hardwoods. Basal area, cubic volume, and board foot volume per acre in stands classed primarily as hardwood were lowest. Respectively, the hardwood figures were less than 30 square feet, below 656 cubic feet, and under 708 board feet per acre.

Hardwood Control

Response to silvicultural treatments was slow. A 25-year study on pine sites where longleaf and loblolly pines predominated evaluated volume growth with and without use of silvicides to control the hardwood component, figure 11. On plots not subjected to hardwood control, very little change took place with respect to hardwoods. Mortality and ingrowth of hardwoods were balanced. The study showed that effective control was accomplished by killing the scrub hardwoods with a silvicide (17). The result was conversion of mixed pine and scrub hardwood stands to pine stands. Loblolly pine made the most substantial gains, although it remained second to longleaf pine in number of stems. Though untreated hardwoods did not show a noticeable change in numbers in 25 years, they declined substantially in their position relative to pine.

Tree Improvement

Following a south-wide interest in forest genetics and tree improvement in 1950, the Alabama Station was requested to cooperate in testing a variety of southern pine seed sources. The study, sponsored by the Southern Forest Experiment Station, involved six seed sources of longleaf pine. The planting was estab-

TABLE 5. RANGE IN DENSITY AND VOLUME IN TREES 4" DBH AND LARGER ON A PER ACRE BASIS

Year	Basal area	Volume	
	Square feet	Cubic feet	Board feet
	Old field pine		
1951	4.0 - 40.2	39 - 711	0 - 2,990
1956	22.0 - 55.8	505 - 1,428	1,190 - 4,070
	Natural Pine		
1951	1.7 - 28.8	26 - 522	95 - 2,170
1956	4.1 - 36.6	105 - 1,073	150 - 2,725

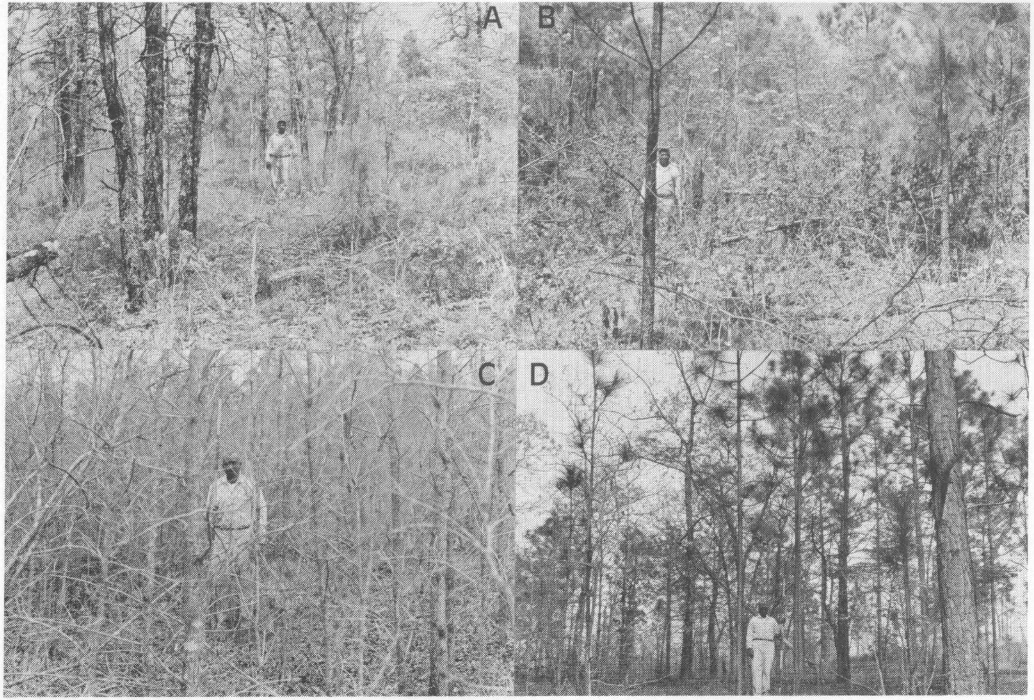

Fig. 11. Rehabilitation of cutover forest lands: (A) Natural regeneration of pine following hardwood control in scrub hardwood stands (AES 1959): (B) Stand of sapling-sized pine released from hardwood competition following chemical application to small hardwood stems (AES 1959): (C) Thicket of hardwood stems after removal of post and firewood with no chemical control of scrub hardwood species: (D) Potential stand of pole-sized pine developed after competing hardwoods were chemically treated (AES 1959).

lished in the spring of 1957 on the Autauga Experiment Forest and measured at 5-year intervals. The designed experiment included 24 plots and occupied approximately 2.4 acres. Results, based on measurements reported to the Forest Service, were published in various USDA series. A similar test of six seed sources of shortleaf pine was established on the forest in the spring of 1953 but not measured since it was not part of the designed study. Eighteen plots, comprising 1.8 acres, constituted the planting. Plots on which official records were kept were established on the Coosa Experiment Forest, to be described later. An unusual loblolly pine seed source, designated the Crossett seed source, was tested on the Unit. Planting in 1956 included 28 plots on approximately 3 acres, and measured every 5 years. This study was discontinued at the end of calendar year 1970 because of lack of interest among cooperators in other states who had established companion studies.

Timber Sales

Although research was the primary objective for the lands within the unit, timber was sold occasionally. From 1941 until 1956 stands of second-growth timber had increased and plantations had grown to merchantable size, justifying a timber sale. Trees marked for sale totaled 195,000 board feet International (1/4-inch) scale. This sale removed all remaining residuals, leaving the land in good condition for future management with adequate stocking established over most of the property.

Project Hatch 411 was revised again in 1962 under the title "Evaluating Forest Practice Alternatives in Natural and Artificial Stands." Records on plantations and natural stands were discontinued on this unit but continued on the Coosa Experiment Forest under this project.

COOSA EXPERIMENT FOREST

The Coosa Experiment Forest was acquired in 1940 as a gift from John Newman. Located in the extreme southeastern part of Coosa County, figure 12, it is a typical example of lands found in this portion of the State.

The early agricultural development of Coosa County required that the settlers remove the virgin forest that completely covered the region to create cropland. Trees growing on ridge crests were principally longleaf and shortleaf pines and on the slopes mainly the same pines in mixture with loblolly pine and hardwoods. Prominent hardwoods were southern red oak (*Quercus falcata*

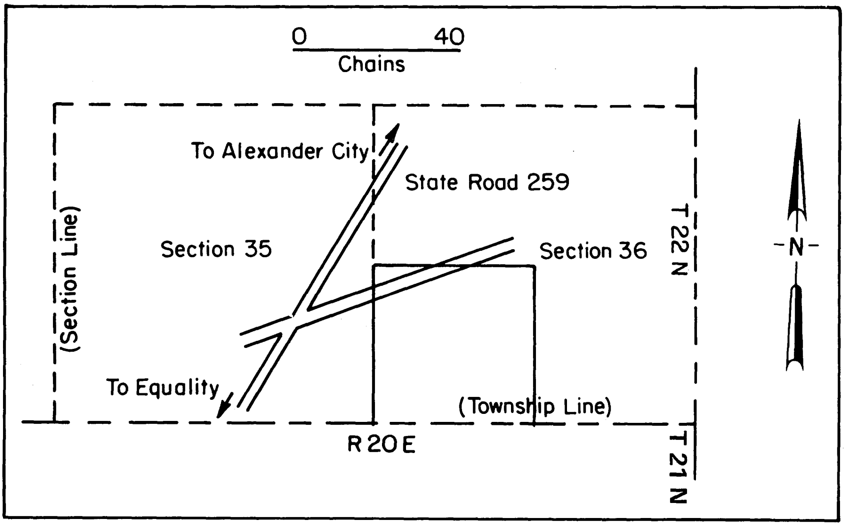

Fig. 12. Survey plat of Coosa Experiment Forest, Coosa County, Alabama

Michx.), white oak (*Quercus alba* L.), and hickory (*Carya spp.*). Poorly drained areas, which occurred along streams and in depressions at stream heads, supported a virgin forest of yellow-poplar (*Liriodendron tulipifera* L.) and sweetgum (*Liquidambar styraciflua* L.) in mixture with lesser species, of which only flowering dogwood (*Cornus florida* L.) had wood of value as shuttle stock for the textile industry.

Rainfall is normally well distributed throughout the year. Those sections of the county having a level to undulating topography and devoted more to agriculture often experience heavy spring rains which delay planting of crops. The early settlers produced crops which supplied them with food as well as material for their clothing. Clearings in the forest were made, and crops such as corn, cotton, sweet potatoes, tobacco, and a little grain were grown. Agriculture declined after 1930. Boll-weevil infestations of cotton along tributaries of the streams that remained after hydroelectric dams were built by the Alabama Power Company caused a progressive phase-out of this crop. Erosion that removed a major portion of the surface soil further depleted the fertility of cropped soils. Farm land, rented on a share basis, became less productive due in part to lack of owner supervision. Terracing was not totally effective; since heavy rains broke the terraces, causing severe gullying and, in some cases, ultimate abandonment of the land for agricultural purposes.

As hilly lands were abandoned, some owners made an effort to prevent annual debris burning in order to allow the take-over of fields by pines that seeded-in naturally and hardwoods that sprouted or that were seeded by rodents.

Soil surveyors predicted in 1929 that lands naturally re-seeding to pines would eventually produce a profitable crop of timber. This concept of the land's potential was to be pursued by the Agricultural Experiment Station when the first experiments with trees were begun on 160 acres of land that had reverted from agricultural uses and from which nearly all of the last remaining merchantable timber had been removed.

The major soil type on the Coosa Unit was classified as Appling sandy loam when the report for the County was published in 1929 (33). The surface layer was low in plant food elements and deficient in organic matter following severe leaching. Although some of these soils supported a mixed forest growth of pine and hardwood, the organic content that may have existed prior to cropping had been lost through cultivation. Surface and internal drainage of the soil were good. Soil surveyors had predicted that the Appling sandy loam was better adapted to forestry uses than to any anticipated future agricultural use.

The invasion of abandoned fields by pines and the regeneration on cutover forest lands made possible a sawmilling economy. By 1940 Coosa County still supported 31 sawmills. Fifteen of these were grouped in the extreme northeastern corner of the county, 12 in the southeastern and central part, and only four in the more mountainous northern and northwestern parts (11). Having a market for forest products encouraged experimental studies with the goal of full productivity and use of idled acres.

The original owner of the Coosa Experiment Forest made an unsuccessful attempt just prior to 1960 to repurchase the 160 acres he had given away in 1940 by approaching the AES through a third party. He had observed that protection from fire had brought back a significant stand of reproduction. With the land more fully stocked, the residual trees that had served as a seed source could be removed. The pulpwood market that had only recently developed locally also made possible the marketing of lower grades of timber and smaller trees removed in thinnings. These potentials were not recognized in 1940 by the owner.

General

The Coosa Unit in its 1940 condition represented a challenge to research-minded people. Open areas suggested that trees should be planted. Understocked forest stands were evaluated with a view toward deriving an income from defective trees by using them for fence posts. Areas of advanced reproduction indicated that thinning would be necessary to stimulate growth to marketable size stems. Little-leaf disease was prevalent in Coosa County and was detrimental to stands of shortleaf pine. Pine growing in openings or in fields abandoned for agriculture for several years, figure 13, produced limbs along the bole that resulted in low-grade lumber caused by the presence of large knots. This conditions suggested that limbs be removed before they reached large diameters. Timbers normally cut from the center of logs derived from the pruned portion of the tree would contain only the smaller knots and yield clear faces. Rapid growth of hardwood stump sprouts that followed the earlier timber harvest would have to be controlled or reduced in number if pine reproduction and planted seedlings were to compete and reach sapling size with their crowns above the hardwood growth. Tests were begun with silvicides that would kill or inhibit growth of competing hardwoods. Existence of a sawmill market stimulated removal of decadent, yet marketable, trees as a step in improving composition of remaining stands. Where quality

Fig. 13. Loblolly-shortleaf pine on old field site showing low-grade (sawlog) boles caused by large limbs (AES 1944)

stems remained from previous logging and were not needed as a seed source, income could be generated through sales to cover costs of improving non-productive acres. Utilization of low-grade hardwood stems for fence posts suggested that methods of fence-post preservation should be researched to determine methods and treatments required to prolong utilization.

Littleleaf Disease Project

Personnel of the Auburn University Agricultural Experiment Station reported in 1934-35 that shortleaf pine was exhibiting foliar symptoms of disease. This prompted a survey by the Division of Forest Pathology, U. S. Department of Agriculture. A report published in 1940 suggested that the symptoms exhibited by shortleaf pine in Alabama represented a disease of unknown origin (30).

In 1941, the Auburn University Agricultural Experiment Station sponsored a survey of the "littleleaf disease" in two selected areas of the State (9). Survey results showed that approximately 42 percent of the cordwood volume in shortleaf pine in 1941 was affected by the disease. In mixed stands of shortleaf and loblolly pine, the disease affected 25 percent of the cordwood volume. In stands of sawtimber size trees, 50 percent of the shortleaf volume exhibited littleleaf symptoms. When this volume was combined with the volume in loblolly pine, the total volume affected by the disease was 28 percent. A similar survey in 1946 revealed that 50 percent of the shortleaf pine cordwood volume was in trees affected by littleleaf. The cordwood volume in shortleaf-loblolly pine affected by littleleaf was 31 percent. Comparable figures for the sawtimber volume affected by littleleaf in shortleaf stands and in shortleaf-loblolly stands combined were 44 and 29 percent respectively (8).

The seriousness of this disease was recognized by researchers at the Alabama Polytechnic Institute (now Auburn University), and a study was initiated on the Coosa Experiment Forest in 1941. Plots were established on which observations could be made, and measurements taken to determine: (1) the spread of the disease into healthy stands; (2) the spread of the disease within stands after all diseased trees were removed; (3) the effect of removing all shortleaf pines from a mixed shortleaf-loblolly stand; and (4) the age at which the disease enters young stands. Plots to study the first objective were located in stands averaging 17 years of age. Plots used for objectives 2 and 3 were located in stands averaging 21–30 years of age. Stands selected for objective 4 averaged 11–20 years of age. Disease symptoms recognized in the study were those described by Hepting and others (24). Trees measured were classified as (1) healthy, (2) with early littleleaf symptoms, (3) with advanced littleleaf symptoms, and (4) dead.

The Bureau of Plant Industry cooperated in the study started by the Auburn Station. Plots were mapped to show topography and fertilizer treatments were applied to compare with plots not fertilized. The fertilization level was 2,000 pounds per acre of 6-8-4 fertilizer applied in March, 1942. Control plots received no treatment.

The littleleaf disease found primarily on shortleaf pine has challenged scientists over the years to find its cause. Three general theories have been advanced. A few consider soil deficiency and past fire history to be correlated with the disease. Most pathologists attribute the disease to a fungus commonly associated with the shortleaf pine roots, which becomes parasitic to the species on soils of low productivity or poor internal drainage.

The Auburn Station study determined that littleleaf disease occurs on trees after 20 years of age. Such trees showing visible symptoms normally die 5–7 years after initial infection, figure 14. While the disease is most common on shortleaf pine, it also occurs on loblolly pine but was not detected on longleaf pine.

Fig. 14. Quality loblolly-shortleaf pine stand on lower slope beginning to show mortality caused by littleleaf disease (AES 1944)

Treating of Fence Posts

The need for posts to fence the Coosa Unit suggested that an effort be made to determine the best method of preservative treatment that would take into consideration ease of application, cost, and ultimate durability of treated posts. Posts were cut on the forest from low-grade sweetgum, peeled and stacked for 60 days to season. Treating methods included the following: (1) hot bath in oil followed by a cold bath in creosote and oil; (2) hot bath in creosote followed by a cold bath in creosote and oil; (3) hot bath in creosote followed by a cold bath in creosote and tar; (4) hot bath in tar followed by a cold bath in creosote and tar; (5) full-length "Osmose" treatment; (6) ground-line "Osmoplastic" treatment; and (7) zinc chloride. Used motor oil was used as a carrier. The number of posts receiving each treatment varied from 10 to 100.

Costs for the treating material varied from 1.5 to 20.0 cents per post. Average material cost of 14 combinations of treatments was 5.9 cents per post. Treated posts were installed in the property fence line in May, 1940. A complete examination of service life of all posts remaining was made in September 1945 and revealed the following:

Treatment	*Percent sound*
Oil bath	4
Creosote bath	92
Creosote and tar	64
Hot bath tar	7
"Osmose"	10
Zinc Chloride	60
None (control)	0

All posts treated at the ground line by the "Osmoplastic" method failed in service prior to the 5-year inspection.

Vegetation Control

Cut-over pine stands had begun reverting to low-grade hardwoods, figure 15, when the unit was acquired by the University. This suggested that some method be developed to use or eliminate low-grade hardwood stems and control stump sprouts. A decision was made during the summer of 1941 to utilize a vegetation control poisoning technique developed by the Southern Forest Experiment Station. An axe developed by Dr. L. J. Pessin (28) of the Southern Forest Experiment Station, and later named the Council tool, was acquired to apply sodium arsenite and sodium chlorate to tree trunks at stump height. The axe and the technique for its use were employed in an experiment designed to determine the number of punch holes required to kill trees of various species and diameters. The Pessin axe was made locally by the Industrial Engineering Department of the University. Additional axes were later purchased from the Council Tool Company. Application of chemical to the trees was as described by Dr. Pessin (29).

The Pessin method was applied to approximately 1,000 trees of the following species: sweetgum, blackgum (*Nyssa sylvatica* Marsh), yellow-poplar, hickory, sourwood (*Oxydendrum arboreum* (L.) DC), winged elm (*Ulmus alta* Michx.), common persimmon (*Diospyros virginiana* L.), white oak, water oak (*Quercus nigra* L.), southern red oak, post oak (*Quercus stellata* Wangenh.), bluejack oak (*Quercus cinerea* Michx.), turkey oak (*Quercus laevis* Walt.), scarlet oak (*Quercus coccinea* Muenchh.), black cherry (*Prunus serotina* Ehrh.), honeylocust, and dogwood.

Diameters of the trees treated ranged from 2 to 24 inches at the stump. Sodium arsenite at the recommended strength (29) was effective in killing approximately 95 percent of the trees treated.

Fig. 15. Low-quality hardwoods occupy good hardwood-pine site prior to removal with a silvicide (AES 1944)

The number of axe holes required varied with tree diameter and ranged from 2 to 12 at the stump height.

Time studies revealed that an average of 3 hours was required with a two-man crew to completely release an acre by poisoning the standing "weed" trees, which ranged between 160 and 280 stems per acre. Sodium arsenite proved effective within 3 days to 2 weeks after application. Wilting of leaves indicated the first stage of effectiveness, with defoliation and death the remaining stages.

Early attempts to eliminate low-grade hardwoods made use of toxic chemicals. These arsenic compounds, toxic to man and livestock, were later replaced by Ammate, 2,4-D and 2,4,5-T in studies to be described later. The ultimate goal in vegetation control was to prepare sites for planting. Pine was planted to bring idle acres back into production following removal of competing hardwoods by poisoning. Final results of early hardwood control work on the Coosa Unit were described by Boggess (4).

Thinning and Pruning

Several acres of old fields occurred on the Coosa Unit when acquired. Loblolly and shortleaf pines had seeded in, but formed an erratic pattern. With ample sunlight and wide spacing, trees grew rapidly and developed large branches that would ultimately produce low-grade lumber. A few residual trees had escaped logging and others had developed over a period of 20 years following abandonment of fields for agricultural purposes.

Researchers decided that stand density would have to be arbitrarily regulated and branches pruned to stimulate stems to develop into usable sawtimber. Three treatments were proposed. On a 1-acre block that was set aside to study crown thinning (thinning from above), trees were removed to an approximate residual spacing of 16 feet by 16 feet, figure 16. Crop trees were pruned to a height of 20 feet. Another 1-acre block was selected for study of low thinning (thinning from below), also to a residual spacing of approximately 16 feet by 16 feet. Low thinning removed all trees with suppressed and intermediate crowns. Crop trees were similarly pruned to a height of 20 feet. A third treatment (no thinning) was established on a one-half acre block for comparison. The thinnings were accomplished in February 1941, and the wood was sold for fuel.

Results of these early experiments were not published by the University. Measurements were turned over to U. S. Forest Service personnel assigned to Auburn as project leaders of a Norris-Doxey project.

Fig. 16. Loblolly pine regeneration released three years prior to photograph in a stand reduced to selected overstory trees at 16' x 16' spacing (AES 1944)

Plantations

Early records of the Coosa Experiment Forest indicate that abandoned fields were planted with various tree species to test growth of both pines and hardwoods in plantations.

Slash pine was planted at spacings of 6 feet by 6 feet, 8 feet by 8 feet, 8 feet by 10 feet, and 10 feet by 10 feet. This species, planted about 100 miles north of its natural range, was to be observed from the standpoint of growth rate and resistance to sleet and snow damage.

Loblolly pine was planted at spacings of 6 feet by 6 feet, 8 feet by 8 feet, and 8 feet by 10 feet while longleaf pine was planted only at a 6 feet by 6 feet spacing.

Black locust (*Robinia pseudoacacia* L.), a legume, was planted because of its potential for fixing soil nitrogen and producing decay-resistant heartwood suitable for fence posts. This species was one of the first hardwoods to be planted for fence post production in Alabama. Ware (35) reported that black locust did not grow as expected on Southern soils and recommended against its further consideration on adverse sites. Although many black locust plantations were established in the Piedmont region of Alabama, few were successful. Goggans and May (23) surveyed the Piedmont region in the area surrounding the Coosa Unit and concluded that the species was unsuccessful because it was planted off-site and did not receive proper care after planting. Further consideration of this species was discontinued.

A few plots were planted to yellow-poplar to test this species on upland Piedmont soils. These plantings were also unsuccessful except on lower slopes where soil moisture was adequate and surface soil had not eroded.

White ash (*Fraxinus americana* L.) was planted as a third potential hardwood on Piedmont soils. Ash plantings were unsuccessful, and only specimen trees remained in 1974 as evidence of the initial planting.

In 1945, a cottonwood (*Populus deltoides* Bartr.) plantation was established utilizing 440 cuttings and 116 seedlings. A field inspection 1 month after planting indicated initial survival to be 73 percent of the cuttings and 93 percent of the seedlings. Only a few specimens reached merchantable size for pulpwood in 20 years. Cottonwood requires a fertile soil with a permanent moisture supply; these conditions do not exist on upland sites in the Alabama Piedmont.

Inventory and Harvesting

In the summer of 1940, all trees 4" in diameter at breast height (d.b.h.) and larger were inventoried by 2-inch diameter classes. Cruise data were incorporated in a forest management plan that scheduled harvesting during the months of November and December, 1944. A local saw operator cut the timber, and sawed it with a portable circular sawmill. The mill, which was located on the property, was operated by 10 employees. Logging was done by 5 men who skidded logs with mules and horses. Lumber was marketed at a concentration yard at nearby Alexander City. The Station received as stumpage 25 percent of the yard price of the lumber. The sale amounted to 98,209 board feet of pine and 56,146 board feet of hardwoods. A study of volumes by log scales and lumber tally for the sale by class of timber appears in table 6. The scale comparisons and lumber yield are reduced to the average log in table 7.

Southern Fusiform Rust

One of the slash pine plantations established in 1940 on an abandoned field at a spacing of 6 feet by 6 feet was selected in 1947 for a study of southern fusiform rust. The purpose of the study was to evaluate tree mortality, incidence and distribution of fusiform rust on tree stems, and the effect of pulpwood thinning

TABLE 6. LOG SCALE – LUMBER YIELD FOR 1944 TIMBER SALE

Species group	Log rule		
	Doyle	Scribner D.C.	Lumber tally
		Board feet	
Pine	1,106	152	1,535
Yellow-poplar	1,033	112	1,100
Gum	1,096	132	1,464

TABLE 7. AVERAGE LOG, LOG-SCALE-YIELD SUMMARY, 1944 TIMBER SALE

Species group	Number of logs	Log Scale		Mill Scale
		Doyle	Scribner D.C.	
		Board feet		
Pine	42	26	3.6	37
Yellow-poplar	9	115	12.5	122
Gum	22	50	6.0	66
Total/average	73	44	5.4	56
Over-run	--	27%	3.5%	---

after removal of diseased trees. The plantation was sampled by means of three permanent plots utilizing 100 sample trees per plot. Initial inspection of the incidence of fusiform rust was made seven years after planting on 300 sample trees. Trees were again examined 11 and 16 years after planting in 1951 and 1956. After 16 years, 72 percent of the trees (215 stems) were still alive and their average diameter was 6.0 inches. Height of dominants was 55 feet and basal area was 172 square feet per acre. At the end of the 16-year period, only 93 trees (31.0 percent of the sample) remained in a healthy state at a density of 375 stems per acre. Infected trees totaled 122 or 40.7 percent, representing a stand density of 492 trees per acre. The 85 remaining trees, (28.3 percent) had died from the disease. In 1947, 1951, and 1956, inspection records listed the standard types of rust infection. Infections were classified according to height above the ground and stem, limb-to-stem or limb cankers. The total percentage of trees with observed symptoms was about the same 11 and 16 years after planting.

Immediately following the 1956 inventory, the plantation was marked for thinning. The thinning removed 38 percent of the basal area, leaving 107 square feet per acre. It also removed 20 trees not infected leaving a residual stand of 295 trees per acre.

Sixty-six infected trees were removed, reducing density in the infected class to 225 stems per acre. The final stand consisted of 43 percent infected trees and 57 percent healthy trees. A summary of the condition of the stand following thinning in 1956 is shown in table 8.

Woodlot Management

Hatch Project 411 was revised in 1957 to include a study involving intensive woodlot management in the Alabama Piedmont. This study was implemented on the Coosa Unit where depleted natural

TABLE 8. NINE-YEAR RECORD OF OBSERVED SYMPTOMS OF INFECTION BY SOUTHERN FUSIFORM RUST ON SLASH PINE PLANTED IN THE ALABAMA PIEDMONT

Type of infection	Location above ground	Trees inspected by year			Results of pulpwood cutting in 1956		
		1947	1951	1956	Trees cut	Trees	Left/acre
	Feet	Number of trees					Percent
A. Multiple infections with at least one stem infection	0-1	11	22	22	16	24	27.3
	1-2	5	13	13	9	16	30.8
	2-4	4	7	7	6	4	14.3
	above 4		8	17	9	32	47.0
Subtotal		20	50	59	40	76	32.2
B. One stem infection only	0-1	5	18	18	9	36	50.0
	1-2		6	6	4	8	33.3
	2-4		2	2	2		
	above 4		5	8	3	20	62.5
Subtotal		5	31	34	18	64	47.1
C. Limb-to-stem infection	0-1	22					
	1-2	10					
	2-4	4					
	above 4	2	3	13	5	32	61.5
Subtotal		38	3	13	5	32	61.5
D. Limb infection only	0-1						
	1-2	4					
	2-4	1					
	above 4		24	16	3	53	81.3
Subtotal		5	24	16	3	53	81.3
E. No infection but infected at subsequent inspections		54	14				
F. Trees apparently healthy		93	93	93	20	295	78.5
TOTAL		215	215	215	86	520	60.0

stands on cut-over sites were a problem. The objective was to utilize silvicides and selective harvesting to modify stand composition of second-growth pine and pine-hardwood stands on irregular topography. An area was selected and divided into ½-acre plots. The treatments were: (1) cut all merchantable hardwood and reserve all merchantable pines over 10 inches d.b.h. for future growth; (2) reserve selected merchantable hardwoods in addition to pines for future growth; and (3) treat with a silvicide (2,4,5-T) all cull trees on one-half of the plots following logging. This made possible an assessment of the effect on future stands of poisoning any remaining live cull trees.

Ten years after the initial inventory of all sample plots, a logging operation was conducted. Five species groups were: pines, yellow-poplar, gums, oaks, and other hardwoods. Trees were grouped by diameter into classes 5–10 inches and 11 inches and larger. The cubic foot volumes in each diameter group by species class immediately after cutting and 10 years later are shown in table 9 (18).

TABLE 9. EFFECTS OF SELECTIVE CUTTING AND CULL TREE CONTROL IN A PIEDMONT PINE-HARDWOOD STAND 10 YEARS AFTER TREATMENT

Post harvest status	DBH class	Species				Other hard-woods
		Pine	Yellow-poplar	Gums	Oaks	
	Inches	Cubic feet				
After cutting 1/	5-10	685	35	130	40	125
	11+	280	35	115	145	20
10 years later 1/	5-10	575	20	140	115	115
	11+	610	70	180	150	10
After cutting 2/	5-10	600	45	115	35	170
	11+	430	95	100	60	110
10 years later 2/	5-10	355	25	130	80	190
	11+	855	165	170	100	135
After cutting and cull tree control 1/	5-10	465	40	100	5	25
	11+	115	100	85	15	---
10 years later 1/	5-10	500	40	120	90	35
	11+	580	135	120	30	---
After cutting and cull tree control 2/	5-10	500	15	125	35	50
	11+	230	30	85	30	---
10 years later 2/	5-10	550	40	130	85	40
	11+	500	40	140	50	20

1/ Selected to leave good merchantable pines but no hardwoods.
2/ Selectively leaving all good trees.

Selective cutting had no effect on the pine component on plots supporting mixed stands. Pines were the dominant component of the original stand, and leaving a few good hardwoods had little effect on the relative predominance of pines ten years after treatment. On all plots, regardless of treatment, smaller pines were either reduced in volume or showed no increase because the residual stand of larger trees offered increasing competition.

Hatch Project 411 was again revised in 1962 under the title "Evaluating Forest Practice Alternatives in Natural and Artifical Stands." Objective 1 was continued on the Coosa Unit. The objective was to evaluate selected silvicultural practices as a means of improving productivity of natural stands on Piedmont soils. This objective was not changed for the duration of the project, which terminated June 30, 1974.

An initial project dealing with woodlot management and reported at the end of the first 10-year period was continued through the 25th year. The experimental area, divided into ½-acre plots, was inventoried. Those plots having 50 percent or more pine stems were classified as pine stands. Plots with pines constituting 25-50 percent were classified as mixed pine-hardwood stands, and those plots where pines constituted less than 25 percent of the stems inventoried were classified as hardwood stands. Silvicides were applied in frills. The results of these treatments, or lack of treatment, on the stands after 25 years are shown in table 10. The number of trees and equivalent basal area are shown for longleaf, loblolly, and other pines, and for scrub hardwoods.

On plots not subjected to hardwood control, mortality and ingrowth of hardwoods were balanced (17); there was little change in the hardwood component. On plots originally classified as pine, the pines showed a considerable increase in 25 years. This was equally true for plots where hardwoods were not treated and the plots treated 15 years later. Pines gained most on plots cleared of hardwoods at the beginning of the 25-year period. On plots with mixed stands at the beginning of the experiment, the pine component increased only moderately where hardwoods were not controlled. Cutting and treating hardwoods with silvicides resulted in a substantial increase in pines, changing the original mixed stands to pine stands. On scrub hardwood plots, pines gained in spite of hardwood competition. Silvicides provided only a small improvement. All scrub hardwood plots became pine-hardwood stands.

TABLE 10. EFFECT OF HARDWOOD TREATMENTS ON STAND COMPOSITION OF A RUNDOWN WOODLOT ON THE UPPER COASTAL PLAIN OF ALABAMA

Initial stand type	Initial hardwood treatment	Hardwood treatment 15 years later	Longleaf pine		Loblolly and other pines		Scrub hardwoods	
			Trees	B.A.1/	Trees	B.A.1/	Trees	B.A.1/
			No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.
Initial stand inventory								
Pine	–	–	19	8.4	5	2.0	48	10.6
Mixed	–	–	18	9.6	2	0.8	89	21.5
Scrub hard-wood	–	–	5	2.4	–	0.2	110	26.6
Stand inventory 25 years later								
Pine	None	None	45	25.5	20	6.5	42	9.7
Pine	Cut	None	80	39.2	6	1.6	7	0.7
Pine	None	Silvicide	47	25.2	19	3.0	6	0.8
Mixed	None	None	30	15.4	9	1.4	90	16.9
Mixed	Cut	None	48	18.8	35	12.4	27	2.8
Mixed	None	Silvicide	46	28.3	33	7.2	12	1.0
Scrub hdwd.	None	None	17	8.2	12	2.3	130	24.0
Scrub hdwd.	Cut	None	19	5.1	6	1.4	52	5.8
Scrub hdwd.	None	Silvicide	22	6.7	28	5.3	6	0.8

1/ Per half-acre plot.

Tree Improvement

The south-wide interest in forest genetics and tree improvement that began in 1951 resulted in establishment of a series of regional seed source plantings.

The Auburn Station joined the south-wide Seed Source Study as a cooperator, and the first planting on the Coosa Unit was established in the spring of 1953.

Six sources of shortleaf pine were planted in a randomized complete block with three replications, comprising 18 plots on approximately 1.8 acres. Measurements have been made on each seed source plantation at 5-year intervals. All data were referred to the Southern Forest Experiment Station, which published the results for the regional cooperators.

TVA Fence Post Study

The Coordinated Fence Post Preservation Investigation in the Southeast, initiated by the Tennessee Valley Authority in 1947, has been described in the section on the Autauga Experiment Forest. Although the name of the study was changed in 1953, objectives remained the same. All of the standards described in the Autauga Forest section of this report apply to the cooperative phase of the study conducted on the Coosa Experiment Forest. The work on the latter unit began in 1948.

Species in the post treatment experiment were shortleaf pine, slash pine, sweetgum, and post oak. Posts were cut from these species and separated into two diameter classes (2.5-4.5 and 4.6-6.0 inches). Posts from each species and size class were separated into two treatment groups. Group I was treated according to project plan by cold soaking in a pentachlorophenol-fuel oil solution. Group II served as controls. Treated posts were set in a forest perimeter fence, and untreated posts were set adjacent to treated posts but not in the fence.

There were 58 untreated pine posts. The 221 treated posts included 56 shortleaf pine, 56 slash pine, 54 post oak, and 55 sweetgum.

Posts were examined 2 years after setting. Approximately 50 percent of the untreated control posts had already failed. They had been attacked by decay fungi and insects, which were responsible for the failures. All remaining untreated posts exhibited signs of deterioration. All treated posts except two sweetgums in the small diameter class were sound and serviceable after 2 years. The two showed evidence of decay alone, and one had failed.

Treated posts in this phase were soaked for 5½ hours in pentachlorophenol. Average retention of the preservative solution was 4.95 pounds per cubic foot. The preservative retention measurements for the failed post and the partially decayed post were higher than average. It was suspected that decay organisms had entered these posts during seasoning.

Twenty-five years of service life inspections of posts installed in the fence line on the Coosa unit are summarized in a published report of cooperative studies with TVA (3). Figure 17 graphically portrays the success and failure of treatments by species for the 25-year period.

1966 Timber Sale

The first timber sale on the Coosa Unit was made in 1944. A second sale was made in 1966 after the unit had been owned by the Station for 26 years. Advertised on the basis of the International (¼-inch) scale, the second sale amounted to 329,806 board feet. Pines made up 60 percent of the volume, yellow-poplar and gums 14 percent each, oaks 8 percent, hickory 3 percent, and miscellaneous hardwoods 1 percent.

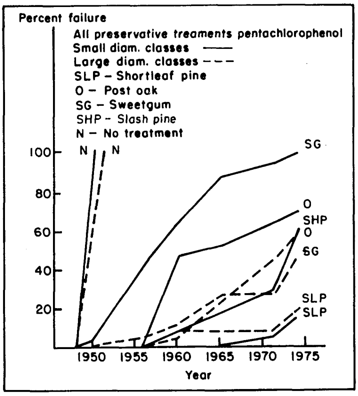

Fig. 17. Twenty-five year summary of fence post failure at Coosa Forest (1948–1975)

LEGEND: All Preservation Treatments Pentachlorophenol
Small Diameter Classes–Solid Line
Large Diameter Classes–Broken Line
SLP–Shortleaf Pine
SHP–Slash Pine
O–Post Oak
SG–Sweetgum
N–No treatment

Penta treated fence posts exhibited low failure rates for 13 years except for small oak and sweetgum posts which showed high failure rates within 10 years.

A comparison of log scales was made based on the timber marked for the sale. Using the International (¼-inch) rule as a standard, the volume advertised would have been 184,691 bd. ft. (56 percent) by Doyle scale or 277,037 bd. ft. (84 percent) by the Scribner rule. The sale area included both natural stands and plantations.

BARBOUR EXPERIMENT FOREST

The Barbour Experiment Forest is located in the west central part of Barbour County, approximately 1¼ miles northeast of Clayton, Alabama, figure 18. It was originally part of the Barbour County "Poor Farm" and was donated to the Experiment Station by the Barbour County Board of Revenue in January 1940. The entire property, consisting of 180 acres, had been heavily cut over in 1938-39. The land in east Alabama surrounding the unit was classified as 47.2 percent productive forest land, 0.1 percent non-productive forest land, 50.1 percent agricultural, and 2.6 percent non-forest by the Southern Forest Survey in 1935 (32). The general area was further classified as being approximately 71 percent in farms. Early settlement of the area was primarily for agriculture. The land had been well preserved from the standpoint of

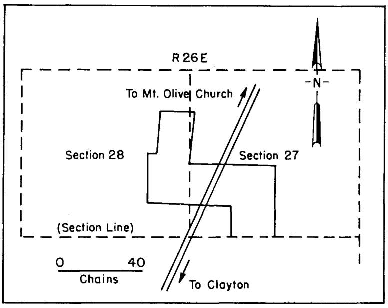

Fig. 18. Survey plat of Barbour Experiment Forest, Barbour County, Alabama

erosion, with only 12 percent of the forest land characterized by sheet, shoestring, or gully erosion. The forested acreage was described as supporting predominantly loblolly pine, with limited areas of shortleaf pine and a variety of hardwoods. In 1935, about one-third of the forest volume was in loblolly pine. The forested acreage had been heavily cut. Only 11.4 percent remained in old-growth timber, which was disappearing rapidly. The cut-over acreage had begun to regenerate naturally; 88.6 percent of the originally forested area supported second-growth pine, generally in understocked stands.

Early attempts to evaluate site quality for loblolly and shortleaf pine indicated that most sites were of fairly low quality. The largest portion of the forested area, 37 percent, had a site index of 80 for loblolly pine (32). Sites supporting shortleaf pine were lower in quality. Thirty-seven percent of these sites were classified as site index 60 and another 37 percent site index 70. Only 3 percent of the sites had a site index of 90 or better for shortleaf pine, while 23 percent had a similar site index for loblolly pine.

The Barbour County area of southeast Alabama was settled early in the nineteenth century when there were no important markets for forest products. Agricultural development was rapid; much of the original forest was sacrificed by cutting and burning to provide crop land. Sawmills were the first markets for timber, and 28 were operating in the county in 1937. Most of the mills were in the vicinity of Clayton and westward from the Barbour Unit. A few were scattered along the Central of Alabama Railroad running west from Eufaula through Clayton westward toward Ozark, in Dale County. In 1937, lumber production in Barbour County was between 20.0 and 29.9 million board feet.

The 1935 Forest Survey described lands in the Barbour County area as low in timber producing capacity and poorly stocked due to the prevalence of cutting followed by fire. Forest lands were further described as supporting only one-third to one-half of their potential growing stock volume.

The first soil survey of Barbour County was made by the Bureau of Soils, U. S. Department of Agriculture, and a map with supporting descriptions was published in 1916 (31). The soil survey showed that most of the Barbour Unit occurred on a Greenville sandy loam. A small portion of the forest, at its northern extremity, occurred on Ruston sandy loam. A small portion of the southeast corner of the property occurred on Ruston gravelly sandy loam. These soil types were identified primarily with forested rather than agricultural lands. Surface soils are gray to grayish-brown. Subsoils are reddish-yellow and moderately friable. All soils in the Ruston series were derived from unconsolidated deposits of the Coastal Plain.

The Barbour Unit lies on the remnants of a southward sloping plain with irregular topography, at an elevation approximately 600 feet above sea level. Mean annual precipitation is approximately 52 inches, occurring mostly in mid-winter and mid-summer.

When the property was acquired, increment borings of residual trees revealed that second-growth stands of pine had become established on land that was cultivated 40 to 45 years earlier. Loblolly, shortleaf, and some longleaf pines had resulted from natural seeding. The initial problem defined for research was to regenerate the forest to pine, figure 19.

Following acquisition, the property was fenced. Posts were treated by the same methods utilized on the Coosa Unit. An access road and fire lines were constructed late in 1940.

Fence Post Treatment

Posts needed for fencing the Barbour Unit were cut from a few overstocked stands on the property. All were pine posts and received four different treatments. The treatments used, the number of posts treated, and the cost per post in 1940 are shown in table 11.

All treated posts were installed in the boundary fence lines of the unit. The condition of each post was examined two and three years after installation. After 3 years, 63 percent of the posts treated with zinc chloride were in good condition. Of the Osmose treated, 97 percent were in good serviceable condition. Only 31 percent of the osmoplastic treated posts (treated at ground line only) were serviceable after 3 years. The hot and cold bath creo-

Fig. 19. Cut-over open stands indicate under utilization of the growing site at time of acquisition (AES 1944)

TABLE 11. TREATMENT SCHEDULE FOR FENCE POSTS BARBOUR EXPERIMENT FOREST

Treatment	Number of posts	Cost per post*
		Dollars
Zinc choloride (10% solution)	185	$ .07
Full length Osmose	239	.06
Ground level osmoplastic	540	.06
Creosote (hot and cold bath)	164	.12

* Exclusive of labor

sote treatment resulted in 92 percent of the posts in good condition. Service life inspections were discontinued after 3 years. Replacement posts, pressure treated with creosote, were used to maintain the property fence line.

Severity of Pruning

A study of the effect of pruning on diameter and height growth of plantation-grown slash pine was begun in the winter of 1940–41. The plantation was 6 years old and was located on an eroded slope recently abandoned from row crop agriculture. Survival was approximately 60 percent at the time the study was begun.

Four degrees of pruning were used. Control trees were not pruned. The second treatment required pruning of all branches to one-fourth of the tree's height. The third treatment consisted of removing branches to one-half of the total height, and treatment 4 extended branch removal to three-fourths of the total height, figure 20.

Treatments were applied to trees on half-acre plots in a randomized block design with three replications. Twenty-five trees on each plot were selected at random for diameter and height measurements. The pruning treatments applied at the beginning of the study were repeated at 2-year intervals thereafter through 1946.

The first measurements in 1942 showed no statistically significant differences in height or diameter growth after two growing seasons. The results of the four treatments on height and diameter growth were reported by Boggess (6). Height and diameter measurements were again compared 3 years after pruning and reported by Boggess *et. al.* (7).

The pruning experiment was terminated in 1946. Comparative results for each treatment by year are shown in table 12.

Fig. 20. Slash pine pruned to a height of 17' with potential of yielding clear lumber free of knots (AES 1959)

TABLE 12. GROWTH OF SLASH PINE AT DIFFERENT PERIODS FOLLOWING DIFFERENT DEGREES OF PRUNING

Height of pruning	Diameter at different periods				Increase 3 years after pruning	
	Original	After 1 year's growth	After 2 years' growth	After 3 years' growth	Diameter	Height
			Inches			Feet
No pruning	1.22	1.97	2.73	3.32	2.10	8.9
One-fourth of height	1.53	2.18	3.00	3.55	2.02	9.4
One-half of height	1.44	2.02	2.68	3.22	1.78	8.1
Three-fourths of height	1.44	1.98	2.60	3.11	1.67	7.5

Height and diameter growth were significantly reduced by pruning to one-half or more of tree height. Pruning to one-fourth of total height had no significant effect, but height growth appeared to increase ½ foot with one-fourth pruning (5).

Pruning Methodology

Following early studies by the AES on pruning of pines, it was found that crop trees can be pruned in one-, two-, or three-step operations. Trees pruned in one-step should have attained a height of 35 feet. Pruning should extend only to the first 17 feet of the bole.

To produce trees with a small knotty core in the first log, it was deemed necessary to begin pruning trees at about four inches d.b.h. The fastest-growing trees should be pruned to a 7-foot height when they reach 15-20 feet in total height. As soon as the trees reach 25 feet, they can be pruned to 12 feet above the ground. When the dominant trees in the stand reach 35 feet in height, a third pruning to 17 feet is recommended.

One operation in the three-step method can be eliminated when initial pruning is delayed until the best trees are 20–25 feet in height, when limbs should be removed to a height of 9½ feet or slightly more. For the second and final step trees should be 35 feet in height as prescribed under the three-step method. Pruning recommendations for slash and loblolly pines are summarized in table 13 (20).

Lumber sawed from mature trees pruned at an early age brought as much as 50 percent more per thousand board feet than lumber cut from unpruned trees, figure 21.

Pine Regeneration

Following the first year of field experimentation on the Bar-

Fig. 21. Unpruned loblolly pine that will yield low grade knotty lumber (AES 1959)

bour Unit, a study of factors affecting establishment of natural pine reproduction was begun since there was no evidence of natural seeding, apparently due to wild fires, figure 22. Experimental plots were established in fall 1941 in a mixed hardwood-pine stand. Loblolly pine was hand-sown at rates of 24,000, 48,000, and 100,000 seeds per acre. The seedbed was treated by removing the duff, by burning, by raking, and by raking and cultivating and compared with no treatment. The first records, which followed the first growing season, showed that duff up to 1½ inches in depth limited establishment of seedlings by reducing the number

TABLE 13. PRUNING RECOMMENDATIONS FOR SLASH AND LOBLOLLY PINES

Pruning method	Pruning height	Length of saw handle	Size of best trees in a young stand	
			Height	D.b.h.
		Feet		Inches
Three-step	1- 7	½ 1/	15-20	3-4
	7-12	7	25-30	4-5
	12-17	13	35-40	5-8
Two-step	1- 9½	2½ 2/	20-25	3-5
	9½-17	13	35-40	5-8

1/ Handgrip type
2/ Meylan saw

Fig. 22. Natural stand of loblolly-shortleaf pine that shows inadequate reproduction with adequate seed source and evidence of fire (AES 1949)

of seeds reaching mineral soil. Light burning did not remove sufficient duff to enhance seedbed conditions. All treatments that created a mineral soil seedbed resulted in germination. The seeding rate of 100,000 per acre proved insufficient to ensure establishment of 1,000 seedlings per acre on exposed mineral soil at the end of the first year. Failure to establish an adequate stand of reproduction, even at this high rate of seeding, was attributed to drought during the growing season; failure of seed to germinate; destruction of seed and seedlings immediately after germination by birds; biological factors, such as insect and disease attack; mechanical injury by man and animals; and the mechanical effects of raindrops (26).

Burning Effects

The need for information on fire behavior in the forest was demonstrated by the disastrous effects of wildfires in the County prior to 1940, when the Barbour Unit was established. The first experiment designed to study effects of fire was begun in 1941. Four acres of second-growth forest where stocking was light were selected for this study. Pine seed trees averaged nine per acre, figure 23.

Fig. 23. Natural stand of loblolly-shortleaf pine burned at 3-year intervals shows lack of seedling development in the understory (AES 1959)

Eight ½-acre plots were established in two blocks and four treatments were assigned to the plots in each block. One treatment was annual burning with a headfire intended to simulate wildfire. The second treatment was annual burning with fire set toward the end of the day in winter (cool fire). The third treatment was cool fire every third year. The fourth treatment was complete protection from fire.

Pine regeneration was tallied before the fires were set. Seedling density prior to burning in three representative years is shown in table 14.

Seedlings surviving the first fire were killed by subsequent fires. On plots burned annually, only a few seedlings ever reached the height of more than 2 feet (20). Burning at 3-year intervals was less destructive to seedlings. On plots protected from fire, new seedlings appeared in substantial numbers. Seedlings escaping fire developed into saplings and, ultimately into pole-sized trees, figure 24. Fire proved a useful silvicultural tool in preparing the seedbed for natural regeneration.

Effect of fire treatments on growth indicated that trees on plots burned every 3 years increased in size and contributed significantly to the total volume per acre on the plot 23 years after the

Fig. 24. Pole-sized trees in a loblolly-shortleaf pine stand with advanced reproduction established in the absence of fire (AES 1959)

TABLE 14. PER ACRE STOCKING OF PINE SEEDLINGS IN LATE WINTER BEFORE FIRES WERE SET IN SELECTED YEARS

Height	Year	Annual hot (wild) fire	Annual cool fire	Cool fire every 3rd year	No fire
Feet		Number			
0 - ½	1944	868	1,027	27	2,500
	1948	10,308	12,208	5,358	6,708
	1959	207	285	420	75
½ - 2	1944	68	106	0	43
	1948	546	436	7,720	6,167
	1959	375	85	280	470
2 - 4½	1944	20	18	13	117
	1948	16	11	126	188
	1959	15	0	1,200	1,195

study was begun (21). Cool (winter) fires did not reduce tree growth. Plots not burned displayed the same progression of small trees into larger size classes. Cool winter fires did not affect growth of trees above 4 inches d.b.h. (15). The density of trees increased on unburned plots from 70 to 277 per acre. After 23 years of fire exclusion, the protected area had become adequately stocked with small trees. Fires limited stocking by killing seedlings established just prior to burning. The density and sawtimber volume per acre in trees of two diameter groups are shown in table 15.

Clearcutting in Alternate Strips

Research by the School of Forestry at Duke University indicated that loblolly pine could be regenerated by clear-cutting narrow strips adjacent to strips of seed-producing trees. This work, published in 1944 (25), suggested that understocked stands of loblolly pine in Alabama might also be regenerated by clearcutting in alternate strips.

A study to test the feasibility of this method was established in March 1941 in an old field stand of loblolly pine that had seeded-in after the land was abandoned from cultivation just prior to 1900 (14). Two strips 2 chains wide and 7½ chains long, oriented with their long axes east and west, were left uncut. One clearcut strip 2 chains wide was established between the uncut strips. All trees were removed from the clearcut strip, yielding 5,205 board feet, International (¼") scale. In February 1949, all trees on the two uncut strips were tallied. Basal area per acre was slightly more than 50 square feet, indicating an understocked stand. Average total height of dominant loblolly pines was 61 feet, and shortleaf

TABLE 15. NUMBER OF TREES AND SAWLOG VOLUME PER ACRE INITIALLY PRESENT AND RESULTING FROM SELECTED BURNING TREATMENTS

Treatment	Year	Diameter groups: 4-8" d.b.h.	9"+ d.b.h.	Volume (International Rule)
		Number of trees		Board feet
Hot annual fire	1941	40	10	700
	1949	19	31	2,100
	1959	12	43	4,200
	1964	8	46	6,000
Cool annual fire	1941	69	8	500
	1949	50	40	2,300
	1959	21	67	5,200
	1964	20	66	6,600
Fire every third year	1941	42	5	200
	1949	45	22	1,000
	1959	98	39	2,700
	1964	115	47	4,300
No fire	1941	59	11	400
	1949	72	32	1,600
	1959	175	50	3,400
	1964	205	72	6,000

pine averaged 49 feet. A summary of stand conditions on the uncut strips appears in table 16.

Reproduction was sampled on the clearcut strip in February 1949. Sixteen circular plots, .005 acre in size, were measured. Table 17 summarizes the condition of reproduction on all strips in the study (14).

A re-inventory of the study was made in June 1954, 13 years after the strip was clearcut and 5 years after final harvest by the shelterwood method from the uncut strips. The stand that had developed on the clearcut strips, figure 25, and the condition of the timber and reproduction on the strips after harvesting by the

TABLE 16. PINE STAND ON UNCUT STRIPS ON A PER ACRE BASIS, FEBRUARY, 1949

Species	Height of dominants	Diameter groups 4" to 7" Class	Diameter groups 8" Class & over	Total	Basal area	Volume Doyle Rule	Volume International (¼") Rule
	Feet	Number of trees/acre			Sq. ft.	Board feet	
North strip							
Loblolly	61	25	38	63	43	2,402	3,631
Shortleaf	52	15	7	22	7	23	405
Longleaf	--	--	1	1	1	64	104
All pines	--	40	46	86	51	2,703	4,140
South strip							
Loblolly	60	18	27	45	40	2,470	3,589
Shortleaf	47	29	9	38	12	391	650
Longleaf	--	1	--	1	--	---	---
All pines	--	48	36	84	52	2,861	4,239

TABLE 17. PINE REPRODUCTION ON CLEARCUT AND UNCUT STRIPS ON A PER ACRE BASIS

Species	Av. height of saplings	Regeneration density Seedlings	Regeneration density Saplings	Regeneration density Total
	Feet	Number of stems		
Uncut strips				
Loblolly	6.1	3,712	2,425	6,137
Shortleaf	10.3	1,275	162	1,437
Longleaf	---	0	0	0
All pines	---	4,987	2,587	7,574
Cut strip				
Loblolly	8.8	2,550	1,400	3,950
Shortleaf	12.9	487	100	587
Longleaf	0.2	12	0	12
All pines	---	3,049	1,500	4,549

Fig. 25. Clearcut area at left was seeded naturally from stand at right managed by the shelterwood method (AES 1949)

shelterwood method, figure 26, are compared in table 18.

The 1941 study indicated that, with an adequate seed source, loblolly pine can be regenerated on narrow clearcut strips adjacent to strips of timber harvested by the shelterwood method (13).

Plantations

Open areas and abandoned fields were planted in 1941 and 1942. Slash (figure 27), loblolly, and longleaf pines were used. No measurements were taken and the resulting stands were included in the overall management plan for the unit. Green ash, the only hardwood planted, was unsuccessful.

No new studies were initiated on the Barbour Unit after 1949. Early studies were continued, remeasurements were taken, and appropriate results published.

Timber Sales

In 1971, a timber sale advertised for the Barbour unit consisted of approximately 591,000 board feet, Scribner rule, of marked pine and hardwood sawtimber and 661 cords of pine and hardwood pulpwood. Bids were obtained from seven buyers, and the

TABLE 18. STAND DENSITY AND VOLUME PER ACRE OF SECOND GROWTH LOBLOLLY-SHORTLEAF PINE 13 YEARS AFTER CLEARCUTTING IN ALTERNATE STRIPS AND 5 YEARS AFTER REMOVAL OF TIMBER FROM INTERVENING STRIPS

Species or group	Trees less than 3.6" d.b.h.		Trees 3.6" d.b.h. or larger				Trees 7.6" d.b.h. or larger	
	Seedlings	Saplings 6/	Tally	Basal area	Total Stemwood volume 1/	Pulpwood volume 2/	Tally	Sawtimber volume 3/
		Number		Sq. ft.	Cu. ft.	Cords	Number	Bd. ft.
Clearcut strip								
Loblolly	2,580	1,550	279	32.6	303	2.9	3	30
Shortleaf	260	200	119	11.4	104	1.7	0	0
All pines 4/	2,840	1,750	398	44.0	407	4.6	3	30
Hardwoods	0 5/	0 5/	2	.4	4	.1	0	0
Shelterwood strips								
Loblolly	1,700	1,430	43	8.7	116	1.2	8	210
Shortleaf	60	250	69	11.8	145	2.0	6	170
All pines 4/	1,640	1,680	113	20.8	269	3.3	15	410
Hardwoods	0 5/	0 5/	5	1.1	14	.2	1	30

1/ Peeled wood, to 2" top
2/ Rough wood, to 3" top inside bark
3/ International ¼" kerf rule, tree scale
4/ Discrepancies in totals are due to a few longleaf pines
5/ None encountered on sample plots
6/ 4½' or more in height

Fig. 26. Natural stand of loblolly-shortleaf pine showing adequate advanced reproduction with no need to retain seed trees in overstory (AES 1949)

Fig. 27. Planted slash pine demonstrates rapid early growth on formerly idle and unproductive land (AES 1944)

sale was awarded to the highest bid price of $33,873.

The bid amount represented a unit price of $52.94 per thousand board foot (MBF) Scribner scale for pine and yellow-poplar sawtimber and $15.00 for other hardwood sawtimber. Unit price for pulpwood was $2 and $6 per cord for hardwood and pine, respectively.

Demonstration Field Day

Soon after the Barbour Unit was established and research had begun, local residents became interested in what could be done with cut-over and burned forest lands. In 1945 this interest was recognized and a field day was held on February 15 to show the results of experimentation. Approximately 60 persons attended. Talks were given during the morning at a meeting held in the theater in Clayton. Participants were the County Agent, the AES Associate Director, a farm forester, and a representative of the U.S. Forest Service. A movie on farm forestry culminated the morning session prior to a barbecue lunch. A field trip to the Barbour Unit highlighted the afternoon program.

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